Regional Review Workshop on Completed Research Activities

Proceedings of Review Workshop on Completed Research Activities of Agricultural Economics, Extension and Gender Research Directorate held at Adami Tulu Agricultural Research Center, Adami Tulu, Ethiopia 07-11, October, 2019.

Part 2: Agricultural Economics Research

Editors: Diriba Mengistu, Hussen Abro, Addisu Hailu and Taha Mume

Oromia Agricultural Research Institute
P.O.Box 81265, Finfinne,Ethiopia

Correct citation: Diriba Mengistu, Hussen Abro, Addisu Hailu and Taha Mume (eds.) 2020. Proceedings of Review Workshop on Completed Research Activities of Agricultural Economics, Extension and Gender Research Directorate held at Adami Tulu Agricultural Research Center, Adami Tulu, Ethiopia 07-11, October, 2019. Oromia Agricultural Research Institute (IQQO), Finfinne, Ethiopia.

Table of contents

Small Ruminant Value Chain Analysis in Fentale Districts of East Shoa Zone, Ethiopia

Shimalis Gizachew Daselegn[1] Asfaw Negesse Senbeta[1], Yassin Esmael Ahmed[1] and Beriso Bati Bukul[1]

[1]Oromia Agricultural Research Institute, Adami Tulu Agricultural Research Centre, P.O.Box 35, Ziway, Ethiopia

Abstract

The study was conducted in four kebele of Fentale districts of Pastoral and Agro-pastoral Area to map out small ruminant value chain actors and their roles, identify the major constraints and suggest the specific areas of intervention for better performance of small ruminant value chain. Both qualitative and quantitative data were collected from primary and secondary sources a total of 98 producers, 12 traders, 20 consumers and 4 exporters were interviewed with separate semi-structured questionnaires. The result of study indicated that small ruminant made by far the greatest contribution to livestock-based livelihoods in study districts. About 98% of pastoralist offers small ruminant for sale to meet their crucial needs at any time during the year. The result of this study revealed that even if small ruminants supplied to the markets by pastoralist more or less meet the quality attributes required by export markets still the majority of producers (72.4%) backyard production type, followed by small scale (23.5%), medium scale (2%) and commercial scale (2%) respectively. Appropriate extension service that will respond to the peculiar needs of export markets, especially on the aspect of providing information and knowledge on the desired small ruminant characteristics and quality requirements of importing countries should be provided for the producers

Key words: small ruminant, value chain, Fentale

Introduction

Livestock production systems in Ethiopia are generally subsistence oriented and productivity is very low [1]. The total livestock population in Ethiopia in 2012 was estimated at 54 million cattle, 25.5 million sheep and 24.1 million goats [2], Ethiopia's annual exports of cattle and sheep meat were valued at USD 79.13 million in 2012 [3], while Botswana with a much lower stock number was able to reach USD 150 million export earnings from beef alone [4]. Sheep and goats are reared in almost all farming systems and agro-ecological zones of Ethiopia. Sheep and goat keeping is a traditional way of life which for centuries has shaped farmers

thoughts, outlook and culture. In various areas of Ethiopia, sheep and goats play significant social and cultural functions including food security, poverty alleviation, ensuring gender equity, weed control and income generation. Ethiopia harbours huge and diverse small ruminant populations and this genetic diversity is a requisite for the present and future livelihoods of a large number of poor farmers [5].

Small ruminant serve as living bank for their owners and serve as source of immediate cash need and insurance against crop failure especially where land productivity is low and unreliable due to erratic rainfall, severe erosion, frost, and water logging problems [6]. Approximately 1.5 billion people are engaged in smallholder agriculture across the world. They include 75% of the world's poorest people whose food, income, and livelihood prospects depend on agriculture. They mainly live in rural communities. Despite their important role as food producers and rural stewards, the commercial prospects for millions of poor smallholders remain challenging. Income opportunities have improved since the long period of depressed commodity prices, from the 1980s until the mid-2000s; as commodity prices have recovered, the agricultural sector has shown signs of revitalization.

Several global agencies have also renewed their investments in agriculture due to the realization that enterprise continues to be the best hope of improving the livelihood prospects for millions of rural families. Agriculture remains the best opportunity for the estimated 1.5 to 2 billion people living in smallholder households to escape poverty. Studies show that income growth generated by agriculture is up to four times more effective in reducing poverty than growth in other sectors [7].

The livestock production systems in Ethiopia have evolved largely as a result of the influence of the natural production environments and socio-economic circumstances of farmers/pastoralists rather than market forces Sheep and goat in Ethiopia and most developing regions are kept under traditional extensive systems. Sheep and goats are largely produced in mixed crop–livestock, specialized pastoral and agro pastoral systems. Livestock production is of subsistence nature. Market-oriented or commercial production is almost non-existent. In various areas of Ethiopia, sheep and goats play significant social and cultural functions including food security, poverty alleviation, ensuring gender equity, weed control and income generation.

Ethiopia is home for diverse indigenous sheep and goat populations, numbering 25,017,218 and 21,884,222 heads [8].respectively, parallel to its diverse ecology, production systems and ethnic communities. According to [9].the total annual meat production comes from cattle (63%), sheep (25%) and goats (12%). At the national level, sheep and goat account for about 90% of the live animal/meat and 92% of skin and hide [10].export trade value. In the lowlands, sheep with other livestock are the mainstay of the pastoral livelihoods. Most of Ethiopia's estimated 48 million sheep and goats are raised by small farmers who used them as a major source of meat and cash income. About three-quarters of the total sheep flock is in the highland, whereas lowland pastoralists maintain about three-quarters of the total sheep and goat herd. Small ruminant population in the continent containing about 27.35 million sheep and 28.16 million goats in the country [11].

Indeed, many development interventions now utilize the value chain approach as an important entry point for engaging small farmers, individually or collectively, in high value export markets [12].

Despite such significant contribution to the national economy of the country, the sector has received less than 3% of the recurrent agricultural expenditures in Ethiopia. Livestock markets in Ethiopia function at three levels consisting of primary, secondary, and terminal markets. [13] Also include a nominal forth tier at the farm gate level, which could hardly be considered to function as a market.

Small ruminant production regarded as the handy source of money in need and is considered to be attractive for poverty reduction and improvement of family food security and livelihood of the poor. Creating competitive market for goat can have an opportunity to fetch good price which will have an impact on purchasing power of pastoral households to convert cash income for nutritional food needed for consumption and other amenities [14]. Introduction of value adding management practices (market oriented fattening scheme) and market linkage is the most important aspect of enhancing the livelihood and source of income for smallholder farmers [15].

Therefore, this study was proposed to analyze small ruminant value chain and design Strategies to link small scale small Ruminant producers farmers to better market t and Improved Income which suggest possible solutions to different stakeholders with the following objectives.

Methodology

Discerption of the study area

The study was conducted in Fentale district, which is located in the eastern dry lowlands of the Rift Valley, situated 200 km east of Addis Ababa.

Fentale District

Fentale district extends between 8^0 42'-$8^0$09 AND latitudes and$39^0$39'-$40^0$04'E longitudes. It is located in the northeast part of East Shewa zone. It is bordered with Amhara Regional State in the west and northwest; with Afar Regional State in the north and northeast; with West Hararghe and Arsi zones in east; and with Boset district and Arsi zone (Merti district) in south and southeast. Because of geographical location i.e. crossed by road that leading east part of the country & coming to Finfinnee do passed through this district has a great advantage for accessing the local products to the market and creates ideal condition for provision of the demanded commodities to the local communities.

Agro-ecology: 100% of the district is low land, Altitude: 900m.a.s.l. – 1000 m.a.s.l (meters above sea level., Annual Temperature: min 18^oc. Max 39^oc, Annual Rain fall: 350mm- 450mm, Rain fall pattern Uni Modal, Land use system in (ha), Cultivated land 19677.25, Forest land 457.00 , Grazing land 79329.37, Land used for construction 6,302.9, Others 28,200.00, Total area of land in the district 133,967.00, Total livestock 781,099 , Goat 129,424, Sheep 106,932 and Major livelihood activities (%) 95 % farming 5% non- farming.

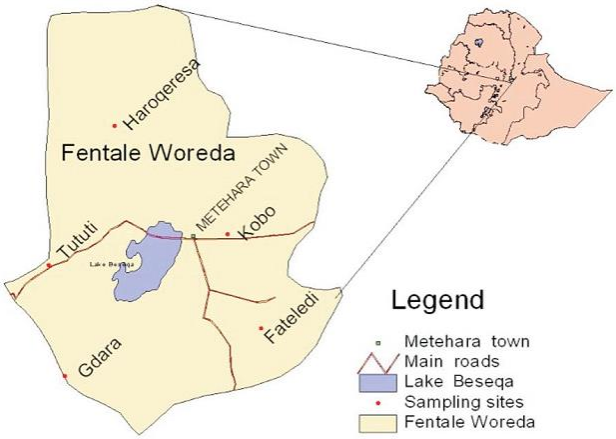


Figure 1, M**ap of Fentale district**

Sources of Data and Method of Collection

Both secondary and primary data were used for this study. Secondary data was collected from Small Ruminant Quarantine at Adama, abettors, District agriculture and natural resource offices, Zonal agriculture and natural resource offices, CSA, published and unpublished materials. Primary data was collected from small ruminant producer farmers, traders and consumers using semi-structure questionnaires and check lists.

Sampling Procedure and Sample Size

A multi-stage sampling procedure was used for the selection of sample household heads. First Fentale districts were selected purposively depending on the small ruminant production potential. Four small ruminant producer kebeles (26HH Banti, 18 HH Debiti, 21HH Haro Kersa &33HH Kobo) from Fentale were selected based on population of small ruminant production.

From total small ruminant producers in the districts 98 samples households were randomly selected exhausting Sample size determined based on [16].as follows:

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

Where: n = is the sample size taken from population, N is the population size of small ruminant producer households and e = 0.09 is the level of precision defined to determine the required sample size at 90% level of precision.

Twelve (12) small ruminant traders were selected from Fentale markets

Four (4) small ruminant exporter were selected from Fentale markets

Twenty (20) small ruminant consumers were selected from Fentale to obtain information related to consumers

Method of data analysis

Descriptive statistics such as frequency, mean, percentage, and standard deviation were used for this study. Marketing margins are also calculated at different points along the value chain and then compared with consumer price.

$$TGMM = \frac{Final\ consumers'price - producers'price}{Final\ consumers\ price} x100$$

$$GMM_P = \frac{Consumers\ price - gross\ marketing\ margin}{consumers\ price} X100$$

Results and discussions

Sex and education status

Descriptive analysis is employed to describe the socio-demographic characteristics of sampled households. As indicated in table 1 below, about 70.40 % of respondent farmers were male while 9.60 % are females. Most of small ruminant producers (73.50 %) are illiterate, flowed by grade 1-6, (9.20 %) grade 7-12, (17.30 %). This shows that most of pastoralists at Fentale areas are not attending primary education.

Access to extension services

The study reveals that the majority of small ruminant producers (65.10 %) have no access to extension service but about 43.90 % have access to extension service. This shows that most of the pastoralists at Fentale areas are not settled which makes access to extension service difficult (Table 1).

Production type

The study reveals that the majority of small ruminant producers (72.40 %) practiced back yard production system flowed by small scale production system (23.50%), medium scale production system (2%) and commercial production system (2 %). Even if small ruminants supplied to the markets by pastoralist more or less meet the quality attributes required by export markets, still the majority of producers practice backyard production type which needs future intervention (Table 1).

Access to credit services

The study reveals that the majority of small ruminant producers (82.70 %) have no access to credit service while only about 17.30 % have access to credit service. This shows that most of pastoralists at Fentale areas were not having access to credit service. (Table1).

Table 1. Descriptive analysis is employed to describe the socio-demographic characteristics of sampled households

Variables		**Number**	**%**
Sex	Male	69	70.40
	Female	29	9.60
Education status	Illiterate	72	73.50
	Attending elementary (1-6)	9	9.20
	Educated (7-12)	17	17.30
Access to extension service	Yes	43	43.90
	No	55	56.10
Production type	Back yard	71	72.40
	Small scale	23	23.50
	Medium scale	2	2.00
	Commercial	2	2.00
Access to credit service	Yes	17	17.30
	No	81	82.70

Source: Survey, 2019

Age, farming experience and distance from market

As shown in above table 2, the average age of respondent were 38.33, farming experience of respondents were 21.04 years and distance from the nearest market was 3.45 km.

Table 2. Average age, farming experience and distance from the nearest market

Variables	**Mean**	**SD**
Age	38.33	13.51
Farming Experience	21.04	12.11
Distance from nearest market	3.45	1.86

Source: Survey, 2019

Last Ten Years Small Ruminant Export from Ethiopia under monitoring of Adama Quarantine

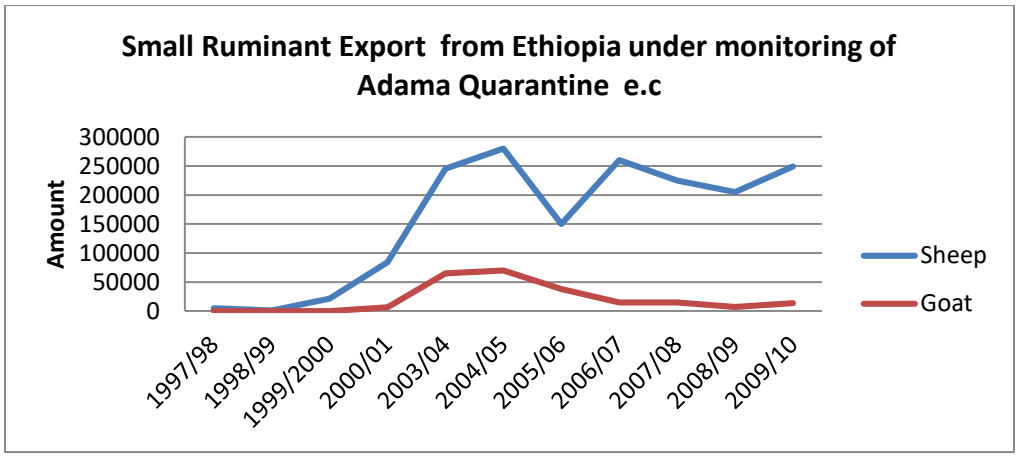


Figure 2, Ten Years Small Ruminant Export from Ethiopia

Source: Adama Quarantine 2019

As shown in figure in the last ten years sheep is dominating the export market from Ethiopia.

Quality requirement of export market

The export market needs the sheep and Goat treated against internal and external parasite. Hence, sheep and goats must be vaccinated and certificated against the following disease PPR, Anthrax, Sheep pox, and Ovine Pasturullosis and quarantined for 21 days after vaccination. Dubai and Saudi Arabia additionally requires blood test certificate against Brucellosis, Rift valley fever and FMD. The live weught of the animal should be 20 to 25 kg and occasionally extended to 30 kg. Mutton should be quarantined for 18 hours in abettors.Total removal of tail in the case of mutton export is a challenge as it reduces the price per kilogram.

Profitability of Small Ruminant

Table 3.Profitability of Small Ruminant

Items	Livestock type
	Small ruminant
Average feed cost (Birr/head)	220.00
Average vet drug cost (Birr/head)	35.00
Average barn cost (Birr/head)	25.00
Average labor cost (Birr/year)	110.00
Average others cost(Birr/head)	80.00
Total average variable cost (Birr/head)	470.00

20 kg live weight S. ruminate (price/head) 40etb/kg	800.00
Revenue(Birr)	800.00
Gross margin(Birr/head)	330.00

In small ruminant production and marketing business the total average variable cost (Birr/head) was 470 ETB while Gross margin (Birr/head) obtained from small ruminant production was 330.00 ETB (Table 3).

Value Chain Analysis

Small Ruminant value chain actors, supporters and major function

(i) **Input suppliers**

Inputs such as feeds and vet drug are supplied by private sectors (vet pharmacy), Woreda Office of Agriculture (WoA), NGOs, open market traders. Most (88%) of the farmers purchased feeds and vet drug from market for small ruminant production.

(ii) Producers

Both small holder farmers and investors are acting as producers in the study area they are primary and most valued actor in the small ruminant value chain.

The major value chain functions that small ruminant producers perform include, managing, (feeding, watering, housing) and marketing. The majority of producers (72.4%) practice backyard production type, followed by small scale (23.5%), medium scale (2%) and commercial scale (2%) respectively.

(iii) Rural collectors

Rural collectors are independent operators at primary markets who buy and transport small ruminant from smallholder farmers, for sale to Butchers, Abettors, larger traders, institutional consumers.

(iv) Brokers/middlemen

Brokers facilitate transaction by convincing farmers to sale his small ruminant and facilitating the process of searching good quality and quantity of small ruminant for exporters.

(v) Large Traders

Large traders are traders that buy small ruminant from rural collectors of Fentale districts and sell to exporter and abettors at different markets.

(vi) Butchers

Butchers are key actors in small ruminant value chain within and outside the study area. They are the last link between domestic producers and consumers.

(vii) Abattoirs

Abattoirs are key actors in small ruminant value chain specially for export market in the study area Functional export abattoirs are located five in mojo(mojo, Luna, organic, Halal and Alawa) three in Bishofu (Abssinia, Elfora and Ashine) one in Fentale (Elfora) and one in Awash Melkassa having a capacity of slaughter 2000 to 3000 per day per each. The study revel Abattoirs are operating under their capacity only 20 to 30 % are operating because the reasons related to the supply of small ruminant.

(viii) Exporters

Exporters are key actors in small ruminant value chain within and outside the study area. They are the last link between producers and foreign consumers. The most important destination markets for Ethiopian small ruminant are Dubai, Oman, Saudi Arabiya, Djibouti, and Somalia land Qatar, Bahrein and Quiet (live animal export) mutton to Dubai and Saudi Arabiya. Offals such as intestines, stomach, brain, penis and liver are exported to China, while liver, kidney and heart are exported to Saudi Arabia. Ethiopia exports about 19,000 metric tons of meat annually. Until very recently, small ruminant weighing from 20 – 30kg were needed for slaughter and the carcass was exported. However, sheep heavier than 30 kg are currently accepted by Bahrain, provided that they are not older than 2 years of age. According to the export abattoirs, there is emerging competition from Kenya and Tanzania for the Dubai market. It was also reported that inconsistent supply of quality animals, cargo space shortage and technical problems in chilling management are some of the major problems of the export abattoirs.

The study shows that live animal export is dominated by sheep (72.6%) while mutton export is dominated by Goat. Sheep demand is high during Arefa holiday in imported countries.

(ix) Consumers

Consumers are final purchasers of small ruminant mostly from producer, butcher and exporters for consumption purpose.

Individual consumers buy animals to slaughter mainly during cultural or religious festivals in the Ethiopian New Year. There is a marked color choice which is largely seasonal or related with certain occasions. Individual consumers buy small ruminant from traders, collectors and small ruminant producers in market places and at farm gate (government employees living in rural areas and other farmers). It was reported that the number of consumers has been increasing over time. Consumers also reported that small ruminant price has increased substantially in recent years.

Small ruminant consumers are individual households (both local and international) and institutional consumers like hotels and university. The majority of sampled consumers preferred the small ruminate from Fentale because of the test preference.

List of supporters and actors and their role in small ruminant value chain analysis of Fentale district

Value chains also include the institutional and governance arrangements that enable these systems to function [17].

Table 4 .List of stakeholders' supporters, actors and their role in small ruminant value chain analysis of Fentale district

S/N	Stakeholders	Activities	Roles/ Function
1	Input suppliers (privet and governmental sectors)	Supply of feed and vet drug	Actors
2	Small holder farmers	Small ruminant rearing, feeding and selling to trader	Actors
3	Rural collectors	Collection, transporting and delivery to traders	Actors
4	Large Traders	Collection of small ruminant, transporting and delivery to traders	Actors
5	Butchers	They are the last link between domestic producers and consumers	actors
6	Abattoirs	Selling, Transporting processed small ruminant meat and mutton	actors

7	Exporters	Selling, Transporting processed small ruminant both live and slaughtered	Actors
8	Adama quarantine	Vaccinate small ruminant and facilitate certification	supporter
9	Adami Tulu Agricultural research center and ILRI	Demonstrating new technologies and giving training and advice test animals for disease TB, brucellosis…	supporter
10	District cooperative office	Organizing farmers and training on cooperative formation and saving advantage	supporter
11	Oromia Credit and Saving Share Company	Credit service but very low	Supporter
12	District Agricultural office	Training and technical support	supporter

Source: survey result, 2019

Value chain map of small ruminant in the study areas

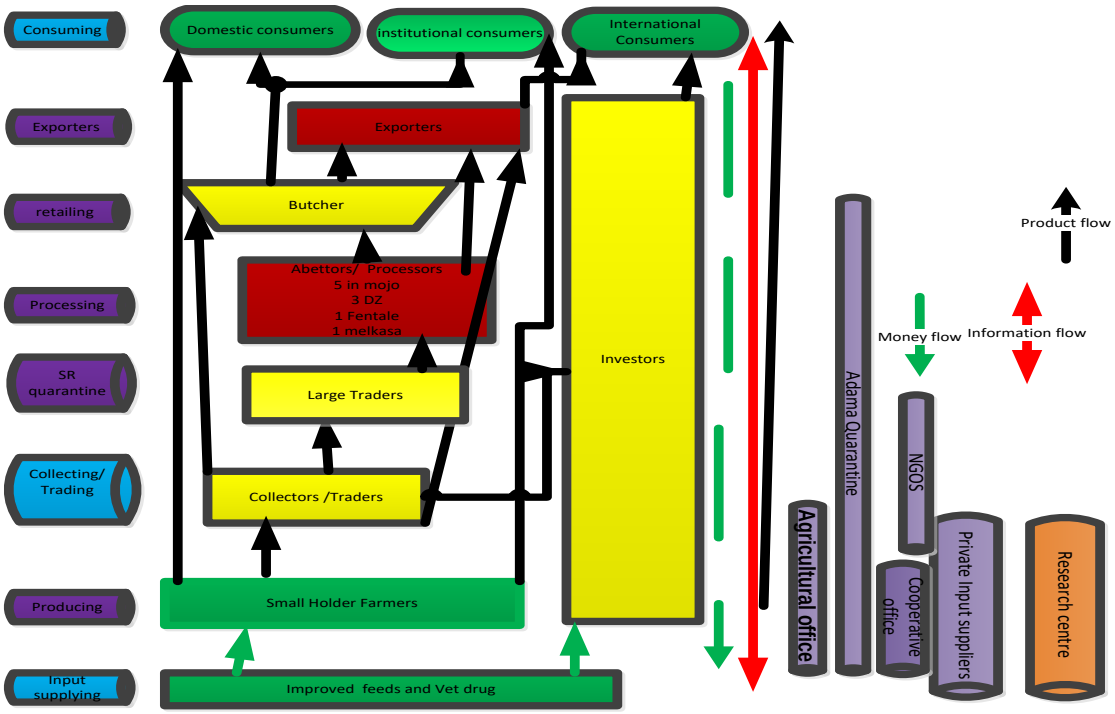


Figure 3. Value chain map of small ruminant in the study areas

Challenges & opportunities of actors along small ruminant value chain

Table 5. Challenges & opportunities of actors along small ruminant value chain

Value chain stage	Constraints	Opportunities
Inputs supply	Shortage of improved breed High cost of inputs like feeds and vet drug	High demand for improved breed, feed and vet drug
Production	low genetic potential, shortage of feed in quality and quantity, disease, lack of technology Less vet service and drug shortage Limited knowledge on quality and minimum kg requirement	Enabling policy environment & support for export market
Marketing	Price setting problem Brokers interferences Illegal traders Shortage of transportation from rural to market place. Removal of tail for mutton export Operation of abattoirs below their capacity	Government investment on infrastructure development Good market demand of the product
Consumers	Limited knowledge on quality and price	High demand because of test preference by consumers High consumption preference

Marketing Channels and Volume/quantity

The small ruminant marketing channel consists of eight different channels. In this particular small ruminant marketing channel, the highest number of small ruminant is exchanged at marketing channel I, (26.50%) flowed by small ruminant marketing channel V (18%).

I. Input suppliers- Producer- Domestic Consumer (26.50%)
II. Input suppliers- Producer- Institutional Consumer (4%)
III. Input suppliers- Producer- collector-Butcher – Domestic Consumer (16%)
IV. Input suppliers- Producer-collector – Abattoirs - Domestic Consumer (5%)
V. Input suppliers- Producer-collector- large trader- Exporters – International Consumer (18%)
VI. Input suppliers- Producer-collector- large trader- Abattoirs – International Consumer (8%)
VII. Input suppliers- Producer- collector- Butcher – Institutional Consumer (10%)

VIII. Input suppliers- Producer- collector- Institutional Consumer (12.5%)

Small ruminant marketing Gross margin and value share

Table 6. Small ruminant marketing Gross margin and value share

Actors	**Description**	Market cMarketing channelshannels**(Birr/head)**							
		I	II	III	IV	V	VI	VII	VIII
Producers	Production cost	470	470	470	470	470	470	470	470
	Selling price	870	780	800	800	950	950	800	800
	Market cost	85	85	50	50	50	50	50	50
	Gross profit	315	225	280	280	430	430	280	280
Collectors	Purchasing price			800	800	950	950	800	800
	Selling price			900	900	980	980	900	1000
	Market cost			50	50	50	50	50	50
	Gross profit			50	50	-20	-20	50	150
large traders	Purchasing price					980	980		
	Selling price					1300	1300		
	Market cost					23	23		
	Gross profit					297	297		
Butchers	Purchasing price			900				900	
	Selling price			1800				1800	
	Market cost			150				150	
	Gross profit			750				750	
	Purchasing price				900		1300		
Processors	Selling price				1300		1950		
	Gross profit				400		650		
Producers share (%)		54	60	59	59	49	49	59	59
TGMM (%)		46	40	41	41	51	51	41	41

The small ruminant marketing channel consists of eight different channels (Table 6). From this marketing channel, the highest producer share were obtained by producers at channel II but the total Market gross margins were highest in channel-V (51%) and VI (51%).

Conclusion and Recommendations

Conclusion

There are multiple actors that involved in small ruminant value chain with diverse roles. Eight different markets channels were identified for small ruminant value chain having different marketing margin. Producer's market share (GMMp) was the highest (60%) from the total consumers' price in channel II. The total gross marketing margin (TGMM) was highest in

channel-V and VI. The result of this study revealed that even if small ruminants supplied to the markets by pastoralist more or less meet the quality attributes required by export markets still the majority of producers (72.4%) backyard production type, followed by small scale (23.5%), medium scale (2%) and commercial scale (2%) respectively. The value chain is constrained by low genetic potential, shortage of feed in quality and quantity, disease, lack of technology, both legal and illegal livestock marketing systems are operating at different magnitudes, lack of market information and lack of integration among chain actors are common problem in the study area.

Recommendations

Farmers obtained more benefit when they sell small ruminant to market channel II. However, the amount of small ruminants supplied along this channel is very small. Therefore it was recommended market channel II for domestic market but market channel V and market channel VI for foreign market because they have the highest total market gross margin for the producers. Moreover, it is quitr esssential to give special attention to the following points.

- Strengthening farmers & consumers linkage is recommended to benefit farmers more from the channel.
- Small ruminant value chain actors should work together in an integrated way to design alternative small ruminant production system, breed and feed improvement, disease control and strengthen sustainable market linkage.
- Empowering producers: Empowering poor pastoralist smallholder farmers help to provide high-quality, sustainable small ruminant production with an identified market destination and access to basic production inputs, credit, capacity-building, market-related information.
- Strengthening the forward and back ward linkage among value chain actors and supporters
- Improving extension services: Appropriate extension service that responds to the peculiar needs of export markets, especially on the aspect of providing information and knowledge on the desired small ruminant characteristics and quality requirements of importing countries should be provided for the producers.

References

[1] Belachew Hurissa and Jemberu Eshetu. (2003). Challenges and opportunities of livestock trade in Ethiopia. Challenges and opportunities of livestock marketing in Ethiopia. In: Yilma Jobre and Getachew Gebru. (eds), *Proceedings of 10th annual conference of the Ethiopian Society of Animal Production (ESAP) held in Addis Ababa, Ethiopia, August 22–24, 2002.* ESAP, Addis Ababa, Ethiopia. pp. 1–14.

[2] CSA (Central Statistical Agency). (2013). Agricultural sample survey, 2012/2013 (2005 EC). Report on livestock and livestock characteristics. Statistical Bulletin 570. Addis Ababa,Ethiopia: CSA.

[3] ECRC (Ethiopian Customs and Revenue Authority).(2012). Raw data on the type, volume, value and destination of export items from Ethiopia. Addis Ababa, Ethiopia: ECRC.

[4] FAO (Food and Agricultural Organization of the United Nations). (2012). *FAO statistical database FAO Stat. 2012.* Rome, Italy: FAO. *(Available from* **http://faostat3.fao.org/faostat gateway/go/to/home/E)**

[5] Gizaw, S., Lemma, S., Komen, H., Van Arendonk, J.A.M. (2007b). Estimates of genetic parameters and genetic trends for live weight and fleece traits in Menz sheep. Small Ruminant Res., 70: 145–153.

[6] Tibbo, M. (2006). Productivity and health of indigenous sheep breeds and crossbreds in the central Ethiopian highlands. PhD Thesis, Swedish University of Agricultural Scinences, Uppsala, Sweden.

[7] Growth Commission. (2008). The Growth Report: Strategies for Sustained Growth and Inclusive Development. World Bank. Washington, DC.

[8] CSA (Central Statistical Authority). (2009). Ethiopian agricultural sample survey. Vol II. Report on livestock and livestock characteristics. Statistical Bulletin 388. CSA, Addis Ababa, Ethiopia.

[9] FAO (Food and Agriculture Organization of the United Nations). (2004). Livestock sector brief: Ethiopia. Livestock information, sector analysis and policy branch (AGAL), FAO, Rome, Italy.

[10] Food and Agriculture Organization of the United Nations. (2007). Livestock and Livelihoods: Priorities and Challenges for Pro-Poor Livestock Policy

[11] CSA (Central Statistical Agency), (2014). Summary and statistical report of the2013/2014 survey on Livestock and livestock characteristics, Volume II Addis Ababa, Ethiopia.

[12] Deutsche Gesellschaft für Technische Zusammenarbeit GmbH (GTZ) (2007). Value Links Manual: The Methodology of Value Chain Promotion, First Edition. Found at Internet address http: //www.value-links.de/manual.html, retrieved 20 February 2015

[13] Solomon Gizaw, Komen H, Hanotte O and van Arendonk JAM. (2008). Indigenous sheep resources of Ethiopia: Types, production systems and farmers preferences. Animal Genetic Resources Information43:25–40.

[14] Aklilu Nigussie and Dana Hoag (2017). Goat Value Chain Analysis in Pastoral Communities of Ethiopia *Journal of Innovative Techniques in Agriculture* volume 1(1), Ethiopia

[15] Weldeyesus Gebreyowhens, Zelealem Tesfay and Yaynishet Tesfay. (2016). Management and Breeding Objectives of Indigenous Smallholder Highland Sheep in Northern Ethiopia. *Journal of Biology, Agriculture and Healthcare*, 6(1): 96-106.

[16] Yamane, Taro. (1967). Statistics: An Introductory Analysis, 2nd Ed., New York: Harper and Row.

[17] Mohamadou, F. (2013). Situation Analysis of Small Ruminants Value Chain in Ethiopia: Draft report. Nairobi: International Livestock Research Institute.

The Status and Factors Affecting the Adoption of Modern Beehives in East Shoa and West Arsi Zones of Oromia Region, Ethiopia

Asfaw Negesse Senbeta[1], Yassin Esmael Ahmed[1] and Beriso Bati Bukul[1]and Shimalis Gizachew Daselegn[1]

[1]Oromia Agricultural Research Institute, Adami Tulu Agricultural Research Centre, P.O.Box 35, Ziway, Ethiopia

Abstract

Adoption is the degree of using a new technology in long-run equilibrium when the farmer has full information about the technology. However, the adoptions of new technologies were determined by different factors at farmers' level. This study was initiated to identify factors affecting the adoption of modern beehives in East Shoa and West Arsi zones of Oromia region, Ethiopia. The study was conducted in four districts two districts were selected from East Shoa Zone and two districts from West Arsi Zone based on modern beehive distribution. Two stage sampling procedure was used to undertake the study. Purposive sampling was used to select the districts and Kebeles that improved beehives distributed. The simple random sampling was used to select sample households. The probability proportional to size was also used to fix sample households taken per selected kebeles for the study. A total of 126 sample households were selected for this study. From the total 126 sample households, 48.40% were adopted modern beehive and the remaining 51.60% were non-adopters. The mean productivity of the modern beehives and traditional beehives were 18.20kg/hive/year and 5.20kg/hive/year. Lack of capital (65.88%), pests (62.71%), high costs of modern hive (62.70%), agro-chemical application (61.88%) and predator (56.75%) were the major beekeeping constraints that ranks from one up to five in the study areas. The result of probit model revealed that beekeeping experiences, family size, beekeeping cooperative members, and access to extension service were positively affects modern hive adoption whereas distance to FTC was negatively affect the adoption of modern hive in the study areas. Provision of training on agricultural chemical application, and pests and predators controls, facilitate access to credit service and access to modern beehives with accessories through strengthening cooperatives as well as access to extension services which can increase honey production are recommended from the output of this research.

Keywords: Adoption, Beekeeping, Modern beehive, East Shoa Zone and West Arsi Zone

Introduction

Apiculture is one of the most widespread agriculture activities that are practiced all over the world and has been identified as one of the several ways of achieving millennium development goals (WBR, 2006). It has potential to improve the living standards in the developing countries through improved food supply, intake and generation of productive employment (WBR, 2006).

Ethiopia stands ninth in the world and first in the Africa in honey production (Tesfaye, *et al*., 2017). These have enabled Ethiopia to take around 23.58% and 2.13% of the total share of honey production on African and on a global level respectively (Workneh and Puskur, 2011; Kiros and Tsegay, 2017). Ethiopia is fourth in beeswax and tenth in honey production in the World (Gidey and Mekonen, 2010). The country has the potential of producing up to 500,000 tons of honey and 50,000 tons of beeswax per annum (EIAR, 2017). But, currently production is limited to 47,706 tons of honey and 5542 tons of beeswax (FAO, 2017 and Kenesa Teferi, 2018). Despite the favorable agro-ecology for honey production and the number of bee colonies the country is endowed with, the level of honey production and productivity in the country is remaining low. One of the prominent factors for this low honey productivity is traditional hives. Despite long period of introduction of improved beekeeping technologies to the country, the number of beekeepers involved in improved beekeeping is very low (Gidey and Mekoneni, 2010).

Generally, about 5.92 million hives is estimated to be found in the rural sedentary areas of the country. Out of which about 95.37% are traditional, 1.2% transitional, and 2.34% frame beehives (CSA, 2017). The modern beehive has a production potential of 20-30kg per colony of honey while the traditional bees hive produce 5-10kg per colony of honey (Kiros Welay and Tsegay Tekleberhan, 2017). However, in potential areas, up to 50–60 kg of harvest has been reported (HBRC, 1997). Even though a lot of efforts have been made by the government and other stakeholders to improve honey production and productivity through improved bee technologies, the current honey production is remain low.

The utilization of improved beekeeping technologies leads to success in beekeeping which is suitable for local bee types and conditions (Kiros and Tsegay, 2017). These conditions may indicate the importance of considering the biology and ecology of the bees in the selection and adoption of technologies. Besides the technological and biological factors, the socio-

demographic conditions of beekeepers were observed to play a significant role in the adoption of technologies.

Oromia region has the largest number of beehives which is about 3 million followed by Amhara region (1.4 million) and SNNP region (1.1 million) from the total of 6.2 million hives in the country (CSA, 2017). East Shoa and West Arsi Zones were among Zones of Oromia region which beehives distributed (CSA, 2017).

Though different organizations strive to disseminate modern beehive, the adopters are not comparable what efforts have been excreted, this might have different reasons such as institutional, socioeconomic and biophysical. Such information's might be different from according the circumstances in which the farmers are living and working, and still no information has been generated on socioeconomic, institutional and biophysical determinants of adoption of modern beehives in East Shoa and West Arsi zones of Oromia Region. Therefore, this study has critical importance to generate such information and as a sort of information for policy makers and planners of governmental and NGOs in setting their policies and strategies of honey production improvement interventions. Therefore, this study is proposed to identify factors that influencing adoption of modern beehives and the major constraints of beekeeping with the following objectives.

Objectives

- To assess the status of modern beehives adoption
- To identify and analyze the determinants of modern beehives adoption
- To identify the major constraints of beekeeping production in the study areas

Research Methodology

Description of the Study Areas

This study was conducted in Gimbichu and Dugda Districts of East Shoa Zone and Shashemene and Arsi Negele Districts of West Arsi Zone, Oromia National Regional State, Ethiopia. East Shoa and West Arsi Zones are among the 18 administrative zones in Oromia National Regional State. East Shoa Zone divided into 10 districts whereas West Arsi Zone divided into 12 districts. From the total the districts located in the zones, Gimbichu and Dugda districts covers for about 12.71% and 10.36% of total area of the East Shoa zone and Shashemene and Arsi Negele districts covers for about 5.20% and 14.30% of total area of

West Arsi Zone respectively. According to CSA's (2013) population projection of the country, total population of these districts, respectively, is estimated to be 309362 (Dugda district = 196,678 and Gimbichu district = 112,684 of East Shoa Zone) and 665,858 (Arsi Negele district = 348,503 and Shashemene district = 317,355 of West Arsi Zone) in 2017 with most population residing in rural areas.

These districts were selected beekeeping potential, wider exposure to modern beehives and accessibility of the area. From the East Shoa Zone Gimbichu and Dugda Districts were selected based on numbers of modern beehive introduced. Gimbichu and Dugda Districts have 31 and 36 Kebeles respectively. About 5800 and 4800 traditional hives, 1179 and 3500 transitional hives, and 689 and 1500 modern beehives were existed in Gimbichu and Dugda districts respectively. From those hives about 580 traditional, 118 transitional and 69 modern hives in Gimbichu district and 350 modern hives in Dudga district were out of bee colony. Agricultural Growth Plan (AGP) and Livestock development office were the government body whereas Sustainable land management (SLM) and Meki Catholic Secretariat (MCS) were non-governmental organizations that supply modern beehives for farmers in the districts.

From West Arsi Zone, Shashamane and Arsi Negele Districts were selected based on were selected based on number of modern beehive introduced. Shashamane and Arsi Negele Districts have 37 and 43 Kebeles respectively. About 14600 and 18868 traditional hive, 3316 and 2045 transitional hives, 1562 and 1600 modern bee hives were existed in Shashamane and Arsi Negele District respectively. From those hives about 580 traditional, 118 transitional and 69 modern hives in Shashamane district and 770 modern hives in Arsi Negele district were out of bee colony/un productive. Agricultural Growth Plan (AGP), Livestock development offices and small enterprise were the government body whereas Meki Catholic Secretariat (MCS), ANCEDA, OXFAM America, international Development Enterprise (IDE), and World Vision were non-governmental organizations that supply modern beehives for farmers in the districts.

Sampling Techniques and Sample Size

Two stage sampling method was used for undertaking the research study. Purposive sampling was used to identify and select districts that have beekeeping potentials and number of modern beehives introduced from the lists of 10 and 12 districts in East Shoa and West Arsi

Zones respectively. Accordingly, four districts were selected purposively based on beekeeping potential and modern beehive introduced. The selection activity was done together with the concerned experts from district office of agriculture and Development Agents. From each selected district, three Kebeles were selected using simple random sampling method. According to Storck et al. (1991), the size of the sample depends on the available fund, time and other reasons and not necessarily on the total population. A total 126 sample sizes were fixed using Yamana (1967) sample size determination formula and randomly drown from the selected four districts.

$$n = \frac{N}{1+N(e)^2} = \frac{9149}{1+9149(0.09)^2} = 122$$

Where: n = is the sample of beekeeper households in the district, N = is the total beekeeper households in the districts (N = 9149) and e = 0.09 is the level of precision defined to determine the required sample size at 90% level of precision. The sample sizes selected from each kebele were determined using probability proportional to size (PPS). Key informants interview discussion was also made with concerned experts and Development agents at each selected Kebeles.

Data Collection Methods

Both primary and secondary data was collected from different sources at different levels. Primary data was collected through focus group discussions, key informant interview and households' interview using checklist and semi-structured questionnaire.

Secondary data were collected from different agricultural and natural resource development offices, livestock agency, trade and market development office at different levels (Zones and districts), different NGOs and stakeholders working on beekeeping, CSA reports, and different unpublished reports

Data Analysis Methods

The tools for data analysis were descriptive statistics such as percentages, frequencies, mean and standard deviations; t-test and $\chi 2$ were also employed to test the continuous and discrete variables, respectively. STATA version 14 was used to analyze quantitative data. Any item that cannot be captured through quantitative analysis was analyzed qualitatively based upon Key informant interviews (KII) with concerned experts and focus group discussion (FGD).

Model Specification for Adoption Decision

Analytical model selected for this study is binary probit model, which significantly identifies the factors affecting the adoption of modern beehive in the study areas. It is also possible to analysis adoption behavior of farmers using simple correlation, and linear probability models. However, these models have their own limitations such as t- ratios are incorrect, exhibit heteroscedasticity, non-normality; their estimated probabilities (Pi) may be greater than one or below zero and assume pi increases linearity with X (Maddala, 1983 and Gujarati, 1995).

The Logit and Probit models overcome such drawbacks as both are based on a cumulative distribution function. It is also true that various adoption studies so far done on crop, livestock, and soil conservation were used Probit and Logit models for identifying the impact of independent variables on dependent variables. However, the outputs of Probit and logit models are usually similar (Aldrich and Nelson, 1984). Therefore, probit model was selected and applied to identify the determinant of modern beehives adoption in this study.

According to the probit model, the probability of an individual farmer adopting a modern beehive given a well-defined set of socio-economic and physical characteristics is represented accordingly.

$$\mathrm{P(Yi} = 1) = \frac{1}{2\pi}\int_{-\infty}^{Zi} e^{s2/2} dz$$

(1)

Where: P (Yi=1) is the probability that a farmer adopting modern beehive, Zi= is the function of a vector of explanatory variables, e = represents the base of natural logarithms. If P (Yi=1) is the probability of farmers adopting modern beehive in that area, then 1-P (Yi=1) represents the probability of farmers not adopting modern beehive in the research area and is expressed as:

$$1 - \mathrm{P}(Y_i = 1) = 1 - \frac{1}{2\pi}\int_{-\infty}^{Zi} e^{s2/2} dz\, i$$

(2)

The probit coefficient is interpreted by marginal effect (Gujarati, 2004). The marginal effect is the likelihood that a farmer adopt modern beehive to the probability of the non-adopter is expressed as:

$$\mathrm{Zi} = \beta o + \beta i Xn + \mu i \qquad (3)$$

Where, Zi - is an underlying and unobserved variable of the ith farmer, βo - is the constant term, βi – is the unknown parameters to be estimated, X_n - are explanatory variables, and μi - the disturbance term.

Hypotheses and definition of working variables

Table 6**.** List of dependent and independent variables

Dependent Variable	Type	Measurement	Expected sign
Adoption of modern beehive	Dummy	1 if yes, 0 otherwise	
Explanatory Variables			
Sex of respondents	Dummy	Male = 1, female = 0	+ve
Age of respondents	Continues	Number of years	+ve
Education level of respondents	Dummy	Literate = 1, illiterate = 0	+ve
Family size of the respondents	Continues	Number	+ve
Total farm land	Continues	Measured in hectare	+ve
Beekeeping experience with modern beehive	Continues	Measured in number of years	+ve
Participation in off-farm activities	Dummy	Yes = 1 and 0 = No	+ve/-ve
Total annual income	Continues	Ethiopian birr	+ve
Access to extension services	Dummy	Yes = 1 and No = 0	+ve
Access to credit services	Dummy	Yes = 1 and no = 0	+ve
Distance to FTC of respondents' residential	Continues	Measured in kilometers	-ve
Access to market information	Dummy	Yes = 1 and no = 0	-ve
Cooperative members	Dummy	Yes = 1 and no = 0	+ve

Results and Discussion

Descriptive Results

Under the descriptive results, the characteristics of households and outcome variables are described using statistical tools like mean, frequency, standard deviation, percentages and inferential statistics like t-test and chi-square test to see the relationship between variables.

Household Demographic Characteristics

Adoption is the degree of use of a new technology in long-run equilibrium when the farmer has full information about the new technology (Feder *et al.,* 1985). The rural household's adoption of modern beehives was influenced by demographic, socio-economic, institutional and psychological factors. Adoption of modern beehives by farm households was therefore, measured in terms of modern beehives users and non-users.

This study result showed that from the total of 126 sample households, 48.40% are adopted modern beehive while the remaining 51.60% are non-adopters. The majority (89%) of the beekeepers were male households compare to the female households in the study areas. The reason behind for the low involvement of female households in beekeeping activity is due to heavy workload chores in home and the beekeeping is relatively labor-intensive activity, which is in line with the finding of (Mujuni *et.al*., 2012).

The mean age of the respondent was found to be 42 years with the youngest being 19 years and the oldest 80 years. The beekeeper household was 8 years mean farm experiences in beekeeping farm. The two-sample t test result indicates that there is a significant difference between non-adopters and adopters in beekeeping experiences at 1% significance level. This result implies that the more experience households in beekeeping had more adopt modern beehives in the study areas (Table 2).

Table 7. Demographic characteristics of households

Demographic characteristics	**Non-adopters (n=65)**		**Adopters (n=61)**		**Total (n=126)**		**t-value**	**Sig.**
	Mean	SD	Mean	SD	Mean	SD		
Age	40.54	13.94	43.75	14.90	42.10	14.45	-1.25	0.21
Beekeeping Experience	6.51	5.02	10.34	5.97	8.37	5.80	-3.91	0.00
Family size	5.82	2.32	7.38	2.87	6.57	2.71	-3.37	0.00

Source: own survey result (2018).

Family size is the number of individual who resides in the respondent's household. The mean family size of the sampled households was found to be seven which ranges from one to twelve members in a house (Table 2). The result shows that the mean family sizes of adopters are greater than non-adopters. There is also significant mean difference between adopters and non-adopters at 1% level. This indicates that beekeepers with large family size opt more for technology adoption. This in turn implies technology adoption increases hive products which contribute to satisfy the need of their family. It is also positively associated with modern beehive adoption.

Education status plays an important role in smallholder farmers' economic activities because it equips farmers with the necessary knowledge of how to make a living (Aman *et al*., 2013). The study result showed that the majority (79%) of the beekeeper households attended formal education in the study areas (Table 3).

Table 8. The respondent's Education Status

Education status	Non-adopters (n=65)		Adopters (n=61)		Total (n=126)		χ^2 -value	Sig.
	Freq.	%	Freq.	%	Freq.	%		
Illiterate	12	18.46	14	22.95	26	20.63	0.39	0.53
Literate	53	81.54	47	77.05	100	79.37		

Source: own survey result (2018).

Land holding, livestock possession and income sources

Land is the most important input factor and base for any economic activity (Amanuel, 2018). Farm size influences household's decision to adopt or not adopt new technologies. This study showed that the mean land holding of sample households was found to be 1.6 hectare (Table 4). This result implies that the farmers who have small land size would adopt modern hive for honey production since beekeeping is for landless as well farmers who had small land (Tessega, 2009).

Table 9. Household land holding and livestock possession

Household Economic factors	Non-adopters (n=65)		Adopters (n=61)		Total (n=126)		t-value	Sig.
	Mean	SD	Mean	SD	Mean	SD		
Land holding (ha)	1.63	1.39	1.60	1.48	1.61	1.43	0.11	0.91
Livestock owned (TLU)	8.70	5.44	6.93	5.31	7.84	5.43	1.85	0.07

Source: own survey result (2018).

In rural areas, owning livestock is an important indicator of household wealth. In addition, livestock generate income, food and provide drafting power for crop cultivations (Tadele, 2016). The mean livestock owning of sample households was 7.84 TLU. Two sample t-test shows that the mean difference in livestock holding between adopters and non-adopters is statistically significant at 10% level (Table 4). This result revealed that farmers who have more livestock are non-adopters of modern beehive because the beekeeping enterprise is labor intensive just like livestock enterprises.

Income sources of households

The households in the study areas were generating incomes from different sources. Crop production and livestock rearing were the major source which households can generate income in the study area (Yassin, 2016). In addition to this, the households also generate an alternative income by participating in off-farm activities (5.32%) like fattening and/or non-farm activities (29.18%) like livestock trading, petty trade, hand craft, driving cart, flour mill,

construction work, house renting and guarding and selling honey (30.77%) which supported by the findings of (Asmiro, *et al.*, n.d).

Type of beehives, honey production and marketing

Households in the study areas were used traditional, transitional and modern beehives for honey production. In the study areas, the households own the mean of 3.24 traditional beehives and 2.67 modern beehives respectively (Table 5).

Table 10. Types of beehives owned by household

Types of hives	N	Mean	SD	Min	Max
Traditional hives	126	3.24	2.92	1	10
Transitional hives	18	1.61	0.5	1	2
Modern hives	86	2.67	1.65	1	6

Source: survey result (2018)

The majority of households (81.30%) preferred modern (frame) beehive followed by traditional (13.01%) and transitional hives (5.69%). The farmers preferred modern beehive because modern hive was suitable for management, reduced predators' attack, easy for honey extraction without killing honeybees and give more honey yield compared to traditional hives. However, beekeepers in the study areas own more traditional hives compare to the modern one because of the high cost of purchasing modern hives and due to lack of harvesting and processing equipment's to use modern hives.

Honey yield was markedly different for the traditional and modern beehives. The mean honey production harvested from traditional and modern beehives were 5.20 kg/hive/year and 18.20 kg/hive/year respectively. There is a great difference between the mean honey yield obtained from the traditional beehive and modern beehive. The result implies that farmers were harvested more double honey production from modern beehives compare to the traditional beehive in the study areas. Even though apiculture presents an opportunity for small producers, for many beekeepers the potential to create a significant livelihood from selling honey remains out of reach. The reason was due to differences in management of bees, climate changes, agro-chemical effect, pests and predators which is in line with the result of (SOS-Sahel-Ethiopia, 2006).

Honey production was harvested once or twice per year based the availability of bee flora and good weather condition. The farmers harvested honey twice a year if bee flora was available and good weather condition otherwise they harvested honey once per year. The first round of

honey harvesting was undertaken starting from October to November and the second round was in February up to April (ZOANR, 2018).

Bee colonies, wax and their sources

The majority of the respondents (95.20%) in the study area got their colonies by catching swarms whereas the remaining respondents were got colonies by purchasing and donation (4.8%). This is in line with Kiros and Tsegay, (2017) that reported 53.2% of the beekeepers got bee colonies by catching swarms. However, the availability of bee colonies in the study areas was decreasing due to feed shortage and unwise application of agro-chemicals.

Beekeepers in the study areas were access bee wax by saving (59.32%), given by development agents (20.34%), donated by NGOs (Meki Catholic Secretariat) (10.17%) and by purchasing (8.47%).

Honey, colony and wax market prices

Honey was the major marketable product of beekeeping. Most farmers sold honey in a semi-refined form after comb pressing followed by sieving to remove most of the wax and other impurity particles. Honey was sold at the market with the average price of 100 birr per kilogram. The price was set based on demand and supply condition in the market whereas the average price of bee colony and bee wax was 440 birr and 300 birr respectively.

Institutional Factors and Access to Institutional Services

There are different institutions that provided services for beekeepers in the study areas, which their impact on modern beehive can be observed directly or indirectly. The beekeepers in the areas had different accesses on beekeeping such as access to market information, access to extension service, access to credit services and near distance to farmers' training centers.

Being member of primary cooperative of beekeeping is an advantageous for farmers to share information for each other. Table 6 below indicates that the modern beehive adopters were members (57.4%) of primary cooperatives compare to non-adopters. The majority (81.7%) of beekeeping farmers in the study areas were not access to credit service (Table 6). This result implied that the intervention is required in delivering credit services by concerned governmental and non-governmental organizations to benefit beekeeping farmers and enable them to adopt modern beehives.

Table 11. Description of categorical and continuous variables

Variables	Response	Non-Adopters (n=65)		Adopters (n=61)		Overall (n=126)		χ2	Sign
		Freq.	%	Freq.	%	Freq.	%		
Cooperative members	No	38	58	26	42.6	64	50.8	3.16	0.08
	Yes	27	41.5	35	57.4	62	49.2		
Credit access	No	56	86.2	47	77	103	81.7	1.75	0.19
	Yes	9	13.8	14	23	23	18.3		
Extension services	No	32	49.2	21	34.4	53	42.1	2.83	0.09
	Yes	33	50.8	40	65.6	73	57.9		
Market information	No	39	60	32	52.5	71	56.3	0.73	0.39
	Yes	26	40	29	47.5	55	43.7		
Variables		**Mean**	**SD**	**Mean (**	**SD**	**Mean**	**SD**	**t-value**	**Sign**
Distance to farmers training center (Km)		2.80	1.98	2.02	1.58	2.42	1.84	2.44	0.02

Agricultural extension was a major source of agricultural information for adoption process, which is seen as the main important service to farmers (Tadele, 2016). Out of the total sample households, 57.9% of farmers had access extension service whereas the remaining 42.1% did not have access extension service (training and advisory services on beekeeping and its management). As indicated (Table 6), 65.6 and 50.8 percent of adopter and non-adopter had access to extension service respectively. The chi-square test result showed that there is significant difference between adopters and non-adopters in access to extension services at 10% level. This implies that majority of the adopters had access to extension service which enable them to have more information about new technologies.

In the study areas, about 44% of the farmers were received market information of modern beehive (Table 6). Information on a technology makes it more understandable to the farmer hence increasing their trust to adopt it. The farmers mainly received price and market information from development agents (25.5%), NGO (catholic) (12.75%), neighbors (3.92%) and Private retailers (2.94%) regarding beekeeping in the study areas.

The distance to farmers training center affected farmers' technology adoption which means farmers who travelled more distance to reach FTC that modern hive availed are non-adopters of the technology (Aman, *et al.*, 2013). Table four above indicates that the farmers travelled at least two kilometer to reach farmers training center where the modern beehive was available (Asmiro, *etal.*, n.d). The two sample t-test result showed that there is a significant difference between adopters and non-adopters with respect to distance travelled to reach

farmers' training center at 5% significance level (Table 6). This result implies the beehive adopter farmers were near to farmers' training centers compare to non-adopters.

The Major Beekeeping Constraints in the Study Area

The major constraints of beekeeping in the study areas were bee pests, lack of capitals, bee predators, lack of accessories, high price of modern beehive and lack of bee forage (Table, 7). In the study areas, honey pests (aunts and spiders (99%)) took the lion share by affecting honey production followed by the predators like lizards (35.87%) and birds and Honey acker (51.10%) respectively.

The farmers in study were applying different methods to protect bee pests and predators that attack honeybees. The measures that beekeepers took are cleaning around the apiary sites; add ash and benzene under hive to protect bee pests.

Table **12.** Major constraints of beekeeping in the study areas

Major constraints	**Percent**	**Pair wise ranking**
Lack of capital	65.88	1
Bee pests	62.71	2
High costs of modern hive	62.70	3
Agro-chemical application	61.88	4
Bee predators	56.75	5
Lack of bee forage	55.16	6
Lack of awareness on modern beehives	46.00	7
Lack of accessories	45.40	8
Bee absconding	43.66	9

Source: Survey result and KII report (2018).

Econometric Analysis

In this section, an econometric analysis was applied to identify the household-level demographic and socio-economic factors that affect the adoption of modern beehives in the study areas. The probit regression model was run to find out why some households adopt modern beehives and others did not. The model chi square test indicates that the overall goodness-of-fit of the probit model was statistically significant at 1% probability level which in turn indicates the usefulness of the model to explain the relationship between the dependent and independent variables. Accordingly, as indicated in Table 8, 23 % of the total variation for the adoption of modern hive is explained by probit model. The result of probit model estimation shows that the decision made by respondents to adopt beehive in the study area is significantly influenced by households' beekeeping experiences, family sizes, member

of beekeeping cooperative, access to extension services and distance of household residence from farmers training (FTC) center where modern beehive are available and supplied (Table 8).

Table 13. Factors Affecting the Adoption of Modern Beehive

Explanatory variables	Coef.	Robust SE.	z	P>z	Marginal Effect
Beekeeping experience	0.085	0.026	3.29	0.001***	0.034
Education status	-0.385	0.338	-1.14	0.255	-0.153
Family size	0.108	0.054	1.99	0.047**	0.043
Farm size	-0.059	0.087	-0.69	0.493	-0.024
Cooperative member	0.568	0.265	2.15	0.032**	0.223
Distance to FTC	-0.192	0.077	-2.49	0.013**	-0.076
Income of household	0.181	0.122	1.48	0.138	0.072
Access to extension service	0.469	0.273	1.72	0.086*	0.185
Market Information	0.015	0.273	0.06	0.956	0.006
Off/Non-farm participation	0.072	0.264	0.27	0.786	0.029
_cons	-2.513002	1.402499	-1.79	0.073	

***, **: implies statistical significance at 1%, and 5% levels, Log pseudo likelihood = -67.40, Wald chi2 (10) = 36.74, Prob> chi^2 = 0.000, Pseudo R^2= 0.23, N = 126. Source: Model result, 2016.

Beekeeping experience: The household's beekeeping experience was found to be positively influence the adoption of modern beehives at 1% significance level. This result implies that households likelihood of modern beehive adoption would increase by 3% as beekeeping experiences increased by one year, keeping other factors constant (Table 8). Longer farming experience implies accumulated farming knowledge and skill, which has contribution for adoption (Melaku, 2005; Wongelu, 2014).

Family size: The household's with large family size was positively influences the adoption of modern beehives which is statistically significant at 5% level. This result indicated that the likelihood of the household adoption would increases by 4% as the number of households increases (Table 8). The reason was farmers with large family size might significantly adopt the technology, to satisfy the need of their family. Hence, it was hypothesized that household with large family would adopt the technology more as large family size assumed to be an indicator of better labor availability in the household. This result is confirmed by the finding of Workneh and Puskur, (2011) and Tadele, (2016).

Cooperative member: Farmers in a given group tend to have and use the same methods of production hence adoption of a technology by a group member would greatly influence the interests of other members in the particular technology. As hypothesized, being member in beekeeping cooperative influences adoption of modern beehive positively and significantly at

5% level. Being member of beekeeping cooperative would increase the household likelihood of modern beehive adoption by 22.3%, keeping other variables constant (Table 8). This is mainly due to information sharing among members on how to operate and profitably about the newly acquired techniques. The result is also supported by the finding of (Mujuni, *et al*., 2012).

Distance to FTC: The distance of beekeepers residence from farmer's training center was negatively influence the adoption of modern beehive at 1% significant level (Table 8). This indicates that the distance of the farmers' residence from the farmers training center far by one kilometer, the likelihood of adopting modern beehive would decrease by 7.6%. The implication of this result is that farmers who are far from farmers training center were not easily access the modern beehive. The finding of this study is supported by the finding of (Tadele, (2016).

Access to Extension service: access to extension service was positively influence on the adoption of modern beehive at 10% significant level (Table 8). Famers' likelihood to adopt modern beehive would increase by 18.5% as farmers get extension service on beekeeping in the study areas. The level of extension information (training and advices) disseminated to the people about a given technology would affect the farmers' ability to take up the technology. Good extension services play a major role in dissemination and hence adoption of technologies. This result is in line with the findings of (Mujuni, *et al*., 2012) and Tadele, 2016).

Conclusions and Recommendations

Conclusion

Ethiopia has huge potential for beekeeping production because of its endowment with diversity in climate and vegetation resources. Even though the government of Ethiopia gives great attention to the beekeeping sub sector to promote modern beekeeping technologies but the adoption of modern beehive is found to be minimal. Create means of alternative income, which enable the farmers to solve their financial constraints. This enables beekeepers to widen the financial bases of poor beekeepers.

Lack of capital, pests, high costs of modern hive, agro-chemical application and predators are ranked as the first up to fifth major constraints affecting beekeeping in the study areas. The result of probit model shows that beekeeping experiences, family size, beekeeping

cooperative member and access to extension service were positively affects the adoption of modern beehive whereas distance from farmer's residence to farmer' training center was negatively affect the adoption of modern beehive in the study area.

Recommendations

Based on the conclusions the following recommendations are drawn:

- An intervention is required on availing accessories of modern hive for farmers and gives training for farmers on modern hive management in order to increase honey production.
- Support beekeepers through facilitating Credit services. Therefore, Beekeepers can buy modern hives with accessories.
- Facilitating access to modern beehives through strengthening the existing cooperatives is recommended from the output of this research.
- Adequate training have to be provided for farm households on agro-chemical application specifically herbicides to minimize the death of honeybees
- Appropriate interventions in disease, pest and predator control should be strengthened to reduce colony disturbance and improve overall productivity.
- An intervention that protect predators attack like honey acker, wax moth and bird as well as controlling methods have to be further studied by biological researchers.
- Extension services like training and advice on beekeeping production and management should be strengthened down to the village level to inform farmers about beekeeping and the new technologies in order to increase modern beehive adoption.

References

Aldrich, J.H. and Nelson, F.D., 1984. Linear probability, logit and probit model: quantitative application in the social science-sera miller McCun, sage pub.Inc, University of Minnesota and Iola, London.

Aman Tufa, Adam Bekele, and Lemma Zemedu, 2014. Determinants of smallholder commercialization of horticultural crops in Gemechis District, West Hararghe Zone, Ethiopia. *African Journal of Agricultural Research*, Vol. 9(3), pp. 310-319.

Amanuel Bekuma, 2018. Review on Adoption of Modern Beehive Technology and determinant Factors in Ethiopia. *Journal of Natural Sciences Research*, Vol.8, No.3, pp. 24. Available on: www.iiste.org

Asmiro Abeje, Kindye Ayen. Mulugeta Awoke and Lijalem Abebaw, n.d. Adoption and Intensity of Modern Bee Hive in wag Himra and North Wollo zones, Amhara Region, Ethiopia. Unpublished report.

Central Statistical Agency (CSA), 2013. Population Projection of Ethiopia for All Regions at Wereda Level from 2014 – 2017. Addis Ababa, Ethiopia.

CSA, 2017. Agricultural sample survey 2016/2017 on livestock and livestock characteristics. Central Statistics Authority. Addis Ababa, Ethiopia.

EIAR, 2017. Ethiopian Institute of Agricultural Research: Livestock and Fisheries Research Strategies. Poultry, Fisheries, Apiculture and Sericulture. Addis Ababa, Ethiopia, pp. 153-224.

FAO, 2017. Food and Agriculture Organization: Livestock Primary

Feder, G., Just, R. E. & Zilberman, D., 1985. Adoption of agricultural innovations in. *Economic Development and Cultural Change*, 33, 255-298.

Gidey Yirga and Mekonen Teferi, 2010. Participatory Technology and Constraints Assessment to Improve the Livelihood of Beekeepers in Tigray Region, northern Ethiopia. *MEJS, Vol. 2 (1): 76-9.*

Gujarati, D.N., 1995. Basic Economics, 3rd edition.McGraw-Hill,Inc: Newyork.

Gujarati, D.N. 2004. *Basic Econometrics, 4th edition*. The McGraw Hill Companies, New York.

Kenesa Teferi, 2018. Status of Beekeeping in Ethiopia- A Review. *Dairy and Vet Sci J*.; 8(4).

Kiros Welay and Tsegay Tekleberhan, 2017. Honey-bee production practices and hive technology preferences in Jimma and Illubabor Zone of Oromiya Regional State, Ethiopia. Acta Universitatis Sapientiae Agriculture and Environment, 9, 31-43.

Maddala, G.S., 1983. Limited dependent and qualitative variables in econometrics. Cambridge university press.

Melaku Gorfu, 2005. Adoption and profitability of Kenyan top bar hive beekeeping technology: A study in Ambasel woreda of Ethiopia. Unpublished M.Sc. Thesis, Alemaya University, Alemaya, Ethiopia.

Mujuni, A. Natukunda, K., and Kugonza, D. R., 2012. Factors affecting the adoption of beekeeping and associated technologies in Bushenyi District, Western Uganda.*Livestock Research for Rural Development*, No., 8, Vol., 24.

Storck, H., Bezabih Emana, Berhanu Adenew, Borowieck, A., Shimelis W/Hawariat, 1991.

SOS-Sahel-Ethiopia (2006). Smallholders apiculture development and trade promotion project terminal report, Addis Ababa, Ethiopia.

Tadele adisu, 2016. Factors Affecting Adoption of Modern Beehive in SaeseTsaeda District of Tigray Ethiopia. *Journal of Energy Technologies and Policy*, ISSN 2224-3232, Vol.6, No.2, pp. 31-34.

Tesfaye B, Genet D, Temaro G., 2017. Assessment of Honeybee Enemies (Pests and Predators) in Bale Zone, Southeastern Ethiopia. *Journal of Agricultural Extension and Rural Development,* 9(4): 53-61.

Tessega Belie, 2009. Honeybee Production and Marketing Systems, Constraints and Opportunities in Burie District of Amhara Region, Ethiopia. MSc Thesis, Bahir Dar University, Ethiopia.

Wongelu Endale, 2014. Adoption of Transitional Chefeka Bee Hive Package: The Case of Wolmera Woreda, Oromia Special Zone, MSc. Thesis. Haramaya University, Haramaya Ethiopia.

Workneh, A., and Puskur, R., 2011. Beekeeping sub sector challenges and constraints in Atsbi Wemberta District of Eastern Zone, Tigray Region, Ethiopia. Journal of Agriculture Extension and Rural Development 3(1), 8–12.

Yamane, T. 1967. Statistics: *An Introductory Analysis. 2nd Edition*, Harper and Row, New York. p. 919.

Yassin Esmael, 2016. Determinants of the Participation Decision of Smallholder Farmers in Potato Sales in Kofele District, Oromia National Regional State, Ethiopia. MSc Thesis, Haramya University, Ethiopia.

ZOANR (Zonal Office of Agriculture and Natural Resource), 2018. Reports of East Shoa and West Arsi Zones Office of Agriculture and Natural Resource, Ethiopia, unpublished**.**

Characterization and Analysis of the Farming Systems of East Wollega Zone, Oromia, Ethiopia

Kifle Degefa, Getachew Biru, and Galmessa Abebe,
Oromia Agricultural Research Institute, Bako Agricultural Research Center, P.O.box 03, Bako,Ethiopia
**Corresponding author: kifledegu2002@ymail.com*

Abstract

The study was conducted to characterize and analyze the existing farming system and to identify the production and marketing constraints of East Wollega Zone with cross-sectional data of 156 sample households. The farming system of the study areas is characterized as mixed farming systems with crop and livestock contributing 56.21% and 28.44% to he livelihood of farming communities in the area, respectively. The survey results showed that low productivity, shortage/lack of improved varieties, weed infestation, high cost of inputs was identified as major important constraints in crop production and high transaction cost, lack of marketing linkage, low price of output and shortage of market information was reported as major constraints in crop marketing. Disease, feed shortage, grazing land

shortage and lack of improved breed were identified as important constraints in livestock production and high transaction cost, low price output, shortage of market information, unorganized marketing system and lack of market linkage were reported as major livestock marketing constraints. Besides, soil erosion, soil fertility decline, water logging, soil acidity and termite were reported as important constraints in natural resources. To improving crop and livestock productivity access improved varieties and breed, capacitate farmers' awareness on disease, minimizes transaction cost, focus on high value crop, expanding soil and water conservation, strengthening market information and linkage where need the urgent concentration for interventions.

Key words: *Crop, farming system, East Wollega, livestock and natural resource*

Introduction

Small-scale crop–livestock farms represent a large fraction of the rural population in the region in general and the East Wollega Zone in specific which is mixed farming system. Accordingly, crop production and livestock rearing contributes significantly to livelihoods of the smallholder farmers. Except for maize majority of crops grown in the zone are local varieties and method of production is majorly oxen plough which is hearted from the farmers' ancestors. The substance farmers in the Zone usually manages a complex whole farm system of at least several enterprises which are not known with market oriented crop production and known for their subsistence production, dominated the zone. Local cattle are the predominant breeds reared in the area and market-oriented dairy and meat production are rarely practiced in the Zone.

Crop, livestock and natural resource production and productivity are constrained by ecological, technical and economic limitations in the zone. These constraints call for an identification and analysis farming system that aids to identify point of intervention in development works to enhance production and productivity of crop, livestock and natural resources.

A farming system is a unique and reasonably stable arrangement of farming enterprises that a household manages according to well defined practices in response to the physical, biological and socio-economic environment with household goals preferences and resources (Garnett *et al*., 2013). It is comprising complex production units involving a diversity of mixed crops and

livestock in order to meet the multiple objectives of the household (Dennis *et al*., 2012) which is similar to the study areas.

Understanding the interdependence of the elements of the farming system and maintaining the balance in the complex set of farmer's objectives are relevant to outlining promising development strategies for such systems (FAO, 2016). The classification of developing countries may be varied as available natural resource base, climate, landscape, farm size, tenure and organization, dominant pattern of farm activities and household livelihood (Dixon *et al*., 2001).

Therefore, this farming system characterized is important to identify and analyze the intensity of production, diversification of crops, other activities and major constraints of the study areas with to characterize and analyze the existing farming system of major agro-ecology and identify the production constraints of the farming system for further interventions of the study areas

Research Methodology

Description of the Study Area

East Wollega Zone is one of the zones of Oromia National Regional State. The East Wollega Zone comprises 17 districts namely Haro Limmu, Limmu, Ebantu, Gidda Ayyana, Kiremu, Guto Gidda, Sasigga, Digga, Leka Dullecha, Jimma Arjo, Nunnu Kumba, Wama Hagalo, Boneyya Boshe, Gudeyya Bila, Gobbu Sayyo, Sibu Sire, and Wayyu Tuka and the capital of the Zone is Nekemte town. The Zone is divided into 291 rural peasant associations and thirty-six towns which are called municipality towns and served as centers of rural districts. The Zone's town; Nekemte, is located at 331 km west of Finfinne. The capital Nekemte is found at the junction roads that connect the Zone to Jimma, West Shewa, West and Horro Guduru Wollega Zones of Oromia National Regional State t and Bure town of Amhara National Regional State. The total land area of the zone is about 14,102.50 km^2 which accounts for about 3.88 % of the total area of the National Regional State of Oromia (EWZFEDO, 2015).

According to the Zone Finance and Economic Development Office it is characterized by three major climatic zones, namely, highland (13%) midland (57%) and lowland (30%) with hilly, undulating and rolling topographical features. A number of permanent rivers including Dhidhesa and Gibe and temporal streams are prevailing in the zone. Its altitude ranges between 1000 and 2798 meter above sea level with the mean annual rainfall ranging between

1400 mm and 2200 mm. The main rainy season runs from the months of May to September. The soil types are clay and red sandy clay. Teff, barley, wheat, faba bean, maize, sorghum, finger millet, potato, hot-pepper and noug are some of the crops grown in the area (EWZFEDO, 2015).

Sampling Techniques

Multi stage sampling procedure was employed to select representative districts and kebeles. The sampled districts and kebeles from which primary data was collected were selected purposively based on agro-ecological and farming system diversities and representation of the specific farming system cluster in the zone. To collect primary data from the farm households, sample respondents were selected from the sampled kebeles within that farming system cluster using stratified random sampling techniques. The stratification was made to capture the existing socio-economic, socio-cultural and agro-ecological diversities of the targeted population. This stratification for instance depends on farmer category, farming system cluster and gender where each respondent was mutually exclusive.

Subsequently, with the consultation of experts from Agricultural and Natural Resource Development Office of the Zone and referring secondary data from the report of East Wollega Zone Finance and Economic Development Office issued in 2015, three districts namely; Diga, Jima Arjo and Boneya Boshe districts were selected depending on their representativeness on the existing socio-economic, socio-cultural and agro-ecological diversities of the targeted population/East Wollega Zone. On the second stage, kebeles were selected with the consultation of experts from each district's based on the criterion of their representativeness on the existing socio-economic, socio-cultural and agro-ecological diversities of the targeted population/each district. Accordingly, six kebeles were selected from Diga and Jimma Arjo districts; two from highland, midland and lowland and two kebeles from midland and lowland were selected from Boneya Boshe district based on three agro-ecology.

Participatory Rural Appraisal (PRA) was undertaken at least in one representative farming system cluster in each district. Focused group discussions were done with a minimum of eight and maximum of twelve people. Members of the focused group were old men and women, youth, development agents of the kebele and experts from each district. These members were selected based on their knowledge on the dynamics of their kebele farming system.

The households interviewed from each kebele representing socio-economic, socio-cultural and agro-ecological diversities of the targeted population were selected randomly from each strata depending on proportion to scale principle. Hence, fifty-three (53), fifty-nine (59) and forty-four (44) farm households were selected from Diga, Jima Arjo and Boneya Boshe respectively.

Types of Data and Method of Data Collection

Types of Data

Both primary and secondary data were collected and analysed for the study. Secondary data were collected from Zonal and District Agricultural and Natural Resource Development Office and Zone Finance and Economic Development Office using checklists and soft copies of these data were also collected from respective offices. The household interview and Focused Group Discussion (FGD) were undertaken by researchers from different disciplines that include crop, livestock, natural resource, socio-economics and extension research teams.

Among the primary data collected household demographic features, socio-economic situation of the household, household's resource endowment, household livelihood activities, households' resource allocation pattern, interaction and relationship between different components of the farming system, access to institutional support services access to market, households' use of modern inputs and technologies and farming system constraints and opportunities.

Method of Data Collection

The primary data were collected from the sampled farm households and key informants while the secondary data were collected from Zonal and District Agricultural and Natural Resource Development Office. The data collection was undertaken in two phases as described in the following paragraphs.

In first phase, reconnaissance survey was conducted by the mulidisciplinary team of researchers to consolidate the pre-hand information for sampling the study sites. Next to this, Zonal Agricultural and Natural Resource Development Office were visited to identify representative district. In this case purposive sampling was used to select study districts, which represent the three traditional climatic zones. Once the study districts were determined, again the team was made informal discussion with the districts' agricultural experts to identify the traditional agro ecologies prevailed in their area along with their specific crops,

livestock and natural resources endowments. The criteria for ecological differences was identified and documented. Finally, one kebele was selected randomly from each agro ecology totally three kebeles. Finally, the team back home and refined the checklists by making discussions around the objectives of the study and the realities of the farming systems cluster across identified farming systems cluster.

In the second phase, focused group discussion were undertaken using PRA tools to collect pre-hand qualitative data. Various PRA tools such as focus group discussion and key informant interview were employed to collect qualitative data. The focused group discussions involved agricultural expert from respective districts and kebele development agents, elders, youths and women. Key informant interviews were conducted to validate the qualitative data collected through focused group discussions.

After analysing the qualitative data, the team identified parameters to be quantified and then the team prepared household survey questionnaire. Finally, formal survey was undertaken and primary data were collected from 156 sample households based on probability proportional to sample size.

Methods of Data Analysis

On spot qualitative data analysis was made for data collected during focused group discussion using PRA tools. Quantitative data were analysed using STATA software and the results are presented in descriptive statistics such as minimum, maximum, mean, standard deviation, frequency and percentage. Graph, pair wise rank and correlation analysis were also employed based on the type of data.

Results and Discussions

Socio-demographic Characteristics

The average family size of the study areas was 6.7 with the standard deviation of 2.5. Sex composition of the respondents showed a male dominancy, with 89.1% males and 10.9% females. The larger proportion of households (64.1%) had medium wealth status while the rest 23.7% and 12.2% were poor and rich, respectively. Relatively large proportion (63.4%) of the respondents belongs to protestant religion followed by Orthodox (31.3%), Muslim (3.2%) and Catholic (1.9%) (Table 1).

Table 14. Socio-demographic characteristics of respondents

Variables	Category	N	%
Sex of HHs	Male	139	89.1
	Female	17	10.9
Wealth status of the HHS	Rich	19	12.2
	Medium	100	64.1
	Poor	37	23.7
Farmers' category	Model	29	18.6
	Follower	127	81.4
Religion of household heads	Muslim	5	3.2
	Orthodox	49	31.3
	Catholic	3	1.9
	Protestant	99	63.4

Source: Survey data (2017)

Livelihoods and Income

Crops remains to be a dominant economic activity and source of livelihood with 97.14%, 86.08% and 69.05% of respondents in the highland, midland and lowland agro-ecologies respectively were participated in crop production. 54.55%, 60.00% and 62.59 of the annual income of respondents in the highland, midland and lowland agro-ecologies respectively was obtained from crops. 17.14%, 2.53% and 7.14% of respondents in highland, midland and lowland agro ecologies were participated in off/non-farm activities. Besides, about 22.86%, 21.52% and 9.52% of sample respondents in highland, midland and lowland agro ecologies, respectively were participated in beekeeping activities. The beekeeping activities contributed about 12.50%, 8.75% and 5.50% to the sample respondents' annual income in the highland, midland and lowlands, respectively (Table 2).

Table 2. Livelihood activities and income generation of respondents

Activities	**Highland (n=35)**			**Midland (n=79)**			**Lowland (n=42)**		
	N	%HHs	% of income contribution	N	%HHs	% of income contribution	N	%HHs	% of income contribution
Crops	34	97.14	54.55	68	86.08	60.00	29	69.05	62.59
Livestock rearing	31	88.57	36.67	58	73.42	29.56	25	59.52	26.96
Beekeeping	6	22.86	12.50	17	21.52	8.75	4	9.52	5.50
Off/non-farm activities	4	17.14	12.50	2	2.53	40.00	3	7.14	21.00

Source: own computation (2017)

Food insecurity and Coping Mechanisms

Months of food shortage and copying mechanisms are indicated in figure 1 below. According the result, severe food shortage occurs during the months of July and August.

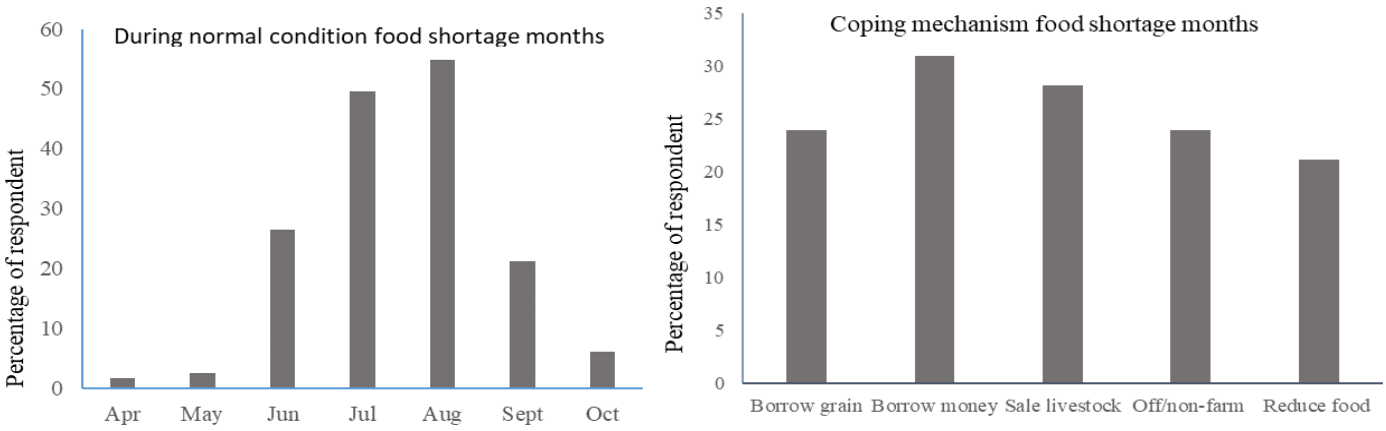


Figure 4. During normal condition food shortage exist months and coping mechanism

Cropping System

The major cropping system in the study areas include mono- cropping, crop rotation, intercropping, double cropping mainly using residual moisture ("Bone") and irrigation farming. Fallowing the land is not currently practiced because of land shortage in all types of farming system clusters. Intercropping is commonly practiced in the lowland areas largely maize with haricot bean. Mono cropping of maize is the most common practice in in lowland and midland areas and wheat and tef in highland areas. Cereal-pulse crop rotation is commonly practiced in the highland areas of the zone particularly tef production followed by faba bean or field pea and Vis Versa has been practiced for long period of time on limed farmers.

The result of focus group discussions revealed that, farmers in the study areas are well aware of the advantages of crop rotation and fallowing lands. In all study districts, farmers have the knowledge that, the crop rotation practice improves soil fertility status and the soil fertility improvement in turn contribute for the productivity of crops.

Major Crops Grown and their Productivity

Cropping patterns adopted by farmers in the study areas depends on agro-ecology factors like climate, soil types, crop types and markets. The major crops produced include maize, tef and millet from cereals; nug from legume and hot pepper and potato from horticulture. Wheat, barley, fab bean and field pea were the major crops grown in highland and midland agro-

ecologies while sorghum, ground nut, sesame were the major crops produced in midland and lowland agro-ecologies. Tef and wheat were the most important crops in the highland farm cluster which covered 0.58 and 0.56 ha of land respectively. In midland and lowland farm cluster maize and sorghum were covered at least 0.90 and 0.61 ha respectively (Table 3).

Analysis of crop yields was done separately at the district level and overall which expressed in quintal per hectare as summarize in table 3. The yield of sample respondents during survey period was below national and regional average (CSA, 2018).

Table 3. Major crops grown with their productivity in major Agro-ecology by respondents

Crops	**Highland (n=35)**			**Midland (n=79)**			**Lowland (n=42)**		
	%hhs grown	Area (ha)	Yield (Qt/ha)	%hhs grown	Area (ha)	Yield (Qt/ha)	%hhs grown	Area (ha)	Yield (Qt/ha)
Maize	62.86	0.42	28.70	92.41	0.91	37.78	83.33	0.89	38.78
Tef	85.71	0.58	11.01	58.23	0.51	9.31	23.81	0.38	7.31
Wheat	60.00	0.56	18.70	11.39	0.24	16.69	0	0	0
Millet	22.86	0.27	16.13	20.25	0.45	17.13	21.43	0.36	19.25
Barley	60.00	0.41	18.25	10.13	0.17	15.23	0	0	0
Sorghum	0	0	19.30	59.49	0.53	24.82	83.33	0.68	24.82
Faba bean	14.29	0.32	10.00	3.80	0.25	9.76	0	0	0
Field pea	8.57	0.24	6.37	1.27	0.13	7.67	0	0	0
Nug	5.71	0.32	6.5	53.16	0.43	7.52	21.43	0.41	8.43
Ground nut	0	0	0	5.06	0.45	11.12	30.95	0.23	12.21
Sesame	0	0	0	3.80	0.25	4.32	14.29	0.34	5.23
Hot pepper	5.71	0.13	11.42	11.39	0.41	12.43	16.67	0.38	15.42
Potato	37.14	0.23	113.23	11.39	0.16	107.32	4.76	0.13	67.12
Tomato	0	0	0	6.33	0.13	45.67	7.14	0.13	76.23

Source: own computation (2017)

Fertilizer Application and Seed Rate of Major Crops

Soil fertility decline is among the major problems that decrease the productivity of crops produced by farm respondents in the study zone. As mitigation strategies, sample respondents reported that they are using inorganic fertilizer (Urea and NPS).

The result showed that inorganic fertilizers application to different crops are variable from one farming system cluster to the other and even from one farmer to the other in the same farming system cluster due to lack of knowledge on the importance of ferilizers, purchasing power, poor awareness on the recommended rate of application. Generally, for all crops except maize farmers use below recommendation rate. The application of inorganic fertilizers and seed for maize is close to the recommended in all farming system clusters (Table 4).

Table 4. Major Crops with their inorganic fertilizers and seed rate used of respondents

	Highland (n=35)						Midland (n=79)						Lowland (n=42)					
	%hhs	Urea (%)	Rate-kg/ha	NPS (%)	Rate-kg/ha	Seed-kg/ha	%hhs	Urea (%)	Rate-kg/ha	NPS (%)	Rate-kg/ha	Seed-kg/ha	%hhs	Urea (%)	Rate-kg/ha	NPS (%)	Rate-kg/ha	Seed-kg/ha
Maize	62.86	72.73	125	72.73	88	24.34	92.41	83.56	124	83.56	94	24.67	83.33	57.14	111	57.14	92	24.31
Tef	85.71	40	30	60	26	30.09	58.23	45.65	36	60.87	37	33.40	23.81	20	50	20	50	33.40
Wheat	60	57.14	34	57.14	70	105.23	11.39	77.78	25	88.89	63	110	NA	NA	NA	NA	NA	NA
Barley	60	33.33	40	38.10	52	164.08	10.13	25	50	37.5	50	148.75	NA	NA	NA	NA	NA	NA
Sorghum	NA	NA	NA	NA	NA	NA	59.494	0	0	6.383	50	14.87	83.333	0	0	5.714	50	14.81
Millet	22.86	12.5	50	87.5	42	19.00	20.25	31.25	41	37.50	63	20.31	21.43	11.11	25	11.11	50	20.31
Pepper	NA	NA	NA	NA	NA	NA	6.33	60	50	60	100	*	14.29	50	50	50	50	*

*= *not estimated by farmers*

Source: Survey data (2017)

Improved Technologies Used by Farmers

Different organizations including research institutes provide full package of agricultural technologies particularly varieties and management practices to farmers under their extension activities. The management practices include agronomic practices like seed and fertilizer rate and methods of application of seeds and fertilizes.

Table 5. Improved technologies used by respondents

Crops	High land (35)		Midland (79)		Lowland (42)	
	Improved varieties (%)	Row planting (%)	Improved varieties (%)	Row planting (%)	Improved varieties (%)	Row planting (%)
Maize	77.27	98.21	93.15	97.96	48.57	97.78
Teff	40.00	0	15.22	6.52	30.00	30
Wheat	33.33	0	22.22	44.44	0	0
Millet	0	0	12.50	0	33.33	0
Sorghum	0	0	0	8.51	0	17.14
Pea	66.67	0	0	0	0	0
G/nut	0	0	0	100	0	100
Pepper	0	100	0	100	0	100
Potato	30.77	100	22.22	100	0	100
Tomato	0	0	6.33	100	0	100

Source: Survey data (2017)

Local varieties and broadcasting methods are used for majority of crops grown in the area. All cereal and legume crops were planted by broadcasting except maize in highland farming cluster. Additionally, limited farmers are practiced row planting on tef, sorghum, wheat and ground nut in midland and lowland farming clusters (Table 5). The result indicated that there is a gap in using improved varieties due to high price of seed, lack of seed, poor seed quality, untimely available. The following table (Table 6) presents lists of improved varieties used by farmers in the study areas.

Table 6. Improved varieties used by respondents of major crops

Crop name	Variety (ies)	Agro-ecology
Maize	BH-660 and BH-661	Highland and some midland
	Limu, shone, BH-546, BH-660 and BH-661	Midland and lowland
Potato	Gudane and Jelane	Highland, midland and lowland
Tef	Guduru and Quncho	Highland and midland
	Guduru, kena and Quncho	Midland
Finger millet	Boneya and Addis-01	Middland

Source: own computation (2017)

Plowing frequency and planting/sowing dates of major crops

The farming systems of smallholders in East Wollega zone were predominantly annual crop productions by using similar cropping calendar of rainfall with traditional land ploughing and planting methods using man and oxen power. The average ploughing frequency for wheat was 4.29 while it was 2.33 for faba bean and 2.00 for ground nut in highland and midland farming clusters whereas lower ploughing frequency in lowland farming cluster (Table 7). This showed that ploughing frequency varied among the crops and land soil fertility status. In addition to low inputs used unsuitable planting methods may be decease crop productivity.

Table 7 also summarized planting/sowing time of major crops. Maize and potato planting is carried out April to May while planting/ sowing of others crops is done Jun to August in highland farming cluster. Majority of crops in midland and lowland farming clusters are planted between May and August.

Table 7. Frequency of ploughing and planting times of respondents

Crops	High land (n=35)				Midland (n=79)				Lowland (n=42)			
	Ploughing frequency			Planting (sowing) time	Ploughing frequency			Planting (sowing) time	Ploughing frequency			Planting (sowing) time
	Min.	Max.	Mean		Min.	Max.	Mean		Min.	Max.	Mean	
Maize	2	4	3.28	April-May	1	5	3.58	May- 1st June	2	5	2.83	May
Tef	3	5	4.00	Last June- 1st August	2	6	4.33	Last Jun-July	3	6	3.70	July- 1st August
Wheat	3	6	4.29	Last June- 1st August	4	5	4.56	Last Jun-1st Aug				
Millet	2	4	3.38	Last May-June	2	5	3.38	Jun- 1st July	2	4	2.78	June-July
Barley	2	4	3.05	May- 1st June	2	4	3.13	May- 1st June				
Sorghum					1	4	2.15	Last March-May	1	4	1.80	Last March-May
Bean	2	3	2.33	Last June- 1st July	2	3	2.67	June-July				
Pea	2	3	2.45	Last June- 1st July	2	3	2.54	June-July				
Nug	2	3	2.5	June-July	1	3	2.75	June-July	1	4	2.22	June-July
G/nut					2	2	2.00	May-June	2	3	2.14	May-June
Sesame					2	3	2.23	May- 1st June	1	4	2.17	May- 1st June
Pepper					4	5	4.50	May- 1st June	2	4	2.50	May- 1st June
Potato	2	5	3.50	April	1	5	3.00	March & Sept.-November	2	4	2.87	April
Tomato					2	5	3.65	November-December	3	4	3.12	November-December

Source: Survey data (2017)

Major Weeds for Major Crops and their Management Practices

All crops across the study areas were affected by two or more types of weeds throughout the cropping season. The dominant weeds frequently observed in crop fields were guizotia scabra spps (*hadaa/tufoo*), bromuss (*Keelloo*) and snowdenia polystarcya (*Mujjaa) and* commelina benghalesis common in maize production. Similarly, Oxallis (tef), avena fatua (wheat and barley) were reported as important weeds in the study areas during survey period (Table 8).

Table 8. Major weeds of major crops and their management practices

Crops	Major weeds	Major control methods	Weeding frequency
Maize	*Tuufoo/hada (Guizotia) Muujja (Snowden) Keello (Bromuss spp) Gororsisa (Commelina)*	Hand weeding,	Two to four, majorly three times
Teff	*Hadaa/Tuufoo (Guizotia) Siddisa (Oxallis) Gororsaa (Commelina) Keello (Bromuss spp) and Grass spp,*	Hand weeding, chemical (2-4-D) application and combination of the two	Mainly once and also twice (mainly when chemical applied)
Wheat	*Hadaa/Tuufoo (Guizotia), Oat(Avena fatua) and Goommanee (Raphatum spp)*	Hand weeding, chemical (2-4-D) application and combination of the two	Mainly twice and once and three times
Sorghum	*Tuufoo/hada (Guizotia), Siddisa (Oxallis) Muujja*	Hand weeding, chemical (2-4-D) application and combination of the two	Once, three times and mainly twice
Finger Millet	*Gargaaraa (Eleusine indica), Hadaa/Tuufoo (Guizotia), Keello (Bromuss spp)and Grass spp*	Hand weeding, chemical (2-4-D) application and combination of the two	Mainly once and also twice

Source: Survey data (2017)

Weed management options exercised by respondents were typically hand weeding and herbicide like 2-4-D. Hand weeding was conducted throughout crop stage ranges of 1-3 times depends on crop types and weed infestation. After 2-4-D herbicide application, at least one-time hand weeding was commonly practiced in the study areas (Table 8).

Labor Shortage and Coping Mechanism

Out of the total respondents 64.1% were reported that there is labor shortage during harvesting, planting/sowing, weeding and threshing. To solve the problem, farmers use different coping mechanisms that include *dabo*, renting/sharing out the land and hire daily laborers (Figure 2).

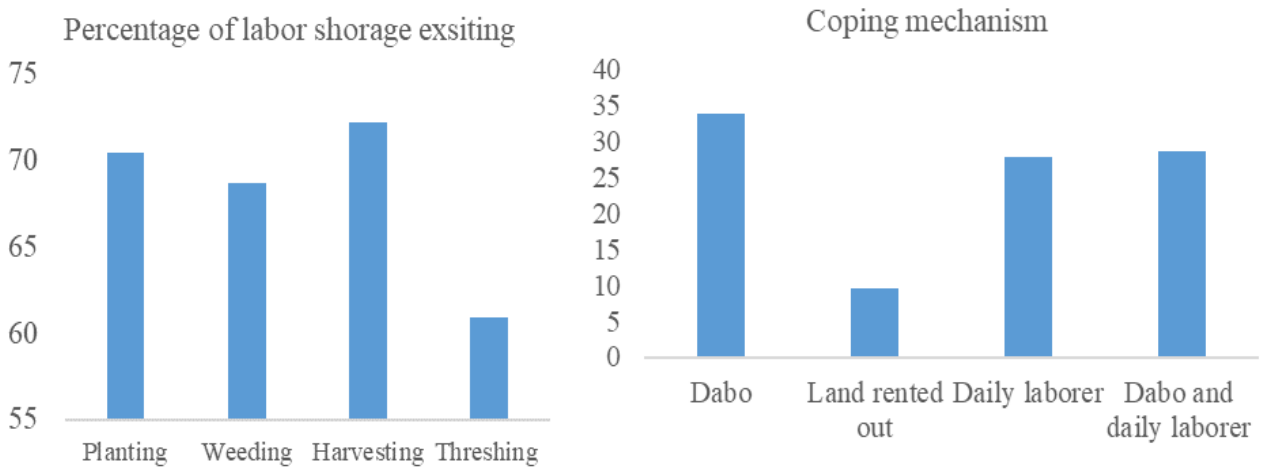


Figure 5. Labor shortage and coping mechanism of sample households

Major Crop Production Constraints

An in depth quantitative analysis was undertaken to understand the constraints that inhibit crop production of the respondents in three farming clusters. Top seven important constraints were ranked in three agro-ecologies (Table 9).

Table 9. Major crops production constraints of respondents

Crop production constraints	Highland (n=35)			Midland (n=79)			Lowland (n=42)		
	N	%hhs	Rank	N	% hhs	Rank	N	%hhs	Rank
Disease	21	60.00	6	43	54.43	7	27	64.29	7
Insects	19	54.29	7	34	43.04		25	59.52	
Termite	12	34.29		53	67.09	4	28	66.67	6
High cost of improved seed	27	77.14	4	62	78.48	2	32	76.19	3
High cost of fertilizer	25	71.43	5	64	81.01	1	35	83.33	2
Shortage/lack of improved seed	31	88.57	2	52	65.82	5	29	69.05	5
Shortage of land	17	48.57		23	29.114		13	30.95	
Lack of capital	15	42.86		27	34.177		22	52.38	
Low productivity	32	91.43	1	37	46.835		19	45.24	
Weed infestation	29	82.86	3	55	69.62	3	31	73.81	4
Poor soil fertility	11	31.43		51	64.56	6	40	95.24	1

Source: Survey result (2017)

The major crops production constraints include low productivity (91.14%), shortage/lack of improved seed (88.57%), weed infestation (82.86%), high cost of improved seed (77.14%), high cost of fertilizer (71.43%), pests (disease (60%) and insect (54.29)) were the main constraints in highland farming cluster which ranked ranges of 1-7 ranks. In the midland farming cluster high cost of fertilizer (81.01%), high cost of improved seed (78.48%), weed infestation (69.62%), termite (67.09%), shortage/lack of improved seed (65.82%), poor soil fertility (64.56%) and disease (54.43%) were the main constraints which ranked ranges of 1-7 ranks. Highland farming cluster crop production constraints including poor soil fertility (95.24%), high cost of fertilizer (83.33%), high cost of improved seed (76.67%), weed infestation (73.81%), shortage/lack of improved seed (69.05%), termite (66.67%) and disease (64.29%) were reported as main constraints which ranked ranges of 1-7 ranks (Table 11).

Major Crops Marketing Constraints

The major marketing constraints that affecting crop marketing in the three farming clusters were identified and ranked in table 10. Accordingly, the major crops marketing constraints include lack marketing linkage (65.71%), low price of grain (62.86%), high transaction cost (51.43%), lack of capital (42.86%) and shortage of market information (37.14%) of respondents were reported as main constraints in three farming clusters (Table 10).

Table 10. Major crops marketing constraints of respondents

Crops marketing constraints	**Highland (n=35)**			**Midland (n=79)**			**Lowland (n=42)**		
	N	%hhs	Rank	N	%hhs	Rank	N	%hhs	Rank
Lack of capital	15	42.86	4	27	34.177	5	22	52.38	4
Low price of output	22	62.86	2	59	74.684	2	26	61.90	2
Shortage of market information	13	37.14	5	49	62.025	4	18	42.86	5
Lack of market linkage	23	65.71	1	72	91.139	1	37	88.10	1
High transaction cost	18	51.43	3	54	68.354	3	23	54.76	3

Source: own computation (2017)

Livestock Production System

The types and number of livestock owned by ample respondents in the three farming clusters are summarized in table 11. The average number of cows and oxen (in TLU) owned by sample respondents in the highland areas 2.46 and 2.86, respectively while it was 2.70 and 3.12 for

midland farming cluster and 2.24 and 3.00 for the lowland farming cluster, respectively (Table 11).

Sheep and goats are important as income source by the farming population. The average number of shoats owned by sample respondents was 0.23, 0.23 and 0.35 in highland, midland and lowland farming, respectively. Donkeys and horses were used for transportation services. About 31.43%, 41.77% and 28.57% of respondents were owned donkey for means transportation service and income generation in highland, midland and lowland farming clusters, respectively. About 60%, 60.76% and 59.52% of respondents in highland, midland and lowland farming clusters respectively had owned chicken of local and improved breeds.

Table 11. Household livestock ownership, proportion of owners and herd sizes (TLU)

Livestock type	**Highland (n=35)**			**Midland (n=79)**			**Lowland (n=42)**		
	N	%hhs	Mean	N	%hhs	Mean	N	%hhs	Mean
Cows	28*[3]	80.00	2.46 (1.55)	57	72.15	2.70 (2.20)	25	59.52	2.24 (1.36)
Oxen	29	82.86	2.86 (1.43)	60	75.95	3.12 (1.84)	31	73.81	3.00 (1.84)
Heifers	15	42.86	1.21 (0.62)	44	55.70	1.62 (1.60)	19	45.24	1.58 (0.90)
Calves	23	65.71	0.50 (0.21)	54	68.35	0.56 (0.36)	20	47.62	0.57 (0.32)
Sheep and goats	28	80.00	0.23 (0.27)	35	44.30	0.23 (0.20)	20	47.62	0.35 (0.35)
Donkeys	11	31.43	1.02 (0.48)	33	41.77	1.02 (0.43)	12	28.57	0.88 (0.32)
Horses	6	17.14	1.28 (0.45)	11	13.92	1.27 (0.47)	3	7.14	1.47 (0.64)
Poultry	21*[6]	60.00	0.10 (0.03)	48*[22]	60.76	0.11 (0.05)	25*[8]	59.52	0.12 (0.06)
Total TLU	33	94.29	9.66 (5.04)	63	81.01	10.63 (7.15)	35	83.33	9.86 (5.44)

*Note: *= Percentage of crossbred breed and numbers in parentheses are standard deviations*

Source: own computation (2017)

Dairy product and their trends over last five years

The average milk per day was 1.30 and 5.00 liters for local and cross breeds, respectively. The result indicated that the average milk yield per day per improved cow was more than three times with the same lactation period of local breed (Table 12). Majority of respondents were reported that milk productivity has decreased from time to time over last five years due to feed shortage and disease.

Table 12. Dairy product and their trends over last five years of respondents

Milk (lit/day)		N	% hhs	Mean
Local		94	85.5	1.3 (0.7)
Cross		2	1.8	5 (2.8)
Lactation period of local cow (months)		94	85.5	6.8 (2.3)
Lactation period of cross cow (months)		2	1.8	6.5 (2.1)
Status of milk over the last five years	Decrease	91	96.8	
	Increase	3	3.2	
Reason to decrease	Disease	43	47.3	
	Feed shortage	85	93.4	

Source: Survey result (2017)

Livestock feeds and feeding system

Livestock producers practiced three grazing systems including own grazing land, crop residues and communal land and combinations of them (Table 13). Straw (tef, barley, wheat, bean, pea) and Stover of maize and sorghum were extensively used by majority of respondents due to relative palatablility and lack of other feed option for the animals. About 77.30%, 80.90% and 31.40% of respondents used own grazing land, crop residues and communal land, respectively. The result revealed that about 26.30% of respondents have been practicing improved forages including alfalfa, Rhodes and elephant grass on soil bunds and around the homestead.

Table 13. Livestock feed sources and feeding system of respondents

Common feeds and source		N	%hhs	Improved forage practiced		N	%hhs
Own grazing land		109	77.30	Practiced	Yes	41	26.30
Crop residues		114	80.90		No	115	73.70
Communal land		45	31.90	Forage types	Alfalfa and Rhodes	9	22.00
Supplementary feed (Fegullo, etc)		33	23.40		Elephant grass	28	68.20
Most common crop residue used					Others	4	9.80
Straw (barley, tef, wheat and finger millet)		106	75.20	Area used for forage	Homestead	13	31.70
Stover of maize and sorghum		64	45.40		On soil conservation	6	14.60
Faba bean and field pea straw		7	5.00		On farm	22	53.70
Reason used	Preferred by livestock	39	27.70				
	No options	42	29.8				
	Preferred and no option	27	19.1				

Source: Survey result (2017)

Livestock Production Constraints

Livestock producers were asked to give their views on most important constraints affecting their livestock farm operations and their responses were summarized in table 14. Accordingly, the makor constraints mentioned by the respondents include disease (trypanosomiasis, black leg, anthrax, pastevrellosis and mastitis lichen, leg and foot and mouth and dermatophytosis), feed shortage, lack of capital, shortage of grazing land, lack of improved breed, water shortage, shortage of veterinary medicine, shortage of awareness in production constraints were reported in three farming clusters.

Disease Shortage of grazing land, feed shortage, lack of improved breed and lack of capital were important constraints ranked one to five on in highland farming cluster. Whereas, shortage of grazing land, disease, lack of improved breed, lack of awareness and feed shortage were the major constraints ranked one to five in midland farming cluster and shortage of grazing land, disease, feed shortage, lack of improved breed and shortage of veterinary medicine were the major constraints ranked one to five in lowland farming cluster. Generally, disease, feed shortage and lack of improved breed were the top three major constraints in all the farming clusters.

Table 14. Major livestock production and market constraints of respondents

Livestock production and marketing constraints	**Highland (n=35)**			**Midland (n=79)**			**Lowland (n=42)**		
	N	%hhs	Rank	N	%hhs	Rank	N	%hhs	Rank
Disease	28	80.00	1	61	77.22	2	32	76.19	2
Feed shortage	25	71.43	3	45	56.96	5	29	69.05	3
Lack of capital	21	60.00	5	15	18.99		19	45.24	
Shortage of grazing land	27	77.14	2	67	84.81	1	35	83.33	1
Lack of improved breed	23	65.71	4	52	65.82	3	27	64.29	4
Water shortage	14	40.00		23	29.11		18	42.86	
Shortage of veterinary medicine	17	48.57		34	43.04		22	52.38	5
Shortage of awareness	19	54.29		47	59.49	4	20	47.62	

Source: Survey result (2017)

Livestock Marketing Constraints

The major livestock marketing constraints includes market/demand fluctuation, price fluctuation, low live animal price, shortage of market information, lack of marketing linkage, unorganized marketing system and high transaction cost.

In highland farming cluster, unorganized marketing system (88.57%), high transaction cost (74.29%), price fluctuation (62.86%), low live animal price and market/demand fluctuation were the top five livestock marketing constraints. In midland farming cluster, lack of marketing linkage (87.34%), unorganized marketing system (74.68%), shortage of marketing information (72.15%), market/demand fluctuation (62.03%) and high transaction cost (58.23%) were were the major constraints ranked one to five. In lowland farming cluster, unorganized marketing system (88.10%), lack of marketing linkage (78.57%), price fluctuation (73.81%), shortage of marketing information (61.90%), low live animal price (59.52%) and high transaction cost (54.23%) were the major constraints ranked one to five (Table 15).

Generally, the result indicated that lack of marketing linkage, shortage of market information, unorganized marketing system and high transaction costs of the subsistence farmers are the most important livestock marketing constraints in three farming clusters.

Table 15. Major livestock marketing constraints of respondents

Livestock marketing constraints	Highland (n=35)			Midland (n=79)			Lowland (n=42)		
	N	% hhs	Rank	N	% hhs	Rank	N	%hhs	Rank
Market/demand fluctuation	18	51.43	5	49	62.03	4	17	40.48	
Price fluctuation	22	62.86	3	29	36.71		31	73.81	3
Low price	20	57.14	4	32	40.51		25	59.52	5
Shortage of information	16	45.71		57	72.15	3	26	61.90	4
Lack of market linkage	11	31.43		69	87.34	1	33	78.57	2
Unorganized marketing system	31	88.57	1	59	74.68	2	37	88.10	1
High transaction cost	26	74.29	2	46	58.23	5	23	54.76	

Source: Survey result (2017)

Feed shortage Months and Copping Mechanism

Majority of the sample respondents reported that feed shortage occurrs during dry season (January to May) and rainy season (August). The mitigation measures used during feed shortage include use reserved crop residues (tef, barley and wheat straw), purchasing of supplementary feeds, purchasing of crop residues (tef straw) and different leaves (Figure 3).

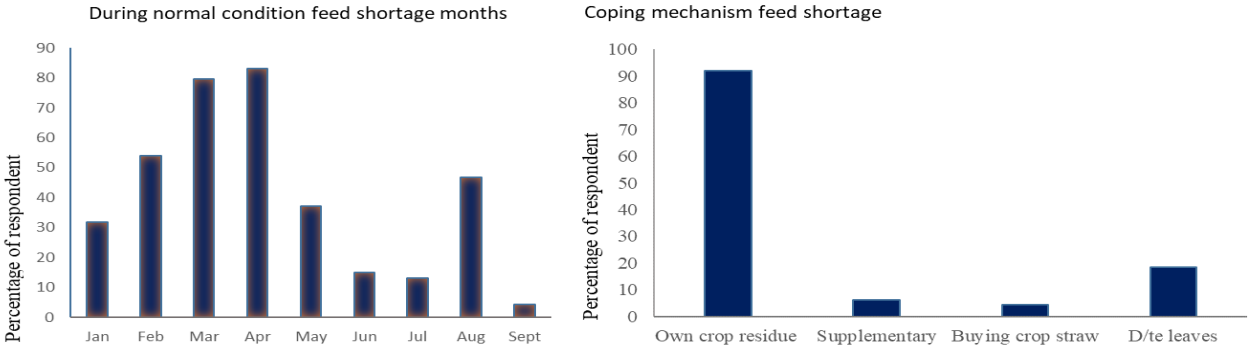


Figure 6. During normal condition months struggle feed and copping mechanism

Beekeeping practice is common practice in rural livelihoods as income generation source and home consumption. Table 16 presents beekeeping practice and major constraint in terms of number and production honey. The survet result shows that 29.5% and 3.9 of the sample respondents had owned traditional and modern beehives, respectively. The five most frequently reported beekepping constraints were herbicide (28.85%), aunts and wild animals (21.79%), lack of awareness (21.79%), low price of honey (19.87%) and shortage of bee forage (16.67).

Table 16. Beekeeping farm practices of respondents

Bee hives and honey	N	%hhs	Mean
Own beehives (n=156)	49	31.4	
Traditional beehives (n=46)	46	29.5	16.3
Modern beehives (n=46)	6	3.9	2.0
Honey harvest (traditional in kg)	46	29.5	67.1
Honey harvest (modern in kg)	5	3.21	29.4
Unit price of honey (kg-1)	38	24.4	43.6

Source: own computation (2017)

Table 17. Major bee keeping constraints

Constraints (n=156)	N	% HHs
Aunts and wild animal	34	21.79
Chemical (herbicide)	45	28.85
Lack of awareness	34	21.79
Shortage of bee forage	26	16.67
Low price of honey	31	19.87
Market fluctuation	15	9.62

Forestry and Agro-forestry

According the survey result, forestry and agro-forestry of the study areas were both natural, plantation and combination of them (Table 18). The result showed that about 82.10%, 7.5 % and 10.40% of respondents owned plantation, natural and combination of them for income generation, soil erosion control, soil improvement and climate balance purpose, respectively. Eucalyptus tree was the dominant tree in the study areas followed gravilia. Majority of the respondents undertake plantations around their home (garden), along the farming land and marginal land with out having plantation strategies and plans.

Table 18. Forestry and rainfall pattern for last five years of respondents

Variables	Response	N	% HHs
Forest on own land (n=156)	Yes	106	68.90
	No	50	31.10
Forest type (n=106)	Natural*	8	7.5
	Plantation	87	82.10
	Both	11	10.40
Purposes of forest (n=106)	Income generation	92	86.8
	Soil erosion control	86	81.1
	Soil improvement (legume and shrubs trees)	87	82.1
	Weather balance (temperature)	43	40.6

**Natural forest which planted by group for conservation purpose and different trees grown by nature.*

Source: own computation (2017)

Plantation and Rainfall Patters Status Over the Five Last Years

According to the respondents (53.80%), plantation has increased over the last five years due to governments massive plantation program (Table 19). This implies that different natural rehabilitation practices of the last five years may be increased the plantation. However, it needs deep analysis of plantation change over time in the study areas. Participant farmers were also asked about the effect of climate change on rainfall pattern. Accordingly, about 63.50% of sample households mentioned that there is late onset and early outset of rainfall.

Table 19. Respondents perception on status of plantation and rainfall pattern over the last five years

Description		**N**	%HHs	Mitigation strategies of rainfall pattern		
Status of plantation (n=156)	Increase	84	53.80	Mitigation (n=156)	N	%HHs
	Decrease	53	34.00	Afforestation	90	57.69
	Same	19	12.20	Change crop varieties	6	3.85
Rainfall pattern (n=156)		**N**	**% hhs**	Waiting for rainfall	10	6.41
Early onset and outset		20	12.80	No response	50	32.05
Late onset and early outset		99	63.50			
Late onset and outset		20	12.80			
No change		13	8.30			

Source: Survey result (2017)

Major Forestry Constraints

The respondents reported that population increase, shortage of land for plantation, livestock grazing system (open grazing), lack of seedling and termite infestation are the major forestry constraints. This result showed that about 39.70%, 35.30 and 25.00% of respondents were reported increase population, shortage of land and open grazing as main important constraints, respectively. About 19.90% and 16.70% of respondents were reported lack of seedling and termite as important constraints, respectively (Table 20).

Table 20. Major of forestry constraints of respondents

Constraints (n=156)	**N**	%HHs
Over population	62	39.70
Shortage of land for plantation	55	35.30
Termite infestation	26	16.70
Lack of seedling	31	19.90
Livestock grazing system	39	25.00

Source: Survey result (2017)

Soil and water conservation (SWC)

Natural resource is a common property of social arrangement regulating the preservation, maintains and consumption of a common pool resources like forest, soil and water were gotten attention from government to sustainable uses of natural resource. According to the survey result about 47.20% and 44.80% of respondents were practiced on their land check dam and terraces practices, respectively for soil erosion decrease, increase soil moisture and improved soil

fertility. Only limited number of farmers were grown gravilia, getra and elephant grass on their soil and water conservation practiced (Table 21).

Table 21. Soil and water conservation type and major constraints of respondents

Soil and water conservation		N	% HHs	Major constraints (n=156)	N	%hhs
Practiced (n=156)	Yes	125	80.10	Soil erosion	97	62.20
	No	31	19.90	Termite	38	24.40
SWC types (n=125)	Terraces	56	44.80	Water logging	27	17.30
	Check dam	59	47.20	Soil acidity	111	71.20
	Grasses	15	12.00	Lack of land	52	33.30
	Multipurpose trees	25	20.00	Poor soil fertility	108	69.20
Purposes of SWC (n=125)	Reduce soil erosion	113	90.40	Soil fertility perception of farmers (n=139)		
	Increase soil moisture	53	42.40	Very good	12	8.60
	Improve soil fertility	109	87.20	Good	93	66.90
	Climate balance	19	15.20	Poor	30	21.60
Farmers perception on SWC	Good	136	87.20	Very poor	4	2.90

Source: own computation (2017)

The major constraints of natural resources identified by respondents were soil erosion, soil acidity, water logging, soil fertility decline and termite. Result showed that about 71.20%, 62.20% and 69.20% of respondents were reported soil acidity, soil erosion and poor soil fertility as main important constraints, respectively. About 33.30% and 24.40% of respondents were reported water lack of land and termite as important constraints, respectively. Only 12.38% of respondents were reported water logging as constraint in the study areas (Table 21). Farmers perception on soil fertility status and importance of soil and water conservation also summarized in table 23.

Agricultural extension services

Technology adoption is highly dependent on information access (Berhanu *et al*., 2006). The type of information to disseminate to farmers and the sources of that information are critical in speeding up the rate of adoption of new technology. Asserting the importance of information sources rather than subsidies are more effective in encouraging fast adoption.

The major sources of service were DAs, BoANR, NGOs and research center used as mean information. The result shows that 91.03% and 26.28% of respondents were obtained information/ advice services from DAs and BoANR, respectively. Only about 4.90% of respondents were gained extension service from research centers. The extension services were focused on crop production (90.38%), livestock rearing (62.18%) and natural resource (76.28%) managements through training and/advice services (Table 22).

The government extension was still the major source of information training and advising farmers. More information on varieties with full package was received from the DAs through FTC and field visit model farmers. About 73.72% of respondents were visited demonstration of FTC and model farmers and about 48.72% of respondents were adopted the visited demonstration (Table 22).

Table 22. Agricultural Information sources of respondents

Extension service received		Frequency	Percent of households
		144	92.31
Extension service sources	Development Agents	142	91.03
	Research centers	7	4.90
	NOGs	21	13.46
	BoANR	41	26.28
Training/ and advice extension services	Crop production	141	90.38
	Livestock rearing	97	62.18
	Natural resource	119	76.28
	Market service	26	16.67
Visited demonstration		115	73.72
Practiced visited technology		76	48.72

Source: survey result (2017)

Credit utilization

In this study, we analyzed the various credit needs of farmers by district. It is the most important in technology adoption in terms of input purchase. According to results presented in table 23, about 43.40% of respondents utilized credit for purchasing inputs (fertilizer, seed and chemical), purchase food items, fattening and petty trade were importance activities attached to credit.

Results shown that about 42.90% and 38.10% of respondents were used for fattening and purchasing fertilize for agriculture activities, respectively (Table 23). The result indicates that there is a big gap for credit access among the rural farmers with viable options for cheaper credit a subject for further investigation. The majority of respondents were reported collateral (42.86%) and high interest rate (9.52%) as important constraints (Table 23).

Table 23. Credit utilization and constraints of respondents

Credit service access (n=156)		Frequency	Percent of households
		145	92.90
Credit service received (n=145)		63	43.40
Purpose of credit (n=63)	Purchase fertilizer	24	38.10
	Purchase food items (grain and others)	6	9.50
	Petty trade	7	11.10
	Buy livestock (fattening, others)	27	42.90
Major constraints (n=63)	Repayment time	16	25.40
	High interest	27	42.90
	Collateral	47	74.60
	Limited/shortage money	20	31.70

Source: Survey result (2017)

Market access and mode of transportation

Market access is critical in economic transformation of rural livelihoods. Improving market linkages along the value chain of major crops increases the opportunities and choices of rural farmers and reduces fluctuations between household consumption and income. Efficient integrated value chains, access to markets and other infrastructure help reduce transaction costs thus raising incomes of the rural poor (Denning *et al*., 2009).

Results from analysis of the market situation were summarized in table 24. Farmer on average access 1.80 market places with average walks of 188.10 minutes. The main modes of transport commonly used for commodity were on foot-walking, donkeys, horses, cart and car. About 80.10% and 28.20% of respondents used walking (foot) and donkey for transportation service, respectively. Using these transport modes farmers preferred cooperatives, small traders and collectors to sell their products.

Information flow reduces market imperfections with choices for the type of market of farmers to sell their products. Regarding of market information access about 65.40% of respondents was

access market information before selling their products. The main sources of this market information were extension office (DAs), traders, neighbor farmers, visit market place, cooperatives and radio (Table 24). The result showed that about 63.81% and 62.86% of respondents were obtained information from neighbor farmers and traders, respectively. About 33.03% and 30.40% respondents were gained information by visiting market before supply their grain to the market and DAs, respectively and these information sources were preferable by respondents which similar to Kindu *et al*., 2014 result.

Table 24. Marketing access and mode transportation of respondents

Variables		Mean	Std. Dev.	Market information sources and preferable		N	% of hhs
Market access in the area		1.80	0. 80	Information access (n=156)		102	65.40
Distance to market (mins)		188.10	114.60		DAs	31	30.40
Sample (n=156)		N	%		Traders	7	6.90
	Foot	125	80.10	Information sources	Neighbor farmers	16	15.70
Main mode	Car	27	17.30		Visit market	34	33.30
of transport	Donkey	44	28.20		Radio	6	5.90
(n=156)	Horse	23	14.70		Cooperatives	8	7.80
	Cart	33	21.20		DAs	28	27.50
Preferable	Cooperatives	105	67.30		Traders	9	8.80
buyers	Small traders	51	32.70	Preferable	Visit market	30	29.40
(n=156)	Collectors	23	14.74	information sources	Radio	13	12.70
					Neighbor farmers	11	10.80
					Cooperatives	12	11.80

Source: own computation (2017)

Conclusion

The study area is characterized by a mixed crop-livestock farming system. In all crop types produced in the study areas, average productivity per hectare is below the national average productivity due to different constraints. Pests (diseases and insects), high cost of inputs (seed and fertilized), shortage of land, weed infestation, shortage/lack of improved varieties, low yield, poor soil fertility and termite are among the major constraints in crop production. High transaction cost, low price output, shortage of market information and lack of market linkage were also reported as major crop marketing constraints.

Livestock production is also the most important for different purposes including sources of food (milk, meat and byproduct of milk), draught power, transportation service, source of income generation (sale live and byproduct) and manure production for soil fertility improvement. The livestock feed resources commonly used in the study areas were primarily natural pasture (communal and own grazing), crop residues and purchased supplementary feed. Improved forage crops were used in the study areas by limited numbrt of farmers. Agro-chemicals, shortage of bee forages, aunts and wild, price fluctuation and shortage of bee were identified as major beekepping production constraints.

The major problems of livestock production were disease and parasite (Trypanosomiasis, pastevrellosis, mastitis, anthrax, black leg, mouth and foot, lichen and lamp skin), shortage of grazing land, shortage of feed, lack of improved breeds and shortage of veterinary medicines. The major livestock marketing constraints include high transaction cost, market price/demand fluctuation, lack of market information, unorganized marketing system and lack of market linkage.

The major constraints of natural resource include soil erosion, termite attack, soil acidity, soil fertility decline, water logging and lack of sustainable land management caused by over cultivation, overgrazing and deforestation.

Recommendations

Based on the findings, the following recommendations were given(1) enhance production and productivity of crops through supplying improved inputs, building capacitates of farmers on integrated pest managements (IPM) to control pests and strengthen marketing linkage; (2) Provide improved breed, improved forage, control disease infection and improving marketing linkage; and (3) expanding natural resource conservation and more awareness on use physical and biological soil conservation which are more critical for soil improvement and increase productivity.

References

Amede T., Descheemaeker K., Everisto M., Peden D., Breugel P. van, Awulachew S. B. and Haileslassie A, 2011. Livestock-water productivity in the Nile Basin: Solutions for

emerging challenges. In: A. M. Melesse (Ed.), Nile River Basin: Hydrology, climate and water use (pp. 297–320). New York: Springer Science+Business Media B.V

Behnke R. and Fitaweke M, 2011. The contribution of livestock to the Ethiopian economy – Part II. IGAD Livestock Policy Initiative (LPI). Working Paper No. 02-11. Odessa Centre, Great Wolford, United Kingdom, 43p.

Bekele M., Mengistu A. and Tamir B, 2017. Livestock and feed water productivity in the mixed crop-livestock system. Animal, 11(10): 1852–1860.

Berhanu G., Hoe Kstra D. and Azage T, 2006. Commercialization of Ethiopian agriculture: Extension service from input supplier to knowledge broker and facilitator. IPMS (Improving Productivity and Market Success) of Ethiopian farmers' project working paper 1. ILRI (International Livestock Research Institute), Nairobi, Kenya. 36p.

Dennis G., John D., and Jean-Mark B, 2012. Understanding African Farming Systems Science and Policy Implications. Food security in Africa: Bridging research and practice Sydney.

Denning G., Kabambe P., Sanchez P., Malik,A., Flor R., Harawa R., Nkhoma P., et al, 2009. Input subsidies to improve smallholder maize productivity in Malawi: toward an African green revolution. PLoS Biology, 7(1), e23.

CSA (Central Statistical Agency), 2018. National Statistics (Abstract). Addis Ababa.

FAO 2016. FAOSTAT. Retrieved 9 August 2016 from http://faostat3.fao.org/browse/R/RL/E

Garnett T., Appleby M.C., Balmford A., Bateman I.J., Benton T.G., Bloomer P., Burlingame B., Dawkins, M., Dolan, L., Fraser, D., Herrero, M., Hoffmann, I., Smith, P., Thornton, P.K., Toulmin C., Vermeulen S.J. and Godfray H.C.J, 2013. Sustainable intensification in agriculture: Premises and policies. Science341(6141): 33-34.

Kindu M., Duncan A.J., Valbuena D., Gerard B., Dagnachew L., Mesfin B. and Gedion J, 2014. Intensification of crop–livestock farming systems in East Africa: A comparison of selected sites in the highlands of Ethiopia and Kenya

SveinE,2002. Livestock Systems: Patterns of Livestock Distribution in North Wälo.

Tchale H. & Sauer J, 2007. The efficiency of maize farming in Malawi. A bootstrapped translog frontier. *Cahiers d'économie et sociologie rurales, 82-83*, 33–56.

Economic Efficiency of Smallholder Farmers in Tomato Production in Bako Tibe District, Oromia, Ethiopia

Kifle Degefa, Getachew Biru and Galmessa Abebe*
Oromia Agricultural Research Institute, Bako Agricultural Research Center, P.O.box 03, Bako, Ethiopia
**Corresponding author: kifledegu2002@ymail.com*

Abstract

The study analyzed tomato production efficiencies and sources of inefficiency differentials of tomato in Bako Tibe district. It was specifically aimed to address the research and development gaps by measuring technical, allocative and economic efficiencies and their sources of inefficiency differentials of tomato in the study area. The study used primary and secondary data obtained from field survey and documents review. Multistage random sampling technique was used to draw 113 sample tomato producers. The result showed that the average technical, allocative and economic efficiencies of sample tomato producers were 72.88%, 67.17% and 50.13%, respectively. Age of household head and education level were significant sources of technical and economic inefficiencies. Family size and experience in tomato production were also significant sources of technical and allocative inefficiencies. Sex of household head, frequency of extension visit and training given on tomato management were also significant sources of technical allocative and economic inefficiencies. For improving tomato production efficiency, capacitating smallholder tomato producers through strengthening education, training and effective farm management is crucial.

Key words: *Bako Tibe, efficiency, inefficiency sources, SFPF, tobit and tomato*

Introduction

Tomato is one of the most popular and widely grown fruit in the world including Africa (Osemwegi, 2010). The crop is the most important vegetable in Ethiopia and rich in vitamin B and C, iron, phosphorus, essential amino acids, sugars, etc and produced at all scales (Anonymous, 2012; Srinivasan, 2010; Ambecha *et al.,* 2012; Quintin *et al*., 2013). It used as fresh, processed (tomato paste, tomato juice, tomato ketchup and whole peel-tomato) and cherry type and income generating crop to small scale farmers as well as provides employment in the production and processing industries. These diverse uses make the tomato an important vegetable in the country.

Though it is contributing a lot to the Ethiopian communities, the crop is characterized by low productivity. It caused by serious reliance on obsolete farming techniques, lack of knowledge on the efficient utilization of available and limited resources (especially land and capital), poor complementary services (extension, credit, marketing, infrastructure and limited use of modern agricultural technologies (fertilizer, high yielding varieties, pesticide, etc) and natural calamities are among the major factors that have greatly constrained the development of Ethiopia's agriculture (FAO and WFP, 2012; Ambecha *et al*., 2012).

Productivity can be increased either through introduction of modern technologies or by improving the efficiency of inputs such as labor and management at the existing technology. In other words, productivity can be increased through dissemination of improved technologies and/or by improving the productive capacity of farmers. To boost the productivity of tomato, Agricultural Research Centers had been made a great effort in development and dissemination of improved tomato varieties with associated agronomic and crop protection practices for the potential production areas (David *et al*., 2011).

However, the promoted technologies have not been used to full potential and no substantial gains could be achieved by using the technologies alone (Gebrehaweria *et al*., 2012 and Ermias *et al*., 2015). Improved technologies and improving the productive capacity of farmers shift production frontier because both are mutually inclusive. In other word, the introduction of modern technology could not bring the expected shift of production frontier, if the existing level of efficiency is low.

Therefore, in order to improve tomato production and productivity it becomes a vital to undertake economic efficiency analysis at farm level under the existing technology to enhance the contribution of the crop by identifying the extent of inefficiency and the factors that contribute to the level of resource use efficiency in smallholder tomato producers. Such information is useful for formulating appropriate policies and for reducing the level of economic inefficiency especially in developing countries.

Moreover, there is no study done on economic efficiency of smallholder tomato producers in the study area and only limit research works were conducted in different part of the country (Berhan, 2014; Leake *et al*., 2018; Gebrehaweria *et al*., 2012 and Ermias *et al*., 2015). Hence, there is a

need to fill the existing knowledge gap by addressing issues related to technical, allocative and economic efficiencies of smallholder tomato producers in the study area on smallholder farmers resource use with to measure the level of technical, allocative and economic efficiencies of tomato producers in the study area and identify the determinants of technical, allocative and economic inefficiencies in tomato production of smallholder tomato producers in the study area.

Research Methodology

Data Sources and Collection Methods

Both secondary and primary data were used in this study. The primary data were collected from sample households through face-to face interviews using a semi-structured questionnaire. The questionnaire included information on the socio-economic characteristics, demographic and farm characteristics, institutional supports, inputs type, amount of inputs, output and price data obtained by sample households. The secondary data which are relevant to the research topic used as additional information to strengthen the primary information provided by the sample household heads for rational conclusion.

Sampling Design and Methods of Data Collection

For this study, Bako Tibe district was selected purposively based on the presence of large number of tomato producers and importance of tomato in the areas. In the second stage, four kebeles (Oda Haro, Sedan Kite, Bechera Oda Gibe and Dambi Dima) were selected randomly having area under tomato and prepare list of tomato producers along with area from district. Finally, from total households about 113 samples of household heads were randomly selected from selected kebeles using Probability Proportionality Size.

Methods of Data Analysis

To address the objectives of the research and to analyze the data, both descriptive and Econometric methods were employed. Simple descriptive statistics (frequency, percent, minimum, maximum and mean were summarized socio-demographic, farmers, farm and inputs of sample households. For the investigation of technical, allocative and economic efficiencies, stochastic frontier production function by using Cobb-Douglas production function was used for its key features that the disturbance term is composed of two parts, a symmetric and a one sided

component (Donkoh *et al*., 2013; Furesi *et al.*, 2013; Mensah and Brümmer, 2016). The linear Cobb-Douglas production functional form was specified as follows:

$\ln Y_i = \beta_o + \sum_{j=1}^{n} \beta_j X_{ij} + \varepsilon_i$ Where, $\varepsilon_i = v_i - u_i$ *and* $1 = 1,2,3 \ldots, n$

Where ln denotes the natural logarithm; j represents the number of inputs used; i represents the i^{th} farmer in the sample; Y_i represent the observed tomato output of the i^{th} sample farmer; X_{ij} denotes j^{th} farm input variables used in tomato production of the i^{th} farmer; β stands for the vector of unknown parameters to be estimated; ε_i is a composed disturbance term made up of two error elements (v_i and u_i) and n represents the number of farmers to be involved in the survey.

The solution to the cost minimization is the basis for deriving the dual cost frontier, given the input price (w_n), parameter estimates of the stochastic frontier production function ($\hat{\beta}$) and input-oriented adjusted output level Y_i^* in the following equation

$\text{Min} \sum_x C = \sum_{j=1}^{7} X_j W_j$

$$\text{Subject to } Y_i^* = \hat{A} \prod X_j^{\acute{\beta}_j} \quad Where, \hat{A} = \text{Exp}(\hat{\beta}_o)$$

The substitution of the cost minimizing input quantities yields as following dual cost function following Sharma *et al.* (1999); Musa *et al*. (2015) and Kifle *et al*. (2016) which is:

$$C(Y_i^*, w;\ \alpha_j) = H Y_i^{*\mu} \prod_j W_j^{\alpha_j} \quad \text{Where, } \alpha_j = \mu\hat{\beta}_j,\ \mu = (\sum \hat{\beta}_j^{-1}) \text{ and } H = \frac{1}{\mu}\left(\hat{A}\prod \hat{\beta}^{\beta_j}{}_j\right)^{-\mu}$$

$EE = \frac{C^*}{C}$ Where, C^* is minimum cost and C is observed cost and following Aiger et al. (1977) $AE = \frac{EE}{TE}$ from EE=TE*AE.

For identify factors affecting technical, allocative and economic efficiencies, a censored Tobit model was used following Bonabana-Wabbi et al. (2013); Sammuel et al. (2014) and Ermiyas *et al.* (2015). The rationale behind using a Tobit model is that there are a number of farm units for which efficiency could be 1 and the bounded nature of efficiency between 0 and 1 and estimation with OLS regression of efficiency score would be lead to a biased and inconsistent parameter estimate (Greene, 2003). As the distribution of the estimated efficiencies is censored from above at the value 1, Tobit regression model (Tobin, 1958) is specified as:

$E_i^* = \sum_{j=0}^{n} \beta_j X_j + v$ Where, $E_i=1$ if $E_i^* \geq 1$ and $E_i = E_i^*$ if $E_i^* < 1$

Where E_i is an efficiency score representing technical, allocative and economic efficiencies; $\nu \sim N(0, \sigma^2)$ and βj are the vector parameters to be estimated; χ_i represent various farm specific variables and E_i^* is the latent variable, with $E[E_i^* / X_i]$ equals $X_i\beta$.

Variables Definition and Hypotheses

Table 15. Definition of output and input frontier variables used in the production model

Variables	Definition	Measuring unit
Output	Endogenous variable in production function and actual quantity of tomato production	Quintal
Land	Total physical unit of land under tomato in hectare (own, renting in and shared in)	Ha
Human labor	Total human labor employed in tomato production process and converted into adult-equivalent by taking into account the age and sex of labor used	MD
Oxen power	Total oxen power which used for ploughing and measured using the total amount of oxen days	OD
Fertilizers	Chemical fertilizers used for tomato production (Urea and NPS)	Kg
Seed	Physical quantity of tomato seed applied by the sample households	Kg
Chemicals	Physical quantity of chemicals such as herbicides, insecticides and pesticides applied by the sample households	Lit

Table 16: Factors affecting efficiencies of tomato production and their hypotheses

Variables	Definition	Measurement	Hypotheses
Age of HH (years)	Age of sample households	Continuous	-ve
Educational level (years)	Proxy variable for managerial ability or enhanced ability to acquire technical knowledge	Continuous	+ve
Household size	Total family size	Continuous	+ve
Total cultivated land (ha)	Total area cultivated during the 2016/17 production years (own, rented in or shared in)	Continuous	+ve

Tomato faming experience in year	Serve as a proxy for experience	Continuous	+ve
Frequency of extension visit (N)	Intermediate for diffusion of new and improves efficiency of farmers	Continuous	+ve
Sex of HH	Female household heads are less farming operation and use inputs less than male households	Dummy	+ve/-ve
Proximity to tomato plot (min)	The distance of plot from residence in walking minutes or km	Continuous	-ve
Livestock holding (TLU)	They could support crop production in many ways; source of cash, draft power and manure	Continuous	+ve
Off/non-farm activities	Income obtained from off/non-farm activities and it's used for purchase of agricultural inputs	Dummy	+ve
Credit utilized	It's important source of financing the agricultural activities of farmers	Dummy	+ve
Participation in training	Important tool in building the managerial capacity of smallholder farmers	Dummy	+ve

Results and Discussions

Summary of frontier variables used to estimate the production function

There was variability in technical inputs and outputs among tomato producing farmers (Table 3). Land, fertilizer, labor, seed, oxen power and chemicals were included in production function. On average, respondents produced 151.04 quintals of tomato using 0.38ha of land, 25.40 man-days labor, 5.16 oxen-days, 38.06 kg of Urea, 57.10 kg of NPS, 0.22 kg of seed and 0.92 lit of chemicals.

Table 17. Summary of frontier variables used

Variables	Unit	N	Minimum	Maximum	Mean	Std. Dev.
Output	Quintal	113	18	876	151.04	132.30
Land	Hectare	113	0.12	1.50	0.38	0.24
Labor	Man-days	113	6	165	25.40	23.79
Oxen	Oxen-days	113	1	25.5	5.16	4.09
Urea	Kilogram	113	9	200	38.06	30.51
NPS	Kilogram	113	15.5	300	57.10	45.76
Seed	Kilogram	113	0.05	1.13	0.22	0.18
Chemical	Liter	113	0.17	4.6	0.92	0.73

Source: own data (2017)

Summary of variables included in the efficiency model

The mean age of the respondents was about 43.50 years with a range of 25 to 88 years. This means tomato producer was in their early middle age. On average tomato producing farmers have adequate production experience which was about one year to 10 years with mean 4.64 years. The family size of the sample farmers ranged from two to 13 with a mean of 6.40 person per household. The average education level of the respondent heads during survey period was about 5.22 years with the minimum of zero year (illiterate) and maximum of 12 years.

The minimum cultivated land holding of the respondent was 0.50 ha while the maximum size was 7.50 ha with mean 1.58 ha. The average tomato producing plot of respondent from residence 25.13 minutes with ranges from 5 to 60 minutes. On average, respondent owned livestock of 8.27 TLU ranging from 1.13 to 22.93 TLU. This indicates that the farming system in Ethiopia is

mainly based on plough by animal draught power that has created complementarity between crop and livestock production.

Table 18. Summary of variables used in the efficiency model

Variables	Min	Max	Mean	Std. Dev.	N	% of 1
Age of household head (years)	25	88	43.50	13.00		
Tomato farming experience (years)	1	10	4.64	2.28		
Educational level of household head (years)	0	12	5.22	2.83		
Household size (N)	2	13	6.40	2.75		
Total cultivated land (ha)	0.50	7.50	1.58	1.19		
Proximity to tomato plot (minute)	5	60	25.13	14.37		
Frequency of extension visit (N)	0	15	3.66	3.05		
Livestock (TLU)	1.13	22.93	8.27	5.55		
Sex of HH (1=male and 0=female)					113	91.20
Off/non-farm activities (1= obtained & 0=not)					113	19.50
Credit (1=received and 0=not)					113	85.00
Participation in training (1= participate & 0=not)					113	17.70

Source; Own data

Regarding the sex of respondents, 91.20% of the respondents were male-headed respondents. This implied that the respondent headship was male. About 19.50% of respondents were participated on different types of off/no-farm activities for different purposes. The survey result showed that 85% of the sample households were received credit from input purchase and other purposes. From the total of respondents interviewed, 17.70% were received training with specific tomato production.

Econometric Analysis

Before running the econometric models, the data was tested against econometric problems like multicollinearity using VIF, hetroskedasticity using Breusch-Pagan test and endogenetity using Durbin-Wu-Hausman chi-square test. The test results indicate that there is no problem of multicollinearity, hetroskedasticity and endogeneity in the model.

Estimation of production and cost functions

The coefficients of the production function are interpreted as elasticity. The highest coefficient of output was to labor (0.38) followed by land (0.32). This indicated that labor and land are the main determinants of tomato production in the study area. Tomato production is relatively sensitive to labor and land. If there is a one percent increase in the size of labor, land, amount of NPS, Urea, chemicals and amount of seed would increase tomato production by 0.38%, 0.32%, 0.24%, 0.29%, 0.22% and 0.23%, respectively. In other words, the increase of these inputs were increase output of tomato production significantly which similar to Alboghdady (2014); Cyprian (2014) and Anim *et al*., 2015).

The returns to scale analysis can serve as a measure of total factor productivity (Gbigbi, 2011) and indicated that there is increasing returns to scale. This implied that there was a potential for tomato producer to continue to expand their production (Shettima *et al*., 2015). In other words, a percent increase in all inputs proportionally would increase the total production by 1.96.

Table 19. Estimation of the Cobb-Douglas frontier production function

Frontier variables	Parameters	Coefficients	Std. Err.
constant	β_0	2.17***	0.14
ln(land)	β_1	0.32**	0.15
ln(labor)	β_2	0.38***	0.16
ln(oxen)	β_3	0.14	0.09
ln(Urea)	β_4	0.29***	0.08
ln(NPS)	β_5	0.24***	0.07
ln(seed)	β_6	0.23***	0.04
ln(chemicals)	β_7	0.22**	0.14
Standard error of u (σ_u)		0.18	0.01
Standard error of v (σ_v)		0.34	0.05
Sigma square (σ^2)		0.08***	0.02
Lambda ($\lambda = \frac{\sigma_u}{\sigma_v}$)		1.89	
Gamma ($\gamma = \frac{\lambda^2}{1+\lambda^2}$)		0.78	
Return to scale		1.96	

*, **, *** significant at 10%, 5% and 1% level of significance, respectively.

Source: own data (2017)

The value of σ^2 for the frontier of tomato output was 0.08 which was significantly different from zero and significant at 1% level of significance. The significant value of the sigma square indicates the goodness of fit and correctness of the specified assumption of the composite error

terms distribution. The estimated value of gamma was 0.78 which indicated that 78% of total variation in tomato farm output was due to technical inefficiency.

Efficiency scores

The results of the efficiency scores indicate that there were wide ranges of differences in TE, AE and EE among tomato producer respondents. The result indicated that farmers in the study area relatively good in TE than AE and EE as presented in table 6.

Table 20. Frequency distribution of TE, AE and EE of respondents

Variables	TE		AE		EE	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
10-20	0		0		7	6.19
21-30	0		2	1.77	11	9.73
31-40	0		9	7.96	19	16.81
41-50	7	6.19	10	8.85	14	12.39
51-60	14	12.39	19	16.81	28	24.78
61-70	28	24.78	23	20.35	13	11.50
71-80	35	30.97	24	21.24	20	17.70
81-90	20	17.70	18	15.93	1	0.88
91-100	9	7.96	8	7.08	0	
Minimum	43.57		23.81		11.87	
Maximum	99.84		98.37		84.78	
Mean	72.88		67.17		50.13	

Source: own data (2017)

The mean TE was found to be 72.88% which indicated that, if respondents in the study area operated at full efficiency level, respondents would have increased their output by 27.12% using the existing resources and level of technology. In other words, it implied that on average respondents in the study area can decrease their inputs by 27.12% to get the output they are currently getting. The majority respondents were operating ranges of 61% to 80% level of TE which indicated that there is a room to enhance their production at least by 20%.

The mean score of AE was 67.17% showed that on average respondents in the study area could increase tomato output by 32.83% if respondents used the right inputs and produced the right output relative to input costs and output price. The tomato producers with an average AE would enjoy a cost saving of about 32.72% derived from (1-0.6717/9837) *100 to attain the level of the

most efficient producer. The majority respondents were operating ranges of 61% to 80% level of AE which indicated that there is a room to save cost production at least by 20% on average.

The mean EE was 50.13% indicated that there was a significant level of inefficiency in the production development. That is the producer with an average economic efficiency level could reduce current average cost of production by 49.87% to achieve the potential minimum cost level without reducing output levels. It can be inferred that if respondents in the study area were to achieve full economic efficiency, the producers' substantial production cost saving of 49.87%. The result also showed that the farmer with average level of economic efficiency would enjoy a cost saving of about 40.87% derived from (1-0.5013/8478) *100 to attain the level of the most efficient producer. This implied that, EE could be improved significantly than TE and AE. The majority of respondents were operating ranges of 50% to 60% level of EE which indicated that there is an opportunity to save cost inputs at least by 40% on behaving a cost minimizing way.

Determinants of efficiency in tomato production among sample households

The major interest behind measuring technical, allocative and economic efficiencies level is to know what factors determine the efficiency level of individual respondents.

Table 21. Determinants of efficiency in tomato production among respondents

Variables	TE		AE		EE	
	ME	Std. Error	ME	Std. Error	ME	Std. Error
Constant	0.6046***	0.081	0.5818***	0.1473	0.3763***	0.1153
AGE	0.0025**	0.0008	0.0003	0.0014	0.0127***	0.0031
EDUCH	0.0087**	0.0032	0.0015	0.0095	0.0493***	0.0074
FSZE	0.0197***	0.0042	0.0087*	0.0043	0.0014	0.0068
SEX	0.0582*	0.0292	0.1858***	0.0529	0.114**	0.0414
EXPER	0.0078***	0.0021	0.032**	0.012	0.0057	0.0084
OFNFA	0.0375	0.029	0.0365	0.0527	0.0052	0.0412
CULTLND	0.0042	0.0059	0.012	0.0107	0.0038	0.0084
CRDTR	0.0401	0.0237	0.038	0.043	0.0392	0.0337
FEXTVST	0.0522***	0.0051	0.011***	0.002	0.0141***	0.0027
TRAING	0.0578**	0.0213	0.0741**	0.0262	0.0984*	0.0468
PROXTY	-0.0036	0.009	-0.0051	0.018	-0.0016	0.0014
LIVSTK	0.0013	0.0014	0.0315	0.047	0.0063	0.0037

Source: own data (2017)

The estimated coefficient of age and education affected TE and EE positively and significant at 5% and 1% level of significance. This implied that age and education contributed positively to TE and EE which may be because of the accumulated experiences that have been gathered over

time and easily access information with better management of farming activity (Adenuga *et al*., 2013); (Cyprian, 2014); (Shettima *et al*., 2015). All these might have implied that as the level of education and age increases farmers are concerned about scarce resources and place more emphasis on increasing levels of output at a given level of inputs.

The coefficient of family size for TE and AE is positive and statistically significant at 1% and 10% level of significance. The result showed that producers those having large family size are more efficient than those with small family size, because; they manage crop plots on time (Essa, 2011).

Sex of respondent head was found to have positively and significant influence on TE, AE and EE at 10, 1% and 5% level of significance which indicated that female respondent headed are the one who responsible for many household domestic activities such as collecting of fire wood from the field, fetching water from the far distant rivers, childrearing and household management obligations and also probably use inputs fewer than male respondent heads (Isah *et al*., 2013).Years of experience in tomato production was significantly and positively affected TE and AE at 1% and 5% level of significance. As experience increases by 1 year, levels of TE and AE increased which indicates that as years' experience increase knowledge and skill on utilizing resources and managements increases (Dokoh *et al*., 2013) and (Shettima et al., 2015).

Extension visit and training were the number of times that the households contact with extension agents and producers received training specifically on tomato production management. Farm respondents who received regular extension visits and received training by extension workers and others appear to be more technically, allocative and economic efficiencies than their counterparts. The coefficient for the access to extension visit had statistically significant and positive relationship with efficiencies at 1% level of significance whereas training had statistically significant at 5%, (TE and AE) and 10% level of significance. This imply that efficiencies increased with the number of visits and training made to the farm respondent by extension workers and others due to facilitation use of modern techniques, adoption of improved agricultural production practices and use inputs in appropriate way (Gbigbi, 2011).

Conclusion

This study was focused to measure the technical, allocative and economic efficiencies of tomato growers in Bako Tibe district. The Cobb-Douglas stochastic frontier result show that labor, land, fertilizer and seed had significant effect on tomato production with return to scale of 1.96 which is increase in return to scale. The findings of the study revealed that the technical efficiency ranges from 43.57% to 99.84% with a mean of 72.88% while allocative efficiency ranges from 23.81% to 98.37% with a mean of 67.17. The economic efficiency of tomato producers ranges from 11.87% to 84.78% with a mean of 50.13%. Factors including sex, frequency of extension visit and training had significant effect on technical, allocative and economic inefficiencies. The results show that age and education of sample households had significant effect on technical and economic inefficiencies while family size and tomato farming experience had significant effect on technical and allocative inefficiencies.

Recommendations

On the basis of this study it is recommended that: as the coefficient of inputs was 1.96 which is the elasticity of production that represent first stage of new classical production function. Therefore, farmers in the study area need to increase the number of inputs to increase production and efficiency, ii)) in the technical, allocative and economic inefficiencies sex, extension, training and experience were found statistically significant. Thus the government and other sectors need to provide training to improve the tomato productivity and efficiencies.

References

Aiger, D., C. Lovell, and Schmidt, P., 1977. Formulation and estimation of stochastic frontier production function models. *Journal of Economics*, 6:21-37.

Alboghdady, M.A. 2014. Nonparametric model for measuring impact of inputs density on Egyptian tomato production efficiency. Int. J. Food Agric. Econ. 2(4):81–90.

Adenuga AH, AM Lawal and OA Rotimi, 2013. Economics and technical efficiency of dry season tomato production. Agris on-line Papers in Economics and Informatics in selected areas in Kwara state, Nigeria, 5: 11-19.

Ambecha, O.G., S. Paul, and B. Emana. 2012. Tomato production in Ethiopia: Constraints and opportunities. Resilience of agricultural systems against crises. Tropentag, 19-21 September 2012, Göttingen-Kassel, Witzenhausen, Germany.

Anim, F.D.K., K. Thaba, and M. Tshikororo. 2015. Resource use efficiency in vegetable production under irrigation: The case of Marutle agricultural cooperative in the Limpopo province of South Africa. J. Hum. Ecol. 50(1):11–17.

Anonymous. 2012. Investment opportunity profile for the production of fruits and vegetables in Ethiopia. Ethiopian investment agency, Addis Ababa, Ethiopia.

Berhan T., Getaw T. and Lemma Z. 2014. Technical efficiency in irrigated small-scale agriculture: Empirical evidence from onion farming in Kobo District of Northeast Ethiopia. J. Agric. Econ. Dev. 3(3):035-046.

Bonabana-Wabbi, J., B. Mugonola, S. Ajibo, J. Kirinya, E. Kato, R. Kalibwani, V. Kasenge, S. Nyamwaro, S. Tumwesigye, W. Chiuri, et al. 2013. Agricultural profitability and technical efficiency: The case of pineapple and potato in SW Uganda. Afr. J. Agric. Resource Econ. 8 (3):145–159.

Cyprian, C.A. 2014. An assessment of irrigated tomato farming on resource productivity of farmers in Vandeikya Local Government Area of Benue State: Application of technical efficiency model. Global J. Human-Social Science: Econ 14(1):1–9.

David, J. S., Dawit Kelemwork, and Dawit Alemu, 2011. Seed, fertilizer, and agricultural extension in Ethiopia. Ethiopia Strategy Support Program II Working Paper 20.

Donkoh, S.A., M. Tachega, and N. Amowine. 2013. Estimating technical efficiency of tomato production in northern Ghana. Am. J. Exp. Agric. 3(1):56–75.

Ermiyas, M., E. Geta, and B. Legesse. 2015. Production efficiency of sesame in Selamago district of South Omo Zone, Southern Ethiopia. Curr. Res. Agric. Sci. 2(1):8–21.

Essa Chanie, 2011. Economic efficiency of smallholder major crops production in the central highlands of Ethiopia. An M.Sc. thesis presented to Agricultural Policy and Trade of Egerton University.

FAO and WFP (Food and Agricultural Organization and World Food Programme), 2012. Crop and Food Security Assessment Mission to Ethiopia. Special Report of Food and Agriculture Organization and World Food Programme.

Farrell, M. 1957. The measurement of productivity efficiency. J. Royal Stat. Soc. 120(3):253–290.

Furesi, R., A.M. Fabio, and P. Pulina. 2013. Technical efficiency in the sheep dairy industry: An application on the Sardinian (Italy) sector. Springer Open J. Agric. Food Econ. 1(4):1–11.

Gbigbi, M., 2011. Economic Efficiency of Smallholder Sweet Potato Producers in Delta State, Nigeria: A Case Study of Ughelli South Local Government Area. *Research Journal of Agriculture and Biological Sciences*, 7: 163-168.

Gebrehaweria, G., R.E. Namara, and H. Stein. 2012. Technical efficiency of irrigated and rain fed smallholder agriculture in Tigray, Ethiopia: A comparative stochastic frontier production function analysis. Q. J. Int. Agric. 51(3):203–226.

Greene, W.H., 2003. Econometric Analysis, 5th ed. Pearson Education Inc., Upper Saddle River, New Jersey.

Isah, H., E. F. Adebayo, O. Gwandi, 2013. Efficiency of sole cowpea production in Gombi of Adamawa State Agricultural Development Programme, Nigeria. American Journal of Advanced Agricultural Research, 1(1): 25-41.

Kifle D., Moti J. and Belaineh L. 2017. Economic Efficiency of Smallholder Farmers in Maize Production in Bako Tibe District, Ethiopia; *Journal of Developing Countries Studies.*

Leake G. W., Gidey K. M., Hareg G. G. and Zenebe A. K. 2018. Resources Use Efficiency of Irrigated Tomato Production of Small-scale Farmers, International Journal of Vegetable Science, 24 (5) 456-465.

Mensah, A., and B. Brümmer. 2016. Drivers of technical efficiency and technology gaps in Ghana's mango production sector: A stochastic meta-frontier approach. Afr. J. Agric. Resource Econ. 11(2):101–117.

Musa H.A., Lemma Z. and Endrias G. 2015. Measuring Technical, Economic and Allocative Efficiency of Maize Production in Subsistence Farming: Evidence from the Central Rift Valley of Ethiopia. Applied Studies in Agribusiness and Commerce, 9(3): 63-74

Osemwegi OO, Oghenekaro AO, Owolo LO. Effect of pulverized *Ganoderma* spp., on *Sclerotium rolfsii Sacc* and Post-harvest tomato fruit preservation. *Journal of Applied Science and Research.* 2010;6: 1794-1800.

Quintin, G., T. Abu, and T. Teddy. 2013.Tomato production in Ethiopia challenged by pest. Report Number 1305, Global Agriculture Information Network, Addis Ababa, Ethiopia.

Samuel, M., A.O. Chris, and M. Richard. 2014. Analysis of economic efficiency and farm size: A case study of wheat farmers in Nakuru district, Kenya. Hindawi Publishing Corporation, Economics Research International, Addis Ababa, Ethiopia.

Sharma, K., Leung, R, Zaleski, M., 1999. Technical, Allocative and Economic Efficiencies in Swine Production in Hawaii: A Comparison of Parametric and Nonparametric Approaches. Agricultural Economics, 20: 23-35.

Shettima, B.G., P.S. Amaza, and A.C. Iheanacho. 2015. Analysis of technical efficiency of irrigated vegetable production in Bornostate, Nigeria. J. Agric. Economics, Environ. Soc. Sci. 1(1):88–97.

Srinivasan, R. 2010. Safer tomato production methods: A field guide for soil fertility and pest management, Publication No. 10:740. AsianVegetable Research and Development Center, Shanhua, Taiwan.

Tobin, J., 1958: Estimation of relationships for limited dependent variables. Econometric, 26 (1): 26-36.

Characterization and Analysis of Farming System in Horo Guduru Wollega Zone, Oromia National Regional State, Ethiopia

Galmesa Abebe, Getachew Biru, and Kifle Degefa
Oromia Agricultural Research Institute, Bako Agricultural Research Center, P.O.box 03, Bako, Ethiopia,
**Corresponding author: galmee2015@gmail.com*

Abstract

Agriculture is a dominant sector of Ethiopian economy which makes a lion share contribution to the Gross Domestic Product, employment and foreign exchange earnings. Agriculture is still believed to remain a sector that plays an important role in stimulating the overall economic development of the country in the years to come. To improve agricultural productivity it requires detail study on existing farming systems. This study was conducted to characterize and analyze the existing farming system, identify the production constraints and opportunities in the study areas. The study was based on primary and secondary data. A three-stage sampling technique was employed to select respondents from the population. The study was based on cross sectional data collected from 123 randomly selected respondents. The result of the study showed that about 86.18% of the sample respondents were male headed with while 13.82 were female headed households. The study zone was characterized by mixed farming systems whereby livestock and crop production take place within the same locality. Farmers in the study area face production and market constraints to improve production and productivity. The production constraints of

livestock production include disease, shortage of grazing land, feed shortage,shortage of veterinary medicine, lack of improved breed and shortage of water while marketing constraints include market price/demand fluctuation, lack of information, lack of market linkage and High transaction cost. The production constraints of crop production were Disease and insect, High cost of inputs, untimely input supply, shortage of land, weed infestation, shortage of inputs, low yield, Poor seed quality and Poor soil fertility while market constraints include low price of outputs, lack of market information, lack of market linkage and high transaction cost. Even though farmers were practicing soil and water conservation (SWC) such as Check dam and terraces, soil erosion, soil acidity, water logging, soil fertility decline and termite were important constraints in natural resources. Improving livestock productivity through providing improved breed and forages, and controling of diseases and illegal livestock trade are important issues that require special attention. Additionally, improving crop productivity through integrated pest management (IPM), improved varieties, minimizing transaction cost, focus on high value crops, expand soil and water conservation, improving access to market information and strengthening linkage are important issues that require special attention to improve crop production and productivity.
Key words: *Oromia, Horo Guduru Wollega, Characterization, farming system*

Introduction

Agriculture is a dominant sector of Ethiopian economy which makes a lion share contribution to the Gross Domestic Product, employment and foreign exchange earnings. Agriculture is still believed to remain a sector that plays an important role in stimulating the overall economic development of the country in the years to come. This would be realized if and only if strenuous efforts are made by the government and other concerned stakeholders including farmers to increase agricultural production and productivity (CSA, 2016).

In many developing countries including Ethiopia, agriculture plays a vibrant role in promoting economic growth and development. The importance of agriculture in Ethiopia is evidenced by its share in GDP (43%), its employment generation (80%), share of export (70%) and providing about 70% raw material for the industries in the country in 2012/13(UNDP, 2013). Furthermore, 90% of the poor earn their livelihood from this sector (Yu *et al.,* 2011). Thus, it is not surprising that policy action in Ethiopia is largely based on influencing the dynamism of the agricultural sector.

Each individual farm has its own specific characteristics, which arise from variations in resource endowments and family circumstances. The household, its resources and the resource flows and

interactions at this individual farm level are together referred to as a farm system. A farming system is defined as a population of individual farm systems that have broadly similar resource bases, enterprise patterns, household livelihoods and constraints, and for which similar development strategies and interventions would be appropriate. In attempting to combat hunger and poverty, developing countries face the challenges of identifying specific agricultural and rural development needs and opportunities, and focusing investment in those areas where the greatest impact on food insecurity and poverty could be achieved. The delineation of farming systems provides a useful framework within which appropriate agricultural development strategies and interventions can be determined, as by definition, they group farm households with similar characteristics and constraints. Only a limited number of systems are delineated within each region (and in this Summary, only the most important of these systems are discussed), leading inevitably to a considerable degree of heterogeneity within any single system. However, the alternative of identifying numerous, discrete, micro-level farming systems in each developing region would detract from the overall impact of the analysis (Dixon *et al.*, 2001).

Farming system is a unique and reasonably stable arrangement of farming enterprises that a household manages according to well defined practices in response to the physical, biological and socio-economic environment and in accordance with the household goals preferences and resources. Agriculture is dominated by about 11.7 million smallholders responsible for about 95% of the national agricultural production while large farms contribute only 5% of the total production (CSA, 2017)). This shows that the overall economy of the country and the food security of the majority of the population depend on small-scale agriculture.

The classification of the farming systems has been based on a number of key factors, including: (i) the available natural resource base; (ii) the dominant pattern of farm activities and household livelihoods, including relationship to markets; and (iii) the intensity of production activities (Dixon *et al.*, 2001).

Research Methodology

Description of the study areas

Horoguduru Wollega is one of the zones of the Oromia National Region State. It is named after the former province of Wollega whose eastern part lies in the area that Horoguduru Wollega now

occupies. Horoguduru Wollega was formed of districts detached from East Wollega Zone.The capital of the zone is shambu town. Shambu is also the capital for Horro district and Shambu town administration itself.

According to the 2007 Census conducted by the Central Statistical Agency of Ethiopia (CSA), this zone has a total population of 570,040, of which 285,515 are males and 284,525 females. Of the population 64,739 or 11.36% are urban inhabitants. There are 121,136 households in the zone with an average of 4.71 persons in the family and 112,403 housing units.

Data Types, Sources and Methods of Data Collection

The study was based on both primary and secondary data. Primary data were collected from the sample farm households using a semi-structural questionnaire. In order to capture better information of the areas, qualitative data collection tools such as focus group discussion and key informants interview were conducted using checklists. Secondary data were collected from published and unpublished materials from the zone and districts.

Sampling Design

A three-stage sampling technique was employed to select respondents from the population. In the first stage, two districts were selected purposively based on crop and livestock production potential. In the second stage, two kebeles were selected purposively from each district based on crop and livestock production potential and accessibility for data collection. Finally, 123 respondents were selected randomly using probability proportional to size. For this study the lowland part of Horo Guduru Wollega was not included because of accessibility problem.

Methods of Data Analysis

Descriptive statistics such as mean, standard deviation, frequency and percentage were used to analysze quantitative data gathered from respondents. The qualitative data were analyzed through systematically organizing the information into major themes.

Results and Discussions

Demographic characteristics of households

About 86.18 % of the sample respondents were male headed while the rest 13.82 % were female-headed households. About 83.33 % of the sample respondents from the Highland were male

headed while 16.67 % were female headed households. About 90.19 % of the sample respondents from the midland areas were male headed while 9.81 % were female headed households. Regarding technology adoption 38.21% of sample respondents were model farmers and 61.79% were follower farmers. According to key informants, model farmers adopt new technologies earlier than followers. About 6.94%, 72.22% and 20.84% of sample respondents in the highlands were rich, middle and poor in wealth status respectively while 11.77%, 84.31% and 3.92% of sample respondents in midland areas were rich, middle and poor in wealth status respectively. Majority of the respondents (62.6%) were protestant. The mean household size of the study area was 7.74 with standard deviation of 2.35 whereas the mean household size of the highland was 7.75 with standard deviation of 2.72 while the mean household size of the midland areas was 7.73 with standard deviation of 1.74.

Table 1: Demographic characteristics households

Variable		Highland		Midland		Total (N=123)	
		No	%	No	%	No	(%)
Sex	Male headed	60	83.33	46	90.19	106	86.18
	Female headed	12	16.67	5	9.81	17	13.82
Farmers category	Model	22	30.56	25	49.02	47	38.21
	Followers	50	69.44	26	50.98	76	61.79
Farmers resource ownership	Rich	5	6.94	6	11.77	11	8.94
	Middle	52	72.22	43	84.31	95	77.24
	Poor	15	20.84	2	3.92	17	13.82
Religion	Muslim	0	0.00	0	0	0	0.00
	Orthodox	26	36.11	10	19.61	36	29.27
	Catholic	8	11.11	0	0	8	6.50
	Protestant	36	50	41	80.39	77	62.60
	Wakefata	2	2.78	0	0	2	1.63
	Other	0	0.00	0	0	0	0.00
		Mean	Std	Mean	Std	Mean	Std
Family size		7.75	2.72	7.73	1.74	7.74	2.35

Source: Survey results, 2017

Land holding and acquisition methods

Land is the most important asset in Ethiopia as well as in the study areas. The study results revealed that, the mean land owned by the sample respondents was 2.57 hectares, out of which about 2.31 hectares is cultivated land. The mean grazing land, forest land, degraded land and residential area land owned by the sample households were 0.54, 0.33, 0 .14 and 0.22 hectares respectively (Table 2).

Table 2: Land holding of the sample respondents

Land category	Highland (n=72)		Midland (n=51)		Total (123)	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Own land	2.49	2.05	2.69	2.30	2.57	2.15
Cultivated land	2.5	1.98	2.08	1.35	2.31	1.73
Grazing land	0.66	1.03	0.43	0.50	0.54	0.80
Forest land	0.37	0.46	0.21	0.23	0.33	0.41
Degraded land	0.19	0.24	0.1	0.06	0.14	0.16
Residential land	0.23	0.17	0.20	0.13	0.22	0.16
Rented in/shared in	2.95	1.51	0.5	0	2.50	1.67
Rented out/shared out	1.77	1.06	1.36	0.96	1.58	1.03

Source: Survey results, 2017

Ownership of farm equipment, communication technology and others

Production assets are a proxy for households' socio-economic status. It helps in increasing farm productivity and assessing the means to disseminate technological information to famers. About 98.40%, 86.18% and 87.81% of farmers owned ox-plough, sickle and hoe respectively. About 77.24% and 69.92% of households owned radio and mobile phone respectively. 56.09% and 46.34% of respondents owned tapped water and electricity/solar respectively (Table 3).

Table 3: Households' house type, farm implement and communication materials

Land category	Highland (72)			Midland (51)			Total (123)		
	%	Mean	Std. Dev.	%	Mean	Std. Dev	%	Mean	Std. Dev
Grass house	15.28	1.9	2.42	5.88	1	0	11.38	1.71	2.16
Corrugated iron house	95.83	2.14	0.92	98.04	1.94	0.81	96.75	2.05	0.81
Ox-plough	98.61	1.67	0.75	98.04	1.90	0.61	98.40	1.77	0.70
Sickle	76.40	4.51	2.76	100	3.19	1.08	86.18	3.88	2.22
Hoe/Jembe	83.33	2.67	1.49	94.12	2.71	1.5	87.81	2.69	1.49
Others	40.28	2.10	1.32	68.63	2.03	1.64	52.03	2.06	1.49
Radio	75	1.22	0.42	80.4	1.05	0.22	77.24	1.15	0.36
Mobile	63.89	1.61	0.93	78.43	1.4	0.81	69.92	1.51	0.88
	Yes	No		Yes	No		Yes	No	
Tapped water	27 (37.5%)	45 (62.5%)		42 (82.4%)	9 (17.7%)		69 (56.1%)	54 (43.9%)	

Electricity/Solar	30 (41.7%	42 (58.3%)	27 (52.9%)	24 (47.1%)	57 (46.3%)	66 (53.7%)

Source: Survey results, 2017

Households Livelihood activities

Horo Guduru Wollega zone is characterized by mixed farming systems. In the mixed farming systems both livestock and crop production take place within the same locality. The major sources of livelihood activities of farmers in study districts were crop production, livestock rearing and off/non-farming activities. About 96.75%, 74.79% and 26.02 of the respondents depend on crop production, livestock rearing and off/non-farm activities for their livelihoods with these activities contributing about 70.13%, 21.6% and 8.27% of total annual income, respectively.

Table 4: Households Livelihood activities

Activities	Highland (72)		Midland (51)		Total (123)	
	% HHs	Contribution %	% HHs	Contribution %	% HHs	Contribution %
Crops	97.22	75.55	96.08	64.71	96.75	70.13
Livestock rearing	79.17	18.5	68.63	24.7	74.79	21.6
Off/non-farming	26.39	5.95	25.49	10.59	26.02	8.27

Source: Survey results, 2017

Livestock ownership

Livestock ownership is generally regarded as key to rural livelihoods. In contrast to crop production, outputs from livestock are season independent and benefits stream in throughout the year. The livestock species found in the study areas are cows, oxen, bulls, heifers, calves, sheep, goat, donkey, mule and poultry.

The survey result shows the average number of cows, oxen, heifers, bulls and calves owned by the farmers were 2.95, 3.09, 2.28, 1.88 and 2.10 respectively. The result indicated that in the study areas cow and ox keeping were the most important. Sheep and goats were important sources of income for the farming households. On average farmers own about 1.00 and 4.67 goat and sheep respectively. Mules, donkey and horses were used for transportation and income generation. The mean holding of donkey, horses and mule by the farmers were 1.5, 1.6 and 0.4 respectively. The mean holding of of poultry was 8.49.

Table 5: Households herd structure and herd size

Livestock type	Highland (72)		Midland (51)		Total (123)	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Cows	2.97	2.02	2.91	2.09	2.95	2.03
Oxen	2.89	1.75	3.37	2.25	3.09	1.97
Heifers	2.36	1.69	2.18	1.86	2.28	1.75
Bulls	1.89	1.10	1.88	1.58	1.88	1.34
Calves	2.23	1.34	1.94	1.71	2.10	1.50
Goats	0.8	1.03	1.2	3.23	1.0	2.17
Sheep	5.8	7.44	2.31	2.35	4.67	6.44
Donkeys	1.53	1.17	1.47	1.26	1.5	1.21
Horses	2.14	1.90	1.09	0.92	1.6	1.56
Mule	0.66	1.32	0	0	0.4	1.06
Poultry	5.17	4.86	11.71	10.26	8.49	8.65

Source: Survey results, 2017

Milk productivity and status

The average milk per day was 1.63 and 1.03 liter at Highland and Midland areas respectively. About 95% of respondents were reported that milk productivity has decreased from time to time over last five years due to feed shortage and disease. The lactation period of the cows was 6.96 and 7.29 months for Highland and Midland districts, respectively.

Table 22. Milk productivity and status for the last five years of respondents

Variable	Highland (72)		Midland (51)		Status	Reason of milk decreasing over last five years
	Mean	Std. Dev.	Mean	Std. Dev.	% decrease	
Milk (lit/day)	1.63	1.47	1.03	0.98	95.00	➢ Feed shortage (74.60%) ➢ Disease and feed shortage (25.40)
Lactation period (months)	6.96	3.78	7.29	3.77		

Source: Survey results, 2017

Livestock production and marketing constraints

Livestock is important assets in income generation, crop production and as symbol of prosperity. Livestock producers face production and marketing constraints as summarized in table 7 below. The major production constraints were disease (84.6%), shortage of grazing land (64.07%) and feed shortage (31.29%). Shortage of veterinary medicine, lack of improved breed and shortage of water were important production constraints mentioned by 21.03%, 13.7% and 12.1% of the households keeping cattle, respectively.

Disease and shortage of grazing land were the most important production constraints of shoats and equines. About 57.89% and 60.34% of the households mentioned diseases are production

constraint for shoats and equines respectively while about 35.78% and 18.96% mentioned shortage of grazing lands. Disease (75.53%) and Shortage of veterinary medicine (18.45%) were important production constraints for respondents who keep poultry.

Market price/demand fluctuation, lack of information, lack of market linkage and high transaction cost are the major market constraint for livestock producers.

Table 23. Major livestock production and market constraints of respondents

Production constraints (n=123)	% of households for cattle	% of households for shoats	% of households for equines	% of households for poultry
Shortage of grazing land		35.78		
Disease		57.89		
Shortage of veterinary medicine		14.76		18.45
Lack of improved breed		5.86		
Feed shortage		10.71		
Water shortage		6.67	7.3	
Marketing constraints				
Market price/demand fluctuation				
Lack of information				
Lack of market linkage				
High transaction cost				

Source: Survey results, 2017

Common livestock diseases

The most common livestock diseases and parasite are summarized in table 8 below. The major and common livestock diseases and parasites such as fungal (36.35%), trypanosomiasis (33.5%), anthrax (28.68%), black leg (22.45%), mastitis (15.94) and lump skin (10.22) were reported. About 93.42% of respondents reported that they are using vaccines and drugs against these diseases and parasites.

Table 24. Common livestock diseases and their solutions

Common Disease	Native Name	% of households reporting
Trypanosomiasis	Gandi	33.5
Black leg	Abba gorbaa	22.45
Anthrax	Abba sangaa	28.68
Ticks	Silmi	4.70
Bloat	Bokoksaa	7.76
Lump skin	Shifshaafi	10.22
Lichen	Dhulaandhula	10.29

Pastereollosis	Goroorsaa	13.21
Fugel	Dhibee lukkuu	36.35
Dermatophytosis	Bichoo	5.75
Mastitis	Dhibee Harmaa	15.94

Source: Survey results, 2017

Livestock Feeding System

The common livestock feeding in study area are Own grazing land, communal land and crop residue (82.11%), own grazing and crop residue (38.21%), communal land and crop residue (25.20%) and Supplementary feed (15.44%).

The most commonly used crop residue for livestock feeding are teff straw (95.12%), barley straw (66.67%), teff, barley and wheat straw (73.17%), wheat and barley straw (46.34%) and faba bean and field pea straw (22.76%). This crop residue are used because it is preferred by livestock (43.09%), no options (30.89%) and preferred and no option (%26.02).

Table 25. Livestock feed sources of respondents

Common feed source		Highland n=(72)		Midland (n=51)		Total (n=123)	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
Own grazing land, communal land and crop residue		60	83.33	41	80.04	101	82.11
Own grazing and crop residue		25	34.72	22	43.14	47	38.21
communal land and crop residue		17	23.61	14	27.45	31	25.20
Supplementary feed (Fegullo, etc)		14	19.44	5	9.80	19	15.44
Most common crop residue used							
Teff straw		68	94.44	49	96.08	117	95.12
Barley straw		36	50	32	62.74	82	66.67
Teff, barley and wheat straw		49	68.06	41	80.39	90	73.17
Wheat and barley straw		27	37.5	30	58.82	57	46.34
Faba bean and field pea straw		13	18.06	15	29.41	28	22.76
Reason	Preferred by livestock	30	41.67	23	45.09	53	43.09
used	No options	22	30.55	16	31.37	38	30.89
	Preferred and no option	20	27.78	12	23.53	32	26.02

Source: Survey results, 2017

Beekeeping practices

Beekeeping is common practice by rural households as income generation source and home consumption. Table 10 presented beekeeping practice and major constraint in terms of number and production honey. Result shows that on average the farmers own about 2.02, 0.81 and 0.56 traditional, transitional and modern bee hive respectively with average yield of 52.7, 5.62 and 9 Kg per year. The major constraints of beekeeping activity were herbicide (26.75%), aunts and

wild animals (25.05%), Shortage of bee forage (21%), price fluctuation of honey (15.22%) and Shortage of bee (11.36%).

Table 26. Beekeeping farm practices of respondents

Variable	Highland (n=72)		Midland (n=51)		Total (n=123)	
	mean	Std. Dev.	mean	Std. Dev.	mean	Std. Dev.
Beehives (traditional)	2.12	1.56	1.87	1.5	2.02	1.52
Honey harvest (kg) per year	74.36	140.03	18.87	23.69	52.7	112.81
Beehives(transitional)	1.3	3.77	0	0	0.81	2.99
Honey harvest (kg) per year	9	23.66	0	0	5.62	18.87
Beehives(modern)	0.9	2.23	0	0	0.56	1.78
Honey harvest (kg) per year	14.4	37.86	0	0	9	30.19
Unit price of honey (kg^{-1})	45		45		45	
Constraints			% HHs			
Aunts and wild animal			25.05			
Chemical (herbicide)			26.75			
Shortage of bee			11.36			
Shortage of bee forage (forest)			21.00			
Price fluctuation			15.22			

Source: survey results, 2017

Crop production pattern and productivity

Cropping patterns adopted by farmers in the study areas depends on agro-ecology factors like climate, soil types, crop types and markets. The major crops produced in selected districts were maize, teff, wheat and barley among cereal crops while faba bean, field pea and nug among pulse and oil crops and potato from horticultural crop (Table 11). The result shows respondents were owned farm plots with 3.17 plots per farmer. This implies that land sub-division issues may be disadvantaging for economic of labor and other inputs usage (Fekadu and Bezabih, 2009; Wondimu, 2010). Teff, wheat and barley are the most important crop in the study areas with mean of 7.57, 9.48 and 5.03 respectively.

The yield of crops during survey period was below national and regional average (CSA, 2017). This implies that all considered bodies may work on how increase the productivity through improved varieties, appropriate inputs recommended of these crop

This study tried to capture soil fertility status depending on the farmer's perception as excellent, very good, good and poor. About 7.55%, 28.30%, 42.45% and 21.7% of farmers perceived their soil fertility as excellent, very good, good and poor respectively.

Table 27. Major crops grown and their productivity

#plot and crop type	Highland (n=72)			Midland (n=51)			Total (n=123)		
	mean	Std. Dev.	Productivity	mean	Std. Dev.	Productivity	mean	Std. Dev.	Productivity
#plot	2.95	1.8		3.51	2.21		3.17	1.98	
Maize	18.56	28.59	30.87	22.15	16.87	30.96	20.44	23.07	30.92
Teff	6.77	5.71	8.72	8.96	6.34	10.06	7.57	6.00	9.22
Wheat	9.55	11.30	12.67	9.38	7.4	21.15	9.48	9.95	15.86
Barley	6.40	10.70	9.09	0	0	0	5.03	9.98	9.09
Faba bean	1.1	0.3	1.5	1.38	1.62	3.25	0.88	1.42	2.19
Field pea	3.8	10.97	5.58	2.57	2.06	5.57	2.88	8.5	5.75
Potato	11.38	26.06	118	7.78	21.96	111	14.11	4.22	114.5
Nug	3.97	7.74	4.65	1.96	1.20	4.27	3.09	5.91	4.48
	Percent			Percent			Percent		
Crop land fertility status	Excellent	6.15		9.76			7.55		
	Very good	26.15		31.71			28.30		
	Good	36.92		51.22			42.45		
	Poor	30.78		7.31			21.7		

Source: Survey results, 2017

Crop land preparation and planting system

The farming systems of smallholders in Highland Midland Wollega zone were predominantly annual crop productions by using similar cropping calendar of rainfall. Table 12 shows that for these annual crop productions, land ploughing frequency, inputs used rate, planting methods and planting period were presented. Land ploughing frequency of plots ranges from 1.63 for field pea to 5.77 times for teff. The result shows that ploughing frequency varied among the crops and land soil fertility status. All respondents for all crops use traditional land ploughing and planting using man and oxen power through source of labor. The respondents used inputs like seed and fertilizer (both NPS and Urea) for all crops was below recommendation rate but the seed rate of teff was above recommendation rate. Therefore, below recommendation inputs used can express low productivity.

The majority of producers in both districts planting their crops by row and broadcasting from March to end of July. All respondents used row planting method for maize, potato and partially for faba bean and field pea. Crops like teff, wheat, barley and nug were planted by broadcasting method (Table 12). In addition to low inputs used unsuitable planting methods may be decease crop productivity. In general there is a knowledge gap using inputs appropriate rate and time of application.

Table 28. Crop land preparation and planting system of respondents

Crop	Frequency of ploughing	Method of planting (%)			Time of planting	Seed rate per hectare	Fertilizer rate (Kg per hectare)	
		Row	Broadcasting	Both			UREA	NPS
Maize	4.7	96.92	3.08	0	May	21.27	122	81.8
Teff	5.77	0	100	0	July	49.63	31.08	70
Wheat	5.18	0	100	0	July	117.92	67.33	72
Barley	3.26	0	100	0	June	106.37	29.09	67.38
Faba bean	1.65	33.33	29.63	37.04	June	150.85	0	21.18
Field pea	1.63	42.30	19.23	38.47	June	106.73	0	26.94
Potato	2.13	100	0	0	March-April	1666.7	90	70
Nug	2.57	0	100	0	June	14.37	25	25
Recommend research rate	Maize	Teff	Wheat	Barley	Faba bean	Field pea	Potato	Nug
Seed (kg/ha)	25	25	125-150	125	150-200	120	2000-2200	
NPS (kg/ha)	100	100	100	100	100	100	195	
Urea (kg/ha)	200	100	100	100	25		165	

Source: Survey results, 2017

Major weeds and weeding systems

All crops across the study areas were affected by two or more types of weeds throughout the cropping season. The dominant weeds by different crops frequently observed in crop fields were guizotia scabra spps (*hadaa/tufoo*), bromuss (*Keelloo*) and snowdenia polystarcya (*Mujjaa.* Besides, Oxallis (in teff), avena fatua (in wheat and barley), commelina benghalesis (in maize), raphatum (in field pea) and cuscuta compestris (in nug) were reported as importance weeds in the study districts during survey period.

Weed management options exercised by respondents was typically hand weeding and herbicide like 2-4-D. Hand weeding was conducted throughout crop stage ranges of one time to 3 times depends on crop types and weed infestation. After 2-4-D herbicide application at least one time hand weeding was common in the study areas.

Table 29. Major weed and weeding system of respondents

Crops	Type of weed	Freq. of weeding	Methods of weeding	Type of chemical	Rate lit/ha
Maize	Guizotia, snowdenia, Bromuss & Commelina	2.56	Hand weeding		
Teff	Guizotia, Oxallis & commelina	1.24	Hand & chemical	2-4-D	0.79
Wheat	Guizotia, oat(Avena fatua) & raphatum spp	1.15	Hand & chemical	2-4-D	0.79
Barley	Guizotia, Avena fatua, bromuss &Raphatum	1.15	Hand & chemical	2-4-D	0.5

Faba bean	Guizotia & Muja	10.73	Hand weeding
Field pea	Guizotia & Muja	0.65	Hand weeding
Potato	Guizotia, commelina& Raphatum	1	Hand weeding
Nug	Guizotia, cuscusta & Raphatum	1.1	Hand weeding

Source: Survey results, 2017

Crop technology (varieties, fertilizers and application)

Majority of farmers used varieties from each crop technology. The many farmers started to use maize new varieties starting from 1995 G.C while they started to use teff, wheat and potato in 2002, 1998 and 2012 respectively. The new varieties of naize used by farmers were BH-660, BH-661 and BH-140 while Kena, Midland and Quncho teff varieties, Danda'a, Digalu, Hidase,Qubsa and Buluk of wheat varieties and Jalanee and Gudannee varieties of potato were widely used by farmers in the study districts.

Table 14. Type of technology used and its current status of respondents

Crops	Type of technology used	When started to use	Current status	If discontinue to use why?	New varieties used for the last 5 years
Maize	New varieties and row planting	1995	Still using		BH-660,BH-661 and BH-140
Teff	Varieties	2002	Still using		Kena, Midland and Quncho
Wheat	Varieties	1998	Still using		Danda'a, Digalu, Hidase,Qubsa and Buluk
Barley	-	-	-	No new varieties	
Faba bean	Row planting	2014	Still using	No new varieties	
Field pea	Row planting	2014	Still using	No new varieties	
Potato	Varieties	2012	Still using		Jalanee, Gudannee
Nug				No new varieties	

Source: Survey results, 2017

Major crops production and marketing constraints

During survey period the respondents listed the major constraints that hinder crop production. These crop production constraints includes pests (disease and insect), high cost of inputs, lack of capital, untimely inputs supply, shortage of land, weed infestation, shortage of inputs, low yield, poor seed quality and poor soil fertility are some of them as listed in table 15 below.

Disease and insect (37.10%), High cost of inputs (50.45%), Untimely input supply (5.6%), Shortage of land (20.76%), Weed infestation (21.34%), Shortage of inputs (13.92%), Low yield (24.18%) , Poor seed quality (6.67%) and Poor soil fertility (10.75%) were important constraints in maize production.

The important constraints affecting teff production high input costs (55.45%), low yield (42.38%) and weed infestation (37.26%). The major constraints affecting wheat are pests (49.25%), shortage of land (25.26%), and low yield (20.47%) while major constraints affecting wheat are pests (33.18%), shortage of land (22.01%), and low yield (32.68%).

Field pea and faba bean were mostly affected pests and low yield main constraints. The most important constraint in potato and nug were pests and low yield and also Poor seed quality for potato. According to the survey result presented in table 15 low price of output, lack of market information, lack of market linkage and high transaction cost were reported as important marketing constraints of major crops in the study districts. In general the market access and market related issues of grain were similar in both the study districts.

Table 15. Major crop production and marketing constraints

Production constraints (n=123)	Maize % hhs	Teff % hhs	Wheat % hhs	Potato % hhs	Field pea % hhs	Faba bean % hhs	Barley % hhs	Nug % hhs
Disease and insect	37.10	19.95	49.25	27.14	50.56	66.06	33.18	15.89
High cost of inputs	50.45	55.45	12.84	5.81			9.5	
Untimely input supply	5.6	9.5	13.92				4.90	
Shortage of land	20.76	29.50	25.26	18.35	5.54	6.64	22.01	13.00
Weed infestation	21.34	37.26	24.92	3.85			19.5	
Shortage of inputs	13.92	35.17	11.48		14.60	19.01	12.50	
Low yield	24.18	42.38	20.47	8.56	22.32	15.00	32.68	6.72
Poor seed quality	6.67			15.65				
Poor soil fertility	10.75	8.10	18.75				14.45	
Market constraints (n=123)								
Low price of output	57.25	16.72	23.57	53.20			34.79	4.54
Lack of information	13.81	23.11	19.01	21.00	14.34	16.25	21.08	5.75
Lack of market linkage	22.83	18.70	13.00	15.63	18.20	20.13	9.58	6.64
High transaction cost	32.59	31.09	25.41	9.15	12.32	23.58	13.85	

Source: Survey results, 2017

Forestry and Agro-forestry

According the survey reported the forestry and agro-forestry of the study areas were both natural and plantation. The result shows that about 39.02% and 36.59% of respondents were grown plantation and both natural and plantation respectively for income generation, soil erosion control, soil improvement and climate balance purpose.

Table 30. Forest type, status and rainfall pattern for last five years of respondents

Forest type		Highland (n=72)		Midland (n=51)		Total (n=123)	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
Natural		13	18.06	11	21.57	24	19.51
Plantation		27	37.5	21	41.18	48	39.02
Both		25	34.72	20	39.22	45	36.59
Purpose	Income generation	52	72.22	44	86.27	96	78.05
	Soil erosion control	29	40.28	19	37.26	48	39.02
	Climate balance	14	19.44	10	19.61	24	19.51
	Soil improvement	22	30.56	18	35.29	30	24.40
Status of forest in the last five years	Increase	28	38.89	24	47.06	52	42.28
	Decrease	20	27.78	17	33.33	37	30.08
	Same	24	33.33	10	19.61	34	27.64
Major type of plantation grown	Eucalyptus	23	31.94	17	33.33	40	32.52
	Gravilia	15	20.83	14	27.45	29	23.58
	Getra	11	15.28	8	15.69	19	15.45
	Bakanisa	9	12.5	12	23.53	21	17.07
	Others	5	6.94	7	13.73	12	9.76
Rainfall pattern in the last five years							
Early set on and early set off		20	27.78	13	25.49	33	26.83
Late set on and early set off		42	58.33	31	60.78	73	59.35
Late set on and late set off		10	13.89	7	13.73	17	13.82

Source: Survey results, 2017

Over the five last years the status of forest was increased (42.28%), decreased (30.08%) and the same (27.64%) of respondents reported, respectively. This implies that different natural rehabilitation practices of the last five years may be increased the plantation. Eucalyptus tree was the dominant one in both districts due to different purposes, especial in terms of income generation. Results shows that about 32.52% and 23.58% of the respondents grown eucalyptus tree and gravilia, respectively.

Agriculture in the Ethiopian in general and in the study areas in particular were rain fed and it is highly dependent on rainfall on set and off set. According to the survey result about 59.35% , 26.83% and 13.82% respondents were reported late set on and early set off, early set on and early set off and Late set on and late set off of rain fall respectively which indicate rain fall fluctuation in the study areas.

Soil and water conservation (SWC)

Natural resource (forest, soil and water) is a common property which need due attention. According to the survey result about 78.86% practice SWC While about 21.14% not practice SWC. Check dam (61.86%) and terraces (38.14%) are the means the farmers practice soil and

water conservation for soil erosion decrease and improved soil fertility. Small farmers were grown local grass and Bakamisa and Ebicha on their soil and water conservation practiced.

The major constraints of land identified by respondents were soil erosion (74.80%), soil acidity (34.96%), water logging (40.65%), soil fertility decline (55.29%) and termite (23.58%).

Table 31. Soil and water conservation type and major constraints of respondents

Practices		Highland (n=72)		Midland(n=51)		Total (n=123)	
		Frequency	Percent	Frequency	Frequency	Percent	Frequency
Practice SWC	Yes	56	77.78	41	80.39	97	78.86
	No	16	22.22	10	19.61	26	21.14
Type of SWC	Terraces	21	37.5	16	39.02	37	38.14
	Check dam	35	62.5	25	60.98	60	61.86
Tree/grass grown on SWC	Local grass	14	25	10	24.39	24	24.74
	Bakanisa, Ebicha	7	12.5	5	12.19	12	12.37
Land related constraints	Soil erosion	52	72.22	40	78.43	92	74.80
	Water logging	23	31.94	27	52.94	50	40.65
	Soil fertility decline	32	44.44	36	70.59	68	55.29
	Soil acidity	22	30.56	21	41.18	43	34.96
	Termite	17	23.61	12	23.53	29	23.58

Source: Survey results, 2017

Agricultural extension services

Extension service is the potential force, which accelerates the effective dissemination of adequate agricultural information to the farmers, thereby enhancing farmers' decision to adopt new technologies. The type of information to disseminate to farmers and the sources of that information are critical in speeding up the rate of adoption of new technology. Majority of extension service sources were DAs, research center and BoANR. About 86.18% of respondent's access extension service while about 13.82% of respondents were not obtained extension services. About 83.74% and 20.33% of respondents were obtained extension service from Das and BoANR respectively while about 4.88% of respondents obtain extension service from research centers. The extension services were focused on crop production (81.74%), livestock rearing (54.47%) and natural resource managements (39.84%) through training and/advice services.

The government extension was still the major source of information training and advising farmers. More information on varieties with full package was received from the DAs through FTC and field visit model farmers.

Table 32. Agricultural Information sources of respondents

Extension service sources		Highland (n=72)		Midland (n=51)		Total (n=123)	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
Extension Access	Yes	62	86.11	44	86.28	106	86.18
	No	10	13.89	7	13.72	17	13.82
Extension service sources	Development Agents	58	80.56	45	88.24	103	83.74
	Research centers	4	5.56	2	3.92	6	4.88
	BoANR	12	16.67	13	25.49	25	20.33
Training/ and advice extension services	Crop production	58	80.56	42	82.35	100	81.30
	Livestock rearing	41	56.94	26	50.98	67	54.47
	Natural resource	28	38.89	21	41.18	49	39.84

Source: Survey results, 2017

Credit access, sources and constraints

Farmers who have access to credit may overcome their financial constraints and therefore buy inputs. The credit availability positively affects the adoption of improved technologies (Tiamiyu *et al*., 2014; Leake and Adam, 2015). Results presented in table 19 about 95.12% of respondents' have access to credit while about 85.37% of respondents utilize credit for purchasing inputs (83.81%), about 5.71% to purchase food during food shortage and about 10.78% to purchase Input and food.

The source of this credit was microfinance like Oromia Credit and Savng Share company (OCSSCO) and Wasasa share companies. The major credit constraints are High interest rate (68.57%), Collateral (20.95%), Limited amount of money (15.24%), High interest rate and collateral (47.62%), High interest rate, collateral and Limited amount of money (85.71%) and High interest rate and Limited amount of money (34.29%) as show in table 19 below.

Table 33. Credit need, sources and constraints of respondents

		Highland (n=72)		Midland (n=51)		Total (n=123)	
		N	Percent	Frequency	Percent	Frequency	Percent
Credit access	Yes	68	94.44	49	96.08	117	95.12
	No	4	5.56	2	3.92	6	4.88
Credit utilization		61	84.72	44	86.28	105	85.37
Source	Microfinance	61	84.72	44	86.28	105	85.37
	Input purchase	50	81.97	38	86.36	88	83.81
Purpose to receive credit	To purchase food	4	6.56	2	4.55	6	5.71
	Input and food purchase	7	11.48	4	9.10	11	10.78
	High interest rate	42	68.85	30	68.18	72	68.57
Major credit constraints	Collateral	12	19.67	10	22.72	22	20.95
	Limited amount of money	9	14.75	7	15.91	16	15.24

	High interest rate and collateral	30	49.18	20	45.46	50	47.62
	High interest rate, collateral and Limited amount of money	55	90.16	35	79.55	90	85.71
	High interest rate, and Limited amount of money	23	37.71	13	29.55	36	34.29

Source: Survey results, 2017

Market and information access

Market access is critical in economic transformation of rural livelihoods. Improving market linkages along the value chain of major crops increases the opportunities and choices of rural farmers and reduces fluctuations between household consumption and income. Efficient integrated value chains, access to markets and other infrastructure help reduce transaction costs thus raising incomes of the rural poor. Results from analysis of the market situation were summarized in table 20.

Information flow reduces market imperfections with choices for the type of market of farmers to sell their product. Regarding of market information access about 79.68% of respondents have market information access before selling their product while about 20.32% have no market information access. The main sources of this market information were extension office (DAs), traders, neighbor farmers and cooperatives. About 68.29%, 56.10%, 24.39% and 18.70% of respondents obtained information from neighbor farmers, traders, DA's and cooperatives respectively. Among these sources neighbor farmers and DA's were more preferable by respondents with information reality (Table 20).

Table 34. Market and information access indicators of respondents

Variables			Highland (n=72)		Midland (n=51)		Total (n=123)	
			N	Percent	Frequency	Percent	Frequency	Percent
Market information access		Yes	58	80.56	40	78.43	98	79.68
		No	14	19.44	11	21.57	25	20.32
			N	%	N	%	N	%
Source of information	DAs		18	25	12	23.53	30	24.39
	Traders		49	68.10	35	68.63	84	68.29
	Neighbor		39	54.17	30	58.82	69	56.10
	Cooperatives		12	16.67	11	21.57	23	18.70

Preferred sources	DAs	11	15.28	7	13.73	18	14.63
	Traders	6	8.33	4	7.84	10	8.13
	Neighbor	23	31.94	16	31.37	39	31.71
	Cooperatives	8	11.11	5	9.80	13	10.57

Source: Survey results, 2017

Conclusions and recommendations

The study was focused on two selected districts of Horo Guduru Wollega zone namely Guduru (Midland) and Horo (Highland). Primary data were collected from the sample farm households using a semi-structural questionnaire. In order to capture better information of the areas, qualitative data collection such as focus group discussion and key informants interview were also conducted using checklist schedule. Secondary data were collected from published and unpublished materials from Horo Guduru Wollega zone and respective districts. A three-stage sampling technique was employed to select sample households from the population. Descriptive statistics such as mean, standard deviation, frequency and percentage were used to analysis quantitative data gathered from respondents.

The study was based on cross sectional data collected from 123 randomly selected respondents. About 86.18% of the sample respondents were male headed with while 13.82 were female headed households. The major sources of livelihood activities in the study area were crop production, livestock rearing and off/non-farming. The average milk per day that the respondents got was 1.63 and 1.03 liter at Highland and Midland respectively. About 95% of respondents were reported milk productivity decreased from time to time over last five years due to feed shortage and disease.

Livestock producers face production and marketing constraints. The major production constraints were disease, shortage of grazing land and feed shortage. Disease and shortage of grazing land were the most important production constraints of shoats and equines. Disease and Shortage of veterinary medicine were important production constraints for respondents who keep poultry. Market price/demand fluctuation, Lack of information, Lack of market linkage and High transaction cost are the major market constraint for livestock producers. The major common diseases and parasites are: fungal, trypanosomiasis, anthrax, black leg , mastitis and lump skin .

Respondents were owned farm plots with 3.17 plots per farmer. Teff, wheat and barley are the most important crop in the study areas with mean of 7.57, 9.48 and 5.03 respectively. All respondents for all crops use traditional land ploughing and planting using man and oxen power through source of labor. All respondents used row planting method for maize, potato and partially for faba bean and field pea. Crops like teff, wheat, barley and nug were planted by broadcasting method.

The dominant weeds by different crops frequently observed in crop fields were guizotia scabra spps (*hadaa/tufoo*), bromuss (*Keelloo*) and snowdenia polystarcya (*Mujjaa.* Besides, Oxallis (in teff), avena fatua (in wheat and barley), commelina benghalesis (in maize), raphatum (in field pea) and cuscuta compestris (in nug). This is managed by hand weeding and herbicide like 2-4-D.

The major production constraints that hinder crop production are pests (disease and insect), high cost of inputs, lack of capital, untimely inputs supply, shortage of land, weed infestation, shortage of inputs, low yield, poor seed quality and poor soil fertility are some of them. Low price of output, lack of market information, lack of market linkage and high transaction cost were reported as important marketing constraints of major crops in the study districts.

Forestry in the areas was both natural and plantation. Over the five last years the status of forest was increased (42.28%), decreased (30.08%) and the same (27.64%) of respondents reported, respectively. According to the survey result about 78.86% practice SWC While about 21.14% not practice SWC. Check dam (61.86%) and terraces (38.14%) are the means the farmers practice soil and water conservation for soil erosion decrease and improved soil fertility.

About 86.18% of respondent's access extension service while about 13.82% of respondents were not obtained extension services. Extension service sources were DAs, research center and BoANR. About 95.12% of sample households' have access to credit while about 85.37% of sample households utilized credit. The source of this credit was microfinance like Oromia saving and credit and Wasasa. High interest rate, Collateral and Limited amount of money are the major constraints of credit.

About 79.68% of sample households have market information access before selling their product while about 20.32% have no market information access. The main sources of this market

information were extension office (DAs), traders, neighbor farmers and cooperatives. Neighbor farmers and DA's were more preferable by sample households with information reality. Based on the survey results, the following recommendations were given:

Livestock production

- Promote improved forage crop through forage research and developments in the zone.
- Control of infectious diseases and parasites by improving veterinary services and vaccine quality
- Improve honey productions through introducing and popularizing improved apiculture technologies
- Improve marketing systems of livestock through controlling illegal traders or organized marketing system, strengthens of market information and linkage

Crop production

- Capacitates farmers on integrated pest managements (IPM) to control pests (disease and insect) for major crops
- The concerning body should support the farmers through timely supply of input with quality
- Agricultural research should develop crops that tolerate weed and pests(disease and insect)
- Expanding of infrastructures accessibility such as information, microfinance and transportation facilities needs development intervention to promote the effective marketing of crops and other products

Natural resources

- Developing and popularizing well adapted multipurpose trees species to the suitable agro-ecologies through development interventions
- Expanding soil and water conservation practice to minimize soil erosions and increase soil fertility

References

Central Statistical Agency (CSA), 2016. Agricultural sample survey 2015/16 (2008E.C): volume V- report on area, production and farm management practice of belg season crops for private peasant holdings. Statistical Bulletin, Central Statistical Agency, Addis Ababa, Ethiopia.

CSA, 2017. Agricultural sample survey 2016/2017 (2009 E.C.): Volume I- report on crops area and production of major. Statistical Bulletin,tatistical Agency, Addis Ababa, Ethiopia.

Dixon, J. and A. Gulliver with D. Gibbon. (2001) *Farming Systems and Poverty: Improving Farmers' Livelihoods in a Changing World.* FAO & World Bank, Rome, Italy & Washington, DC, USA.

Fekadu Gelaw and Bezabih Emana, 2009. Analysis of technical efficiency of wheat production: a study in Machakel Woreda Ethiopia. Journal of Agricultural Economics, 7(2):1-34.

Leake G.S. and Adam Bekele. 2015. Factors determining allocation of land for improved wheat variety by smallholder farmers of northern Ethiopia. *Journal of Development and Agricultural Economics,* 7(3): 105-112.

Tiamiyu, S.A., Usman, A. and Ugalahi, U.B., 2014. Adoption of On-farm and Post-harvest Rice Quality Enhancing Technologies in Nigeria. *Tropicultura*, 32(2): 67-72.

UNDP (United Nation Development Program). 2013. Towards building resilience and supporting transformation in Ethiopia. Annual Report, 2013. www.et.undp.org. (Accessed on March, 2016).

Wondimu Sakita, 2010. Economic efficiency of export oriented crop production in Ethiopia: The case of haricot beans in Adama And Dugda Districts, East Shewa Zone, Ethiopia.

Yu, B., A. Nin-Pratt, J. Funes, and S. Asrat Gemessa. 2011. Cereal Production and Technology Adoption in Ethiopia. ESSP II Working Paper 31. Addis Ababa, Ethiopia: Ethiopia Strategy Support Program II, International Food Policy Research Institute.

Assessment of Current Status of Fishermen Cooperatives in Selected Oromia Water Bodies, Ethiopia

Addisu Hailu and Alemayehu Abebe

Oromia Agricultural Research Institute, Batu Fish and Other Aquatic Life Research Center, P.O.Box 229, Batu, Ethiopia

Correspondent author:addihailu@gmail.com, Addisu Hailu, Batu.

Abstract

This study was conducted to assess current status of fishermen cooperatives in selected Oromia water bodies, Ethiopia to update the information that be used in fisheries management in major lakes and reservoirs. Both primary and secondary data sources were used to conduct the study. The primary data was collected from the fishermen organized at Lakes Zeway, Langano and Beseka and Koka, Fincha and Gilgel-Gibe reservoirs. Research Papers, literatures and different secondary information source were reviewed. The Tobit model was employed to identify determinanats of household participation in saving. Data were analyzed using STATA version 14. A total of 154 fishermen and 18 fishermen cooperatives operating on the selected Lakes and reservoirs were interviewed during the survey. The livelihoods of majority of fishermen were fishing activities and some of them depend on mixing farming; crop production, livestock and petty trade. Among the respondents, 88 (57.14) were involved in fishing activities year round. The majority of fishermen in selected water bodies responded that their average fish catch per day were less than 10 kg. The main commercial fish species in Zeway, Koka, Langano water bodies were Nile Tilapia, African Catfish, Common Carp and Curcian Carp. Whereas Nile Tilapia and Common Carp fish species were the major commercial species in Fincha and Gilgel-Gibe reserviors and African catfish in Lake Beseka. The Tobit model result showed that family size of household, access to fishing equipment, number of livestock unit, access to credit services and annual income of household from farming were significantly affecting saving decision of households. Based on these findings, it was recommended that government policy intervention should focus on awareness creation and education on lakes and reservior managements, increasing the availability and accessibility of credit services for fishermen, providing fishing equipments, increasing fishermen income through income source diversification and awareness creation for fishermen on how to improve their saving practices.

Keywords: *Fishermen; Cooperative; Fishing activity; Saving decision; Tobit model; Water bodies*

Introduction

Ethiopia is a land-locked country and depends on its inland water bodies for fish supply for its population. The country's water bodies have an estimated surface area of 7,334 km² of major lakes and reservoirs, and 275 km² of small water bodies, with 7,185 km of rivers within the country (FAO, 2003-2015). According to Breuil *et al.* (2014), the fishery is predominantly artisanal, currently involving 15,000 fishers (of which 5,000 are considered full-timers), fishing from 2,342 boats (366 motorized steel or wooden vessels, and the rest are reed or raft vessels), with some 17,240 nets and 28,000 hook gear. Gear in use ranges from a variety of traps and spear, to gillnet and beach seine, and hooks on hand and long line. Motorized fishery is typical

for Lake Tana. Primitive locally produced wooden boats are common in lakes Zeway, Langano and Hawassa and Koka reservior. Beach seines are used on lakes Zeway and Langano and Koka reservior. The use of gillnets and hook gear is widespread in the country's water bodies.

Ethiopia has the potential to produce over 51,500 tons of fish per annum. However, their exploitation and their contributions to food security and growth in the country are very less despite the technologies capable of resolving the problems of fisheries production (Dayan-dan, 2014). Fisheries resource in Ethiopia, in spite of its significant contribution to poverty alleviation and food security, is an unexploited natural resource (Kebede *et al.*, 2017). Water bodies located in the Rift Valley show signs of overexploitation whereas those located in remote areas with poor infrastructure which make up the majority remain underutilized (Janko, 2014; Tesfaye and Wolff, 2014). Hence, the existing role of fishery is insignificant in the country's overall economy because the fishery sector in the country is far below its potential (Kebede et al., 2017). The current production is still far below the estimated potential yield, which suggests the possibility for further expansion of the fishery.

Fishery cooperatives played a significant role in helping small-scale farmers to cope with competitive and fluctuating market and high transaction cost to develop their communities and have the potential to empower small-scale fishers against environmental and socio-economic shocks. They can: a) increase-fishers' price negotiating power with market intermediaries, help stabilize markets and improve post-harvest practices and facilities, b) -increase market competition by setting up auctioning systems, c) use their greater negotiating power to make cost-saving bulk purchases of fishing gears, equipment and d) facilitate micro-credit schemes for fishers to reduce their dependency on intermediaries and give them greater freedom in selecting buyers (FAO, 2009). According to Deacon (2012), fishery cooperative defined as a group of cooperatives' members who are joined voluntarily to participate in catching fishes or supplying fishes from fish farmers. Cooperatives, as business entities and as self-help associations, play a significant role in improving the socio-economic situations of the members and the communities (Ochan, 2014).

There are many rivers and lake available in Ethiopia which used for a fish production, but there is still a problem regarding fish production and productivity to increase the profit of private and

GDP of the country. According to Tola et al.(2017), the fishing sector of the economy has various problems, among others, mismanagement of the resource, inappropriate policies and institution, inadequate technical and material backup to the sector and market are the major ones. Therefore, the objectives of this study were:

- To assess the current status of fishermen cooperatives in selected water bodies
- To assess factors that affect saving practice of fishermen
- To assess women participation in fishermen cooperative
- To identify the major challenges of fishermen in selected water bodies

Methodology

Description of Study Area

Assessments of current status of fishermen cooperative was undertaken in selected water bodies of Oromia region. The research was conducted in East Showa Zone at Zeway Lake, Koka reservior and Beseka Lake fishery cooperative, West Arsi Zone at Langano lake fishery cooperative, Horo Guduru Wollega Zone at Fincha Reservoir fishery cooperative and Jimma Zone at Gilgel-Gibe reservoir fishery cooperative in 2018. Further description of the study Lakes and reserviours is as follows.

Koka reservior

The Koka Reservoir is located in the Awash River Basin in central Ethiopia (8 26^0N, 39 02^0 E). The 1200 km-long Awash River, this has its head waters in the plateau near Addis Ababa at 2300 m (above mean sea level), discharges below sea level into Lake Abbe in the Danakil Desert. The Koka Reservoir is located 90 km south of Addis Ababa at an elevation of 1600 m. It has a surface area of about 200 km^2 and a capacity of 1650 Mm^3. The Koka dam consists of concrete with a length of 458 meters and a maximum height of 47 meters. It was created by the construction of the Koka Dam across the Awash River. The reservoir has an area of 180 square kilometers. The reservoir supports a fishing industry; according to the Ethiopian Department of Fisheries and Aquaculture, 625 tonnes of fish are landed each year, which the department estimates is either 52% or 89% of its sustainable amount. Both the reservoir and the dam are threatened by increasing sedimentation caused by environmental degradation as well as the invasive water hyacin.

Langano Lake

Langano is a lake in the Oromia Region of Ethiopia, exactly 200 kilometers by road south of the capital, Addis Ababa, on the border between the East Shoa zone and West Arsi Zones. It is located to the east of Lake Abijatta in the Main Ethiopian Rift at an elevation of 1,585 meters (Lake Langano is 18 kilometers long and 16 km wide, with a surface area of 230 square kilometers and a maximum depth of 46 meters (CSA, 2005). The lake has a catchment 1600 square kilometers in size, and is drained by the Hora Kallo river which empties into the adjacent Lake Abijatta (Robert et al, 1992).

Lake Langano is popular with tourists and city-dwellers. The lake is brown in colour and at first sight one may think that the lake is not clean. However this is not the case, the reason for the colour is due to the richness of minerals including high sulphur levels which have led many to believe that the lake water has healing properties. There are a number of resorts around the lake and water sports are popular. There is a variety of wildlife around the lake, which includes hippos (rare), monkeys, baboons, warthogs, and a huge variety of birds. The area around the lake is largely deforested, however, and a large number of herders live around the area (Samuel, 2002).Two earthquakes had their epicenter near this lake, the first in 1906 (a magnitude 6.8 on the Richter scale), and the second in 1985 (magnitude 6.2).[4] After the earthquake of 1906 there formed a 25–30 m tall geyser on Edo Laki Island on the northern part of the lake. The geyser disappeared circa 1966 – 1970, leaving a hot spring.

Zeway Lake

Lake Zeway is one of the freshwater Rift Valley lakes of Ethiopia. It is located about 160 kilometers South of Addis Ababa. The districts holding the lake's shoreline are Adami Tullu Jido Kombolcha, Dugda and Zeway Dugda. On the average, the lake is located at an elevation of 1650 meter above sea level and the lake is shallow and has an open water area of 434 km^2 and shoreline length of 137 km, a maximum depth of 8.9 m and an average depth of 2.5 m (Von Damm and Edmond, 1984). The maximum length and width of the lake is 32 km and 20 km, respectively (LFDP, 1997). There are two main feeder rivers to L. Ziway; namely, Meki originating from Gurage Mountains in the north-west and Ketar from the Arsi Mountains in the east; and it has one out flow in the south through Bulbula River, draining into Lake Abijata. Lake Zeway contains five main Islands: Tullu Guddo (4.8 km^2), Tsedecha (2.1 km^2), Debresina (0.3 km^2), Funduro (0.4 km^2) and Gelila (0.2 km^2). Debresina and Gelila have only a few inhabitants,

the other three are inhabited by several hundreds of people (Yared Tigabu, 2003).Technologies such as fish smoking technology was demonstrated at Tullu Gudo under Lake Zeway condition.

Fincha Reservoir

Fincha reservoir is one of the reservoirs in Ethiopia used for hydroelectric power generation. The reservoir is found in the Western part of the country in Horro Guduru Wollega Zone, 286 km far from the capital city, Addis Ababa. The reservoir, situated at 9°33'N/37°24'E is surrounded by four administrative Woredas, namely Jimma Genet in South-West, Horro in West, Guduru in East and Southeast and Abay Choman in North and Northeast. It has an area of about 350 km2 at an elevation 2000 m.a.s.l. The reservoir has a mean depth of 7 m, maximum depth of 17 m with the temperature of 230C.

Beseka Lake

Lake Beseka is located about 190 km from Addis Ababa, the capital of Ethiopia to the East. The lake is found in the rift valley system at 955m.a.s.l. The time series of satellite data documented that Lake Beseka's surface area was about 3km^{2}in 1957 (Tessema, 1998), but reached 54km^2 in 2006. The fish resource of the lake was estimated to be about 205 tonnes per year whereas current production does not exceed 17 tonnes per year. For its high salinity, the lake water is not used for drinking purpose both for human and domestic animals although it is in area where water scarcity is much prominent (Getachew, 2015).

Gilgel-Gibe Reservoir

Gilgel-gibe reservoir is located 250 km Southwest of Addis Ababa and 75 km Northeast of Jimma City. It covers an area of 51 km^2 at an altitude of 1670 meters above sea level. The four districts bordering the reservoir are Omonada, Sekoru, Tiro afeta and Kersa with 6, 4, 5 and 2 Kebeles (smallest administrative unit) within ten kilometers from the shore line of the dam, respectively.

Sampling Technique and Sample Size

A team of four members comprising BFOALRC staff conducted the survey using structured questionnaires with individual interview method. Three stage sampling procedures were used for the selection of sample household heads. In the first stage, three representative lakes namely lakes Zeway, Langano and Beseka and three representative reservoirs namely Koka, Fincha and Gilgel-Gibe were selected purposively from Oromia Regional State. In the second stage, two

cooperatives were selected purposively from each selected water bodies. In the last stage, from selected cooperatives about 154 sample of household heads were randomly selected from total fishermen involved in selected lakes and reservoirs using Yamane (1967) formula.

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

Were;

n = the sample size, N= population size (sampling frame) and e = level of precision considered 9%

Table 1: List of study sites and fishermen selected

No.	Name of Water bodies/site	Number of fishermen selected	Percent
1	Koka reservior (Site 1=fishermen cooperative organized at Koka reservior)	37	24.03
2	Lake Langano (Site 2=fishermen cooperative organized at Langano lake)	21	13.64
3	Zeway lake (Site 3=Fishermen cooperative organized at Zeway lake)	44	28.57
4	Fincha Reservior (Site 4=fishermen cooperative organized at Fincha reservoir)	19	12.34
5	Beseka lake (Site 5=fishermen cooperative organized at Beseka lake)	13	8.44
6	Gilgel-Gibe reservior (Site 6=fishermen organized at Gilgel-gibe reservoir)	20	12.99
	Total	154	100

Source: Own survey results, 2018.

Types of Data and Methods of Data Collection

For this study both primary and secondary data were used. The secondary data were explored from different sources including Horro Guduru Wollega Zone and selected district Bureaus of livestock and fishery development, East Shoa Zone and selected districts of livestock and Fisher resource developments, West Arsi Zone and selected districts of livestock and Fisher resource developments and Sokoru district livestock and Fisher resource developments. Central Statistical Authority (CSA) and literatures were used as secondary data. On the other hand, questionnaires and checklists were prepared and employed to collect primary data from fishermen and key informants. The study employed cross-sectional data collection tools because it is better and more effective for obtaining information about the current status or the immediate past of the

case under study. It is also appropriate and suitable to use data collection tools such as questionnaires, interviews, Focus Group Discussions (FGD) and key informants interviews. The data collection survey and focus group discussions were undertaken in 2018. Both quantitative (questionnaire, secondary documents) and qualitative data collection instruments (FGD, key informant interviews (KI) have been used. The formal survey was undertaken through personal interviews with a structured questionnaire administered. Before data collection, the questionnaire was pre-tested on five farmers to evaluate the appropriateness of the design, clarity and interpretation of the questions, relevance of the questions and to estimate time required for an interview. Subsequently, appropriate modifications and corrections were made on the questionnaire. The questionnaire covered different topics in order to capture relevant information related to the study objectives. In both types of data information on the socio-economic aspects of households including demographic characteristics, farm resources and source of income for the fishermen and fishing activities and constraints with fishing activities.

Method of data analysis

After data was collected from primary, it was analyzed using different methods of data analysis. Before analysis, quantitative data gathered using the survey was coded and entered into statistical software known as Statistical Package. The data analysis was carried out using the STATA-14 software. Simple descriptive statistical methods such as average, percentage, standard deviation, and frequency distribution were used. In addition to this, descriptive tools such as tables, and pie chart were used to present data. The qualitative data analysis was used to see the relationships between the variables and they were then analyzed through systematically organizing the information and giving attention to local situations, opinions, perceptions and preferences of households and institutions operating in the district.

Econometric model

In a Probit model the variable of theoretical interest, y*, is unobserved; what isobserved is a dummy variable, y, which takes on a value of 1 if yi* is greater than 0,and 0 if otherwise. In contrast, Splett, et. al.(1994) devised what became known as the Tobit (Tobin's probit) or censored normal regression model for situations in which y is observed for values greater than 0 but is not observed (that is censored) for values of zero or less.

The standard Tobit model is defined as

$$y^* = X_i\beta + \mu_i, i = 1,2,3,.. n \qquad \textit{Equation}(1)$$

$$Y_i = Y_i^* \quad if\ Y_i^* > 0$$

$$= 0 \quad if\ Y_i^* \le 0 \qquad \textit{Eqaution}(2)$$

Where: Yi: the observed decision of household savings Yi * is the latent variable which is not observed β is Vector of unknown parameters Xi is vector of independent variables affecting household saving decision.

Table 2. Dependent and independent variables

Description of variable	Measurement	Expected sign
Hh Probability of Saving	Dummy (1= saving, 0 = not-saving)	
Age of the household head	measured in years	-
Sex of the household head	Dummy(1=male,0=female)	-
Family size of the households	Continuous variable measured in adult equivalent	-
Marital status of household	Categorical (1=single 2=married 3=divorced 4= widowed)	+
Education of household head	Dummy (1=illiterate 2=followed formal education)	+
Access to credit	(1 ,if the household access credit, 0 otherwise)	+
Access of income of households from farming	Dummy(1=access of income from farming,0=not	+
Average fish catch per day	Continuous variable measured by kilogram	+
Access of own fishing equipments	Dummy (1 ,if the household access of own fishing equipments, 0 otherwise)	+
Fishing experience	Continuous variable measured in Years	+
Access of own transportation	Dummy (1, if the household access of own transportation, 0 otherwise)	+
Access of extension service	Dummy (1 ,if the household access of extension service, 0 otherwise)	+
Livestock	Continuous variable measured in tropical livestock unit number	+

Results and discussions

The results discussed in this paper -focus mainly on current status of the fishery cooperative in selected water bodies of Oromia Region.

Socio-Economic Characteristics of Sampled Households

Demographics characteristics

As shown in Table 3, out of total households heads interviewed about 98.05 percent was male headed while 1.95 percent was female headed households. Education empowers people, strengthens their abilities to meet their wishes and increase their productivity and potential to improve their quality of life. In terms of education, the survey results show that about 5.84% of

the sampled household heads was illiterate, 5.19% was able to read and write, 61.69% attended formal education (1-8 grades), 25.32% was attended formal education (9-12 grades) and 1.95% of sampled household holds Diploma and above formal education. The average age of sampled farm household heads was 34.39 year with a range of 18 to 80 years. A family size ranging between 1 and 14 is witnessed in the selected farming households. The available data indicates that average family size in each household is 5.46 (Table 3).

Most of the fishermen have long experience on fishing activity. The average fishing experience of the respondents ranges 13.62 years. This study is in line with Endabu et al (2015), which found that most fishermen at Zeway lakes have involved in fisheries activity in the last ten years.

Table 3. Demographics characteristics of sampled fishermen in selected Oromia water bodies

Categorical variables

Variables		**N**	**%**
Sex	Male	151	98.05
	Female	3	1.95
Education	Illiterate	9	5.84
	Adult Education	8	5.19
	Primary education	95	61.69
	Secondary education	39	25.32
	Diploma and above	3	1.95
Marital Status	Single	26	16.88
	Married	126	81.82
	Divorced	0	0
	Widowed/er	2	1.30
Continous variables			
Variable		**Mean**	**SD**
Family size (number)		5.46	3.58
Age (year)		34.39	11.04
Fishing experience (year)		13.62	9.85

Source: Own survey results, 2018.

Land Size and Allocated Pattern

One of the most important factors that influence crop production is resource endowment, availability of land for crop production and livestock rearing. As indicated in Table 4, out of 154 sampled fishermen 51.30 percent have own cultivated land while 48.70 percent of fishermen have no cultivated land. This implies fishing activity is a sole income source for majority of fishermen. The survey revealed that the average cultivated land owned by sampled households was 1.01 hectare. As depicted in Table 4, also that the average rented land and shared in land 2017/18 production season were 1.10 and 1.14 hectare, respectively.

Table 4. Average land size of smpled households in 2018.

Variables	**N**	**%**
Own land availability Yes	79	51.30
No	75	48.70
Variable	**Mean**	**SD**
Own cultivated land	1.01	0.97
Homestead land	0.23	0.11
Grazing land	0.5	0.20
Rented in land	1.10	1.13
Rented out land		
Shared in land	1.14	0.62

Source: Own survey results, 2018.

Access of institutional services

Institutions play a significant role in promoting people's participation in the supply of services and resources for human development, improving resource allocation and for ensuring effective public service delivery. The supporting function institutions are those who are not directly related to agricultural productions but provide different supports to the fishermen. Support service providers are essential for fishery sector developments and include sector specific input and equipment providers, financial services, extension service, and market information access and dissemination. In the study areas, there are many institutions supporting the agricultural sectors in one way or another. The most common support providers are Livestock and Fisher Resources Development Offices(LFRDO), District Trade and Market Development Office (DTMDO), IMX, Oromia Micro Finance Institutions and Agricultural Research Center.

Extension service

As depicted in Table 5, only 21.43% of the fishermen reported that they had access to extension service in 2018. About78.57% of the fishermen reported that they had no access to extension service. The extension services providers were Batu fish and other aquatic life research center, Livestock and Fishers Resource Development experts and NGOs. The extension services provided were on Water bodies' management, fish production, net making and fish marketing (Table 5). According to survey results, the major problem related to extension service were lack of service provider nearby (94.48%), do not have a time to get service (2.56%) and possesses the required information about (1.71%).

Table 5. Fishermen access to extension services and problem related to extension service

No.	Items		N	%
1	Access to extension services	Yes	33	21.43
		No	121	78.57
2	Problem related to obtain extension service	Lack of service provider nearby	111	94.48
		Already have the required information	2	1.71
		Do not have time to get the service	3	2.56
		Lack of interest of experts to give service	1	0.85
3 Type of extension services provided for fishermen		Water bodies management	10	31.25
		Fish production	1	3.13
		Net making	2	6.25
		Water bodies management, fish production, fish marketing and net making	19	59.38

Source: Own survey results, 2018.

Access to credit services

Finance is the crucial element starting fish production and marketing. Fishermen mainly require credit to purchase fishing equipments, i.e., gears, boats, refrigerator and others materials and also for family consumption. As depicted in Table 6, 24.03% of fishermen access for credit and 75.97% of fishermen reported that they have no access for credit service. The main institutions that provide credit for fishermen were micro-finance institution (Oromia Credits and Saving Share company (OCSSCO) (88.57%) and relatives/friends (5.72%) (Table 6). The main objectives households take of the credit were to purchase fertilizer, to purchase to purchase fishing equipments(60%) and family consumption and agricultural inputs. improved seeds/seedling and for family consumptions. The providers of credit services were micro finance institutions (88.57%), relatives/friends (5.72%) and fish traders (2.66%). The major problems

farmers reported related to credit services were lack of service providers (73.17%),high loan interest rates(10.57%) and need collateral to take credits (8.13%) (Table 6).

Table 6. Access to credit service and problems of credits services of sampled households

No	Items		N	%
1	Access to credit services	Yes	37	24.03
		No	117	75.97
2	Purpose of credit taken	Purchasing of fishing equipments	21	60.00
		For family consumption	2	5.71
		Purchase agricultural inputs	6	17.14
		For both family consumption and purchase fishing equipments	6	17.14
3	Source of credits	Micro finance Institutions	31	88.57
		Relatives/friends	2	5.72
		Bank	1	2.86
		Fish traders	1	2.86
4	Problems related to credit services	High interest rate	13	10.57
		Need collateral	10	8.13
		Credit provider not give attention for fishery	2	1.63
		Lack of service providers/lack of access	90	73.17
		Lack of interest to take credit	8	6.50

Source: Own survey results, 2018.

Livelihood activities of fishermen

Crop production

It is clear that crop production pattern of an area depends mainly on agro-ecology factors namely climate, soil types, crops types, community crop production habit and also marketing factors. According to survey results, maize, teff, wheat and sorghumwere the major crops farmers produce for consumption and source of cash in line with fishing activities (Table 7).

Table 7. Major crop produced by selected fishermen in selected study area

Variables		**N**	**%**
Maize	Yes	65	42.21
	No	89	57.79
Teff	Yes	52	33.77
	No	102	66.23
Wheat	Yes	22	14.29
	No	132	85.71
Sorghum	Yes	6	3.90
	No	148	96.10

Source: Own survey results, 2018.

Livestock production of fishermen

Livestock plays significant role in the economy of the fishermen in the studies area. In general they provide food (milk, meat, egg, hides and skin) as power for cultivation, serve as means of transportation, and manure production for soil fertility management and as saving. Farmers' kept livestock for food, cash, draught power and manure production and used as a source of income to purchase fishing equipments. In terms of population of livestock fishermen organized at Fincha, Koka and Gilge-Gibe are higher compared to fishermen organized at others selected water bodies. As indicated in Table 8, on average about 1.97oxen were kept by sampled households in study area. On average fishermen have 2.61 local cows. Goats and sheep are also kept by fishermen to meet the need of money and source of meat for home consumption.

Table 8. Livestock population and purpose of rearing in selected districts

Variables		**N**	**%**
Livestock owned	Yes	91	59.09
	No	63	40.91
	Total	154	100
Variable		Mean	SD
Oxen		1.97	1.01
Cows		2.61	1.53
Heifer		1.95	1.23
Calf		2.05	
Goat		4.61	4.24
Sheep		4.79	3.86
Horse		1.5	0.54
Mule		1.33	0.57
Donkey		1.97	1.35
Poultry		8.38	8.18

Source: Own survey results, 2018.

Fishing activities

Fish serves as a source of human diet and source of income for fishermen cooperative organized in selected water bodies of Oromia region. The importance of fishing in terms of economics, food security and employment opportunity for people lives near lakes and reservoirs are enormous. Artisanal or non-motorized fishery is one of the most significant economic activities in the studies area.Fishery is practiced in a traditional way and tools as past time activity.

Season of fishing activities

Fishing activity is seasonal and the supply of fish is mostly available during fasting time. As indicated in Table 9, about 57.14% of fishermen were involved in fishing activities year round. The primarily source livelihood for those fishermen involved in fishing activity was carching fish year round. Besides, about 24.04 percent of selected fishermen were involved on fishing activities during fasting time. Peak fishing occurs during the fasting months (February, March, April and August) when meat markets are dwindling.

Table 9. Time of fishing activities in selected water bodies of Oromia Region

Variables	N	%
Year round	88	57.14
During fasting time	37	24.03
September-April	14	9.09
January-May	15	9.74
Total	154	100

Source: Own survey results, 2018.

Fishery cooperative

Currently the majority of fishermen have been organized into fishermen cooperatives, in line with the policy of the Government. The Ministry of Agriculture has granted commercial fishing rights only to fishermen cooperatives, each of which has to pay in return for the privilege of exploiting the lake resource. According to the survey results, there were 34 fishery cooperatives on selected water bodies of Oromia region. Of these 34 fishery cooperatives, 18 were selected for this research and name of those cooperatives are indicated in Table 10 below.

As indicated in Table 10, financial capital of fishermen cooperative is less than 100,000 Birr expect Melka koffe fishermen cooperative and Zeway Batu fishermen cooperative which 140,00 and 100,000 Birr, respectively. Total numbers of boat of cooperative in Zeway lake and Koka reservoir are high compared to other water bodies (Table 10). Currently, fishers' cooperatives exist in most fisheries but they are generally weak. The cooperatives have bylaws and these could be developed to cover fisheries management issues considering that cooperatives have the potential to participate in co-management arrangements with government provided that they are strengthened (ACP Fish II, 2013). Fishermen cooperative activities are coordinated by a governing board including a chairman, a vice-chairman, a secretary and a treasurer elected by the

cooperative members, who manages the cooperative according to the annual plan approved by its general assembly.

Table 10. Name and number of fishing technologies of selected cooperatives

No	Zone	Selected Water bodies	Name of fishermen cooperative	Total cash of fishermen cooperative	Total boats of fishermen cooperative	Total gears of fishermen cooperative
1	Horro Guduru	Fincha	Abdi Boru Fishermen Cooperative	26,000	3	6
			Gudatu Diga Fishermen Cooperative	32000	5	3
			Oda Giregna Fishermen Cooperative	-	-	-
2	Jimma	Gilgel-Gibe	Gurmu Kanisa Fishermen Cooperative	10,000	4	12
3	Arsi		Gudata Bula Fishermen Cooperative	27,000	12	50
			Gora Hadha Degaga and Arara Fishermen Cooperative	75,000	30	40
		Koka	Derara Fishermen Cooperative	50,000	40	30
			Koka Negawo Fishermen Cooperative	48,000	-	-
			Mali Bari Fishermen Cooperative	30,000	24	24
	East Shoa		Abosa Fishermen Cooperative	14,000	5	5
			Melka Fesasa Fishermen Cooperative	32,000	-	-
		Zeway	Melka Koffe Fishermen Cooperative	140,000	25	25
			Meki Denbel Fishermen Cooperative	10,000	26	26
			Zeway Batu Fishermen Cooperative	100,000	73	135
		Langano	Oyitu Langano Fishermen Cooperative	20,000	30	30
		Beseka	Beseka Fishermen Cooperative	6,000	-	-
			Langano Fishermen Cooperative	80,000	60	60
4	West Arsi	Langano	Keraro Eddo Mindaye Fishermen Cooperative	75,000	12	12

Source: own survey results, 2018.

Type of fishing equipments used for fishing activities

According to survey results steel boat, wooden boat and yebela/bofofe were the major types of boats fishermen was used for fish catch at selected water bodies. Most fishers operate with basic rafts made of papyrus or scirpus. Wooden boats are also the major boats fishermen used for fishing purpose on selected water bodies. Motorized boat is found on Lake Zeway and Fincha reservior. Motorized boat in lake Zeway where there are mostly used for fish collection and transport purpose. In case of Fincha reservior steel boat was supplied for fishermen by non-government organization (fish for all). Average purchase price of steel boat was 49,571.43 birr

which is so expensive for fishermen to purchase. On average fishermen holds 1.07 wooden boat and purchase price or preparation cost was 6,222.35 Birr (Table 11).

Gears in use include gillnets, beach seines and hook/long-line on selected water bodies. The use of gillnets and hook gear is widespread in the selected water bodies, whilst beach seines are principally used on Koka reservior, lakes Zeway and Langano. On average fishermen hold 1.33, 5.56 and 4.98 number of beach seines, gillnet and hook/long line, respectively.

Table 11. Type of fishing equipments fishermen holds

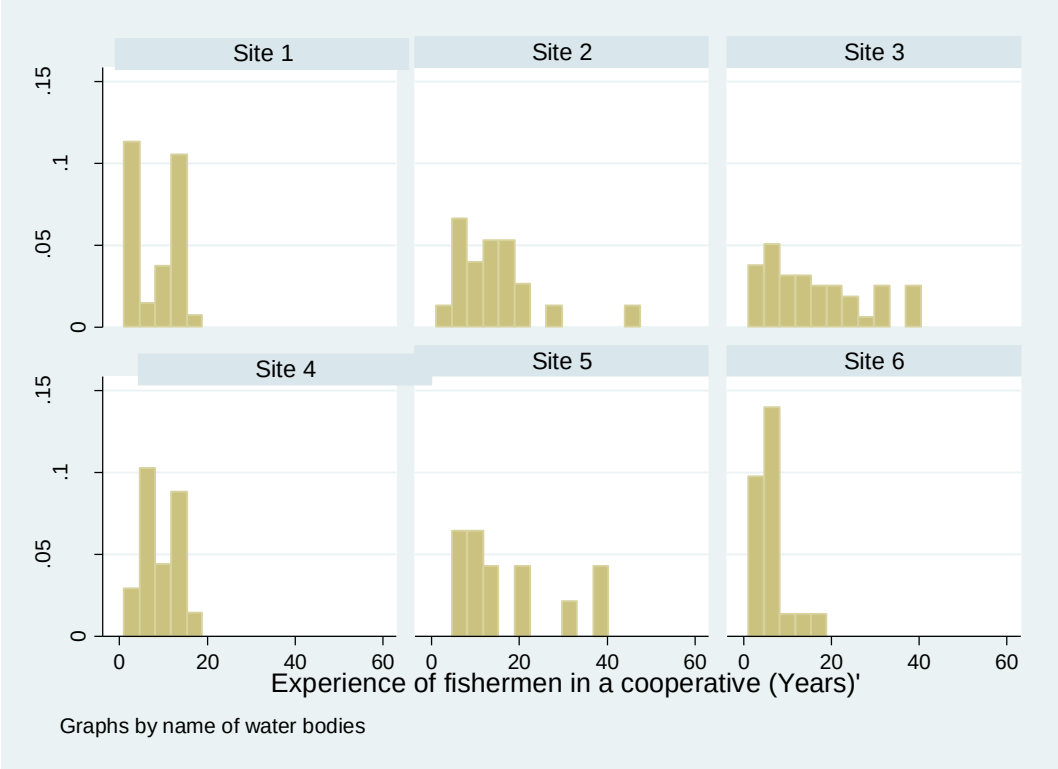
Type of boat/gear (No)	Site 1		Site 2		Site 3		Site 4		Site 5		Site 6		Total		F-value
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
Steel boat	1.5	0.77	-		-	-	1		-	-	-		1.11	0.33	5.44*
Wooden boat	1.08	0.28	1		1.2	0.4	-		1		1		1.07	0.25	7.59***
Yebela/Bofofe boat	1	-	-	-	1		-	-	-	-	-		1	0	-
Beach seine	2	1.63	1.12	0.48	1		1		-		-	-	1.33	1.01	3.90**
Gillnet(50m)	12.77	31.75	1		2.59	2.59	1		4.27		1.93		5.56	18.22	1.04
Hook/long line (by 100)	26.5	33.23	-	-	3.62	2.19	1	-	4.28	2.22	2	-	4.98	8.11	6***

Source: Own computation, 2018.

Fish production and experience

As indicated in Figure 1, the majority of fishermen experience involved in cooperative are less than 20 years on selected water bodies. In case of lakes Zeway, Langano and Beseka fishermen involvement in one cooperative goes until forty years. Whereas in case of Koka, Fincha and Gilgel-Gibe reservior fishermen responded that experience involved in one cooperative were less than 20 years.

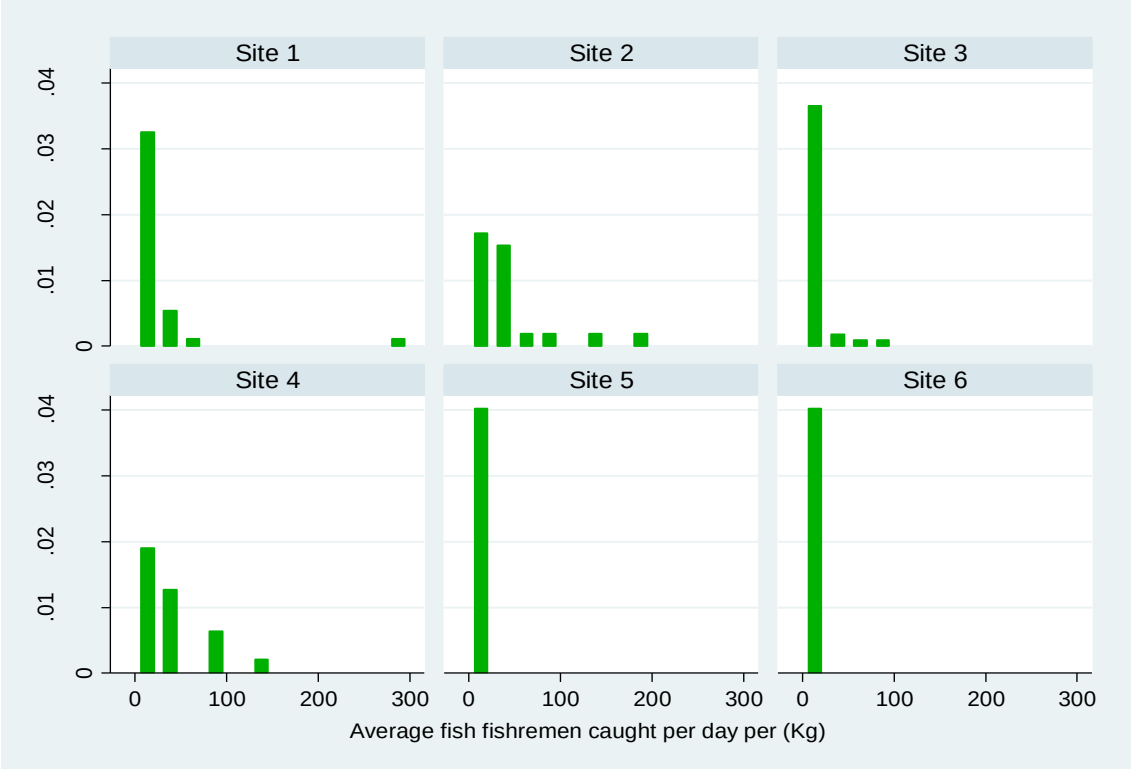
Figure 1: Average experience of fishermen in fishermen cooperative



Fish catch

The estimated mean catch per day in kg was summarized in Figure 2 by selected water bodies. As indicated in Figure 2, the majority of fishermen in selected water bodies respond that average fish catch was less than 10 kg per day. Langano Lake and Fincha reservior fishermen respond that they obtain average fish catch above 50 kg per day. Fluctuations of fish yield are there in all selected water bodies due to different internal and external factors. According to Focus Group Discussion the yield of fish especially in Rift valley area was decreasing from time to time due to overfishing, expansion of small size fish nets which is not recommended, climate change and etc.

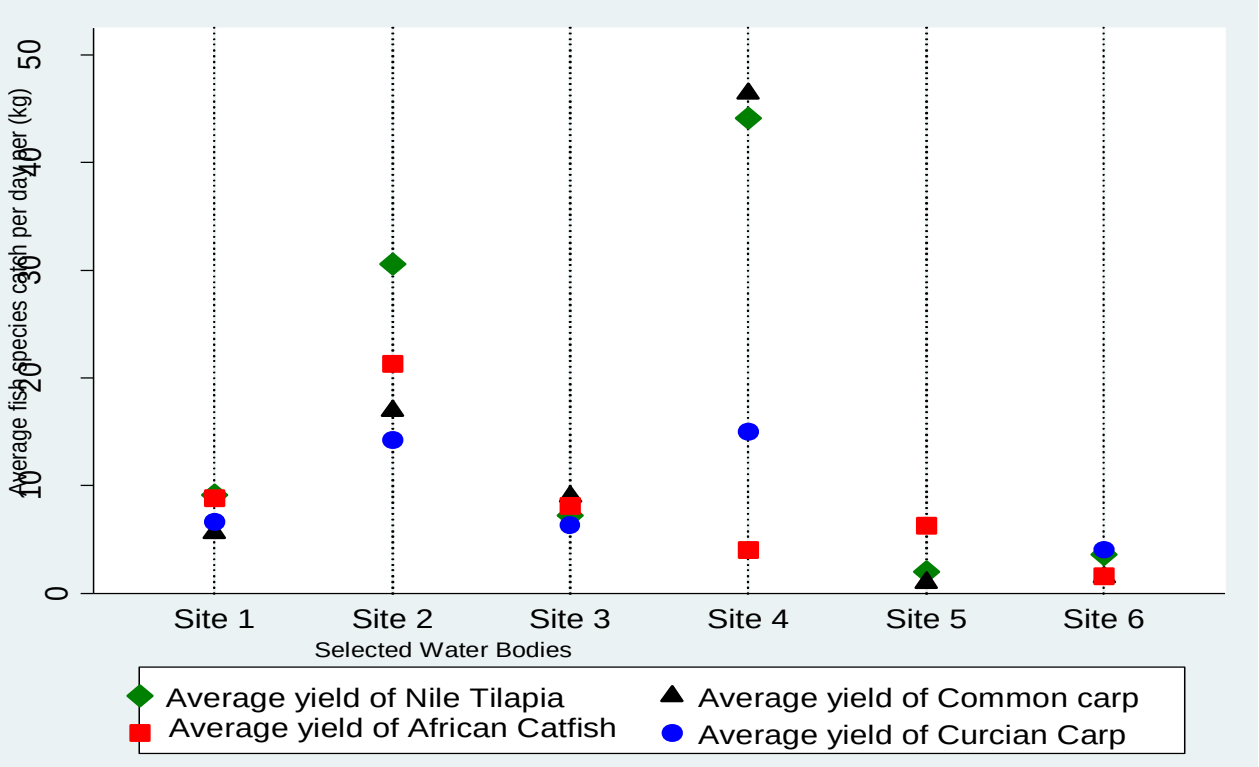
Figure 2: Average fish catch per day (kg) by fishermen



Fish species

The main commercial fish species at Koka reservior, Langano and Zeway lakes are Nile Tilapia, African Catfish, Common Carp and Curcian Carp whereas in Fincha and Gilgel-Gibe reservior Nile tilapia and Common Carp are important commercial fish species. In the case of Beseka fishermen use only African catfish as a commercial fish (Figure 3). According to survey results catch proportion varied among species in different water bodies. For instance, the catch of Nile Tilapia and Common carp in Langano Lake and Fincha reservior are above 10 kg per day. While all species in case of Lake Zeway, Lake Beseka, Gilgel Gibe and Koka reservior fish catch per day were less than 10 kg per day (Figure 3).

Figure 3: Yield of fish species in selected water bodies of Oromia region



Source: Own computation, 2018.

Purpose of fishing in selected water bodies

As indicated in Table 10, fishermen involved in fishing activities for source of income by selling fish and for family consumption to fulfill their children balanced diet. In terms of acceptance in the market Nile Tilapia species is the important species in the case of Koka reservior, Lake Langano, Lake Zeway, Fincha reservior and Gilgel-Gibe reservior. However, in case of Beseka lake African catfish commercial accepted species. According to Focus Group Discussion catch of Nile Tilapia species was decreasing from time to time due to overfishing while catch of common carp and catfish were increasing.

Table 12. Type of fish species and purpose of fishing

Purpose of fishing		Site 1		Site 2		Site 3		Site 4		Site 5		Site 6		Total	
		N	%	N	%	N	%	N	%	N	%	N	%	N	%
N.Tilapia	Sale/income source	6	17.65	1	4.76	2	4.65	3	15.79	-	-	-	-	12	8.70
	Consumption	0	0	-		-	-			-	-	-	-	-	-
	Both	28	82.35	20	95.24	41	95.35	16	84.21	-	-	19	100	126	91.30
African catfish	Sale/income source	16	45.71	3	14.29	11	25.58	-	-	2	15.38	-	-	33	25.58
	Consumption	-	-	-	-	-	-	-	-			-	-		
	Both	19	54.29	18	85.71	32	74.42	-	-	11	84.62	15	100	96	74.42
Common carp	Sale/income source	9	25.71	2	10	5	12.20	5	26.32	-	-	-	-	21	27.65
	Consumption	-	-	3	15	-	-	-	-	-	-	-	-	3	2.52
	Both	26	74.29	4	75	36	87.80	14	73.68	-	-	4	100	95	79.83
Curcian carp	Sale/income source	5	45.45	3	42.86	9	26.47	-	-	-	-	-	-	16	29.09
	Consumption	3	27.27	2	28.57	6	17.65	-	-	-	-	-	-	23	23.64
	Both	3	27.27	2	28.57	19	55.88	-	-	-	-	-	-	26	47.27
Rank in commercially accepted fish species		1. N.Tilapia		1. N.Tilapia		1. N.Tilapia		1. N.Tilapia		1.Catfish		1. N.Tilapia			
		2. A.Catfish		2. A. Catfish		2. Common Carp		2. A.Catfish				2. A.Catfish			

Source: Own survey results, 2018.

Saving practice of fishermen at selected water bodies

According to survey results, about 144(93.51%) of respondents have saving practice as a cooperative from selling of fish. Amount of saving as a cooperative is different from site to site which was depending on bylaws of cooperatives. From total 154 respondents, only 95 (61.69%) of respondents have practices of saving individually. In addition, most households prefer to save money in cash than asset. With regard to institution fishermen saving 76 (80%) of respondents reported that they have saved their money in formal institution (Bank) and 13 (13.68%) and 6(6.32%) percent of respondents reported that they save their money in informal institution (Ikub) and at home own box, respectively (Table 13). As depicted in Table 13, among those who practice saving, 46.88% save any time when they get income, followed by once in week (19.79%) and every day (17.71%).

Table 13. Saving practice of fishermen at selected water bodies of Oromia Region.

Saving practice		**N**	**%**
Saving in cooperative	Yes	144	93.51
	No	10	6.49
Saving individually	Yes	95	61.69
	No	59	38.31
Saving in institutions	Bank	76	80.00
	Ikub	13	13.68
	At home own box	6	6.32
Mechanism of saving	Cash	85	88.54
	Asset	1	1.04
	Both	10	10.42
Time of saving	Every day	17	17.71
	Once in a week	19	19.79
	Once in the month	15	15.63
	At any time when income generated	45	46.88

Source: Own survey results, 2018.

Econometric Results

Twelve explanatory variables were considered in the econometric model out of which five variables were found to be significant determinants of the sample households saving practice. Econometric Tobit analysis has shown that family size of household, access of fishing equipment, number of tropical livestock unit, income from farming activities and access of credit for household also significant determinants at saving decision of household. As shown in the Table 14, family size has statistically significant at 5% and positive effect on the decision to save. This is because as family size increases, households are expected to allocate more labor for fishing activities and thus there will be more income generated and left for saving. As family adult equivalent increase by one unit, probability of household saving increases by about 8.1%. Holding all other variables constant This finding is contradicted with Rehman *et al.* (2010) who found that family size significantly and inversely affecting household saving.

The number of tropical livestock unit of household has positively and significantly related to household saving at 1 percent. As tropical livestock unit of household increases by one unit it will result probability household savings increase by 80.3 percent. The result of the Tobit model indicated that sample households who had large livestock unit have high saving capacities. This is an implication that irrespective of bigger number of livestock one cannot easily increase fish production because livestock is an indicator of economic wealth and place for fishing activities in purchasing fishing equipments. Another possible explanation for the positive coefficient of the number of livestock may be due to the reason that, when number of livestock increases the need for more improved fishing technologies, which requires the need for additional capital and this increases demand for previous savings. The findings of the study agree with Degu (2007) shows positive and significant relationship between households saving and livestock ownership.

Availability of own fishing equipments (gears and boats) positively and significantly determines household saving at 1 percent. The result of the Tobit model indicated, when access to own fishing equipments change from “no access” to “own fishing equipments access” probability of saving increases at about 87.7percent. This is because fishermen who are own fishing equipments catch more fish and spent more time on fishing activities and it will result- in an increased household saving.Another possible explanation for the positive coefficient of availability of own fishing equipments may be due to the reason that, when fishermen own

fishing equipments fee cost paid for rent of fishing equipments will reduce and as a result probability of saving increases.

In this study it was found out that credit has a significant positive effect on savings of fishermen. Availability of credit service positively and significantly determines household saving. Holding other variables constant, when access to credit change from "no access" to "credit access" probability of saving increases at about 49.6percent. The result was due to the fact that access to credit can increase an opportunity to invest and participate in different income generating activity which can enhance income and saving level at the same time. This finding is in line with Zegeye (2018) which confirm that access of credit positive and significantly influence saving decision of households. This result is also concurring the research hypothesis and the finding of (Abdelkhalek et al., (2009); Mahmoud (2008); Pailwar et al., 2010).

In this study annual income of the household from farming was positively related and coefficient is significantly different at 5 percent level. Other things remain constant, as annual farm income of the household - increases by a unit, the probability of household decision for saving increases by/at about 70.9 percent. This is due to the fact that when income from farming increases households' tendency to save increase it means as income increase proportion of income saved also increases which are because share of income consumed decreases. The results agreed with a study conducted in Gamo Gofa Zone which shows that a statistically significant relationship between income and savings decision of households (Gizework, 2015).

Table 14. Estimation of Tobit model for factors affecting fishermen saving decision

Variable	Coef.	Robust Std. Err	Marginal effects (dy/dx)	Std.Err
Age of household head	-0.165	0.015	-0.165	0.015
Marital status of household	-0.156	0.247	-0.156	0.247
Education level of household	0.135	0.095	0.135	0.095
Family size of household	0.081**	0.041	0.081**	0.041
Number of livestock household owned	0.803***	0.223	0.803***	0.223
Fishing experience of household	0.023	0.015	0.023	0.015
Average fish caught per day	-0.001	0.002	-0.001	0.002
Access of own fishing equipment	0.877***	0.266	0.877***	0.266
Access of extension service	-0.174	0.238	-0.174	0.238

Access of credit access of household	0.496*	0.254	0.496*	0.254
Annual Income of household from farming	0.709**	0.305	0.709**	0.305
Own transport service of household	-0.232	0.234	-0.232	0.234
Constant	-3.101**	1.215		

Source: Own computation (2018)

Dependent variable: saving decision (save =1/0)

***significant at 1%, **significant at 5%, *significant at 10%

Role of Women in fishing activity

According to survey results 35.71 percent of respondent reported that women were a member of fishery cooperative (Table 15). Besides, 64.05 percent of respondent reported that women have the role in decision making of fishery cooperative. Female members of the fishing cooperative participate in processing and selling activities than fishing. In fisheries, men and women often have distinct roles. At selected water bodies fishery only men go out to fish, but women are often involved in marketing and post-harvest processing. In general, women's participation in the fishery sector is restricted especially; fishing is unthinkable because nature of fishing activities is difficult for female. Post-harvest processing, preparing food, shopping and cooking are the main tasks of women in fishery cooperative in the study area.

Table 15. Women role in fishery cooperative at selected water bodies

Variable		**N**	**%**
Are women member of cooperative?	Yes	55	35.71
	No	99	64.29
	Total	154	100
Do women have a role in decision making of a fishery cooperative?	Yes	98	64.05
	No	55	35.95
	Total	154	100

Source: Own survey results, 2018.

Major constraints of fishery sector

Farmers operating in fishing have many constraints. As depicted in Table 14, the major existing production constraints that hinder fish production were lack of improved fishing technologies, low fish yield, low price of fish, expansion of illegal fishermen and traders, overexploitation of fish stock, transportation problem, lack of market access and market place, low demand for fish consumption, low awareness in fish production and consumption, fishery regulation problem,

theft problem (stolen of fishing equipments), lakes/reservior pollution due to chemical inflows, climate change, Water hyacinth problem and lack of support for this sector from governments and NGOs. The fishermen were interviewed to rank them according to their importance: Accordingly, expansion of illegal fishermen was ranked as the first most important constraint while fishery regulation problem was ranked as the least observed constraint at Koka reservior (Table 16). In case of lake Langano fishermen responded that lack of market access and market place as first important constraints followed by fishery regulation problem (poor lake management) while in case of Zeway lake first ranked constraint was fishery regulation problem followed by expansion of illegal fishermen and traders. But the rank of constraints at Fincha reservior, Lake Beseka and Gilgel-Gibe reservior were different from others three i.e. at three of them, the respondents' ranked lack of improved fishing equipments as the first most important constraint.

In general, the three top ranked problem of fishing activities in selected water bodies were expansion of illegal fishermen, lack of improved fishing technologies and fishery regulation problem. This research is in line with the finding of Hussien Abegaz *et al*. (2010) in which lack of transportation facilities, proper fishing gears; they all use hook for fishing, poor post harvest handling, low price of fish as a result of low bargaining power of producers, lack of proper fish processing and storage facilities, poor extension service, lack of awareness, poor culture of eating fish, lack of permanent fish market places (shops) are the main fish production constraints in Afar region.

Table 16. The major constraints of fishermen inn selected water bodies

Major Constraints	Yes/No	Site 1		Site 2		Site 3		Site 4		Site 5		Site 6		Total	
		Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Lack of improved fishing technologies	Yes	17	45.95	11	52.38	28	63.64	17	89.47	13	100	20	100	106	68.83
Low yield/fish caught per day	Yes	15	40.54	8	38.10	32	72.73	12	63.16	6	46.15	14	70	87	56.49
Low selling price of fish	Yes	18	48.65	15	71.43	12	27.27	16	84.21	8	61.54	13	65	82	53.35
Expansion of illegal fishermen	Yes	28	75.68	17	80.95	43	97.73	7	36.84	3	23.08	11	57.89	109	71.24
Overexploitation of fish stock	Yes	9	24.32	8	38.10	36	81.82	10	52.63	-	-	11	55	74	48.05
Transportation problem	Yes	10	27.03	7	33.33	1	2.27	13	68.42	10	76.92	8	40	49	31.82
Lack of market access and market place	Yes	19	51.35	20	95.24	12	27.27	16	84.21	9	69.23	11	55	87	56.49
Low demand for fish consumption	Yes	2	5.41	4	19.05	1	2.27	4	21.05	1	7.69	4	20	16	10.39
Lack of awareness in fish production and consumption	Yes	4	10.81	6	28.57	5	11.36	2	10.53	4	30.77	1	5	22	14.29
Fishery regulation problem	Yes	28	75.68	18	85.71	44	100	2	20.53	3	23.08	7	35	102	66.23
Theft problem	Yes	12	32.43	1	4.76	3	6.82	1	5.26	-	-	9	45	26	16.88
Water pollution due to chemical inflow to lake/ reservior	Yes	8	21.62	3	14.29	32	72.73	-	-	-	-	1	5	44	28.57
Climate change	Yes	16	43.24	6	30	34	77.27	-	-	1	7.69	3	15	60	29.22
Water hyacinth problem	Yes	8	21.62	-	-	4	9.09	-	-	-	-	1	5	13	8.50

Source: Own survey results, 2018.

Conclusions and recommendations

Conclusions

This study was conducted in East Shoa Zone at Zeway lake, Koka reservior and Beseka Lake fishery cooperative, West Arsi Zone at Langano lake fishery cooperative, Horro Guduru Wollega Zone at Fincha Reservoir fishery cooperative and Jimma Zone at Gilgel-Gibe reservoir fishery cooperative in 2018. The objectives of this study are to assess the current status and performance of fishery cooperatives, to assess factors that affect saving practice of fishermen**,** to assess role of women in fishery cooperative, to identify the major challenges of fishermen in selected water bodies. To address the objectives of the study, both quantitative and qualitative method were used to collect the data from primary and secondary sources using structured questionnaires, key informants interview, Focus Group Discussion and reviewing relevant literatures.

The study used a three-stage sampling procedure in which three lakes and three reservoirs were selected purposively and then, fishery cooperatives were selected purposively. At third stage simple random sampling technique applied to select the sample respondents in proportion to size. Descriptive statistical tools such as frequency, percentage, mean, and standard deviation were used to analyze the quantitative data and documents analysis and focus group discussion used. The results for sex and marital status shows that majority of 151(98.05%), 126 (61.69) and 95 (81.82) of the respondents were male, married and attend primary education respectively. As far as the socio-demographic characteristics of the respondents is concerned, the results reveal that the family size, average age, and fishing experience of the respondents were 5.46, 34.39 and 13.62with the standard deviation of 9.85, 11.04 and 3.58respectively.

According to this study, nile tilapia, catfish, common carp and curcian carp were the commercial fish species at selected water bodies. The major constraints that affect fishermen were lack of improved fishing technologies, low fish yield, low price of fish, expansion of illegal fishermen and traders, overexploitation of fish stock, transportation problem, lack of market access and market place, low demand for fish consumption, low awareness in fish production and consumption, fishery regulation problem, theft problem (stolen of fishing equipments), lakes/reservior pollution due to chemical inflows, climate change, Water hyacinth problem and lack of support for this sector from governments and NGOs. With

regard to extension service, 33(21.43%) of them did get extension service since 2018. Again the results of the study show that 37 (24.03%) of the respondents have access to credit service respectively.

Results of the Tobit model applied in this study reveal that family size of household, access of fishing equipment, number livestock unit, credit access of household and annual income from farming of household are significant determinants of saving decision.

Recommendations

Based on the results of the study the following points were recommended:

- The current pressure on the Lakes/Reservoirs threatens sustainability of the fishery and hence management system of the Lakes/Reservoirs should be addressed though sustainable management of the Lakes/Reservoirs watershed.
- Woreda level livestock and cooperative offices should be conduct fish stock assessment before organizing any new fishery cooperatives in the Lakes/Reservoirs in the study area.
- Rights and responsibilities should be bestowed on fishing communities to restore, protect and manage local aquatic and coastal ecosystems on water bodies.
- Government agencies should create enabling legislation and policy framework that would separate fisheries cooperatives members with unorganized fishermen that would alleviate cheating gears or catch fish and conflict between members and fishermen.
- Policies for alternative markets, credit and income source, and with members can help empower fisheries cooperatives
- Accessibility of fishing technologies should be improved through strengthen both public and private partnership involved in disseminating and supporting fishing communities.
- Accommodative credit policy should be employed; meaning that **MFI**s and other development agencies need to introduce credit policies targeting low income fisheries communities.
- To improve women in fishing activities and saving practices emphasis should be given for women by improving in access to boats/gear, equipment and markets through providing credits services.

- ❖ To improve the saving behavior of fishermen in the study areas, the households should able to avoid negative personal saving habits that may impair its saving behavior and adopt good saving practices even at small amount of income.
- ❖ Finally, it is recommended that the government and other concerned bodies should provide capacity building training on awareness, culture and attitude of saving to boost the level of fishermen saving.

References

Abdelkhalek, T., Arestoff, F., Mekkaoui de Freitas, N., and Mage, S. (2009). A Microeconometric Analysis of Households Savings Determinants in Morocco. http://basepub.dauphine.fr/bitstream/handle/123456789/5550/A27CA046d01.pdf.

Abegaz H, Gashaw T, Abebe Ch (2010). Fishery Development Program: Riverine Fishery Assessment in Gambella Peoples' Regional State. Report for Agricultural Extension Directorate, Ethiopia.

ACP Fish II. 2013. Final Technical Report: Provision of Technical Assistance to review and improve the catch and effort data recording system (CEDRS) and deliver basic training in stock assessment in Ethiopia. 159 pp.

Breuil, Christophe. Grima, Damien. 2014. Baseline Report Ethiopia. Fisheries in the ESA-IO Region: Profile and Trends SmartFish Programme of the Indian Ocean Commission, Fisheries Management FAO component, Ebene, Mauritius. 24 pp.

CSA 2005 National Statistics Archived 2008-07-31 at the Wayback Machine

Dayanandan (2014). Fishery management by people organization for livelihood enhancement: Evidence from Ethiopia. College of Business and Economics Hawassa University.

Deacon R.T. (2012). Fishery Management by Harvester Cooperatives

Degu A.2007. Household Savings Behavior and Determinants of Savings in Rural Savings and Credit Cooperatives In Selected Districts of Western Amhara Region, Ethiopia. An MSc Thesis Presented to The School of Graduate Studies of Haramaya University, Ethiopia.

Endebu M, Lema A, Genet T, Mitike 1, Regassa B, Dejen E and Abegaz H. 2015. Fisheries Baseline Survey Describing Status of Fisheries in Lake Zeway,Ethiopia. Journal of Fisheries and Livestock Production.

FAO. 2003-2015. Fishery and Aquaculture Country Profiles. Ethiopia (2003). Country Profile Fact Sheets. FAO Fisheries and Aquaculture Department [online]. Rome. Updated 1 January 2003. [Cited 13 July 2015]. http://www.fao.org/fishery/facp/ETH/en

FAO. 2009. National Aquaculture Development Strategy of Ethiopia. Addis Ababa. FAO. 33 pp.

Getachew Senbete. 2015. Fisheries and Crocodile Resource Potential of Lake Beseka,East Shoa Zone, Ethiopia. International Journal of Fisheries and Aquatic Studies 2015; 3(1): 308-311.

Gizework Messele.2015. Assessment Of Factors Affecting Saving Practices Of Members Of Rural Saving and Credit Cooperatives (The Case Of Gamo Gofa Zone, SNNPRS),Hawassa University, Ethiopia.

Janko, A (2014). Fish Production, Consumption and Management in Ethiopia. International Journal of Economics and Management 3:183.

Kebede A, Meko T, Hussein A, Tamiru Y (2017). Review on Opportunities and Constraints of Fishery in Ethiopia. International Journal Poultry Fish Science 1(1):1-8.

Mahmoud, Touny A. (2008). Determinants of Domestic Saving Performance in Egypt: An Empirical Study. Retrieved May 7, 2011, from faculty.ksu.edu.sa/.../Mahmoud%20Touny

Ochan Dorgi. (2014). The Role of Cooperative Agency in Promoting Agricultural Cooperatives in a Country. The Case of Gog Woreda, Southern Gam-bella, Ethiopia. Journal of Business Management & Social Sciences Research (JBM&SSR).Vol 4, No.3

OECD. 2018. OECD-FAO Agricultural Outlook #AgOutlook [online]. www.agri-outlook.org [cited 9 March 2018]. Paris.

Pailwar, Veena K., Kaur, Jaspreet., Saxena, Khushboo., and Nijhara, Mitesh. (2010). Impact of Membership of Financial Institutions on Rural Saving: A Micro-Level Study. EABR & ETLC Conference Proceedings Dublin, Ireland

Rehman, H., Faridi, M. Z. and Bashir, F. (2010). Households Saving behaviour in Pakistan: A case of Multan district. Pakistan Journal of Social Sciences, 30(1), 17-29

Robert Mepham, R. H. Hughes, and J. S. Hughes, A directory of African wetlands, (Cambridge: IUCN, UNEP and WCMC, 1992), p. 15.

Samuel Kinde. 2002. Earthquake Risks in Addis Ababa and other Major Ethiopian Cities – Will the Country be Caught Off-guarded?" published March 2002 (accessed 4 June 2008).

Splett, N. S., P. J. Barry, B. L. Dixon, and P. N. Ellinger. 1994. “A Joint Experience and Statistical Approach to Credit Scoring.” Agr. Fin. Rev. 54(1994):39S54.

Tesfaye G, Wolff M (2014). The state of inland fisheries in Ethiopia: a synopsis with updated estimates of potential yield. Ecohydrology and Hydrobiology 14:200-219.

Tessema Z. Hydrochemical and Water Balance Approach in the Study of High Water Level Rise of Lake Beseka. M.Sc. thesis, University of Birmingham, UK, 1998.

Von Damm K. and Edmond I (1984). Reverse weathering in the closed basin lakes of Ethiopian Rift. Amer. J. Sci., 284:835-862LFDP, 1997

Yared Tigabu (2003). The current status of Lake Ziway. In: Wetlands and Aquatic Resources of Ethiopia: Status, Challenges and Prospects. Proceeding of the workshop organized by Biological Society of Ethiopia, Addis Ababa, Ethiopia. Pp. 1-10.Splett, et. al. [1994]

Zegeye Paulos Borko 2018. Determinants of Household Saving the case of Boditi Town, Wolaita Zone, Ethiopia. (2018). Journal of Banking and Finance Management, 1(3), pp.11-19.

Impact of Integrated Soil and Water Conservation Practices on Farm Household Income in East Harerghe Zone of Oromiya Region, Ethiopia

Kibret Ketema, Jafer Mume, Solomon Ayele, Hussein Abro and Roobe Elemo
Oromia Agricultural Research Institute, Fedis Agricultural Research Centre,
P.O. Box 904, Harar, Ethiopia
Corresponding authors E-mail: kebret2012@gmail.com

Abstract

This study aims at assessing the impact of Soil and Water Conservation (SWC) interventions on farm household income and farmers' perception towards implementation of SWC practices in East Harerghe Zone of Oromia Region, Ethiopia. Multi-stage sampling procedures were employed to selected a total of 283 sample households, consisting 133 SWC participant and 150 non-participant households. Primary data were collected from sampled households through household survey using semi structured interview schedule. The collected data were analyzed using descriptive statistics, logit and PSM models. The analysis of farmers' perceiption on soil erosion problem showed that the majority of the sampled households (79.8%) perceived that soil erosion as severe problem before the SWC intervention in the study area. The household survey and group discussions revealed that farmers were strongly agreed that SWC practices has a positive effect on increasing availability of water resources, livestock feeds, crop yield, household income and in rehabilitating degraded lands. The PSM model result indicated that the SWC intervention has increased crop production value and annual income of the SWC participant farmers by 11,085 and 14,933.24 Birr respectively comared with that of non-participants. The result of logit model showed that farmers participation in SWC practices were significantly influenced by age of household head, educational level, livestock ownership, farming experience, extension contact, distance to main market and perceived erosion problem in the study area. Hence, such SWC interventions should consider variations among the households at planning and implementation of SWC practices. Moreover, strengthening extension services, encouraging participation of the communities and providing other institutional supports should be considered.

Key words: *Soil erosion; Soil and Water Conservation; Perception; Impact; Income; PSM; East Hararghe*

Introduction

The Economy of many developing countries, including Ethiopia, is heavily dependent on agriculture, and the livelihoods of the majority of their populations depend on this sector. Ethiopian economy is mainly based on agriculture which is the source of livelihood for the majority of its population (CSA, 2016). The sector accounts for nearly 45% of GDP, 90% of export revenue, and source of livelihood for more than 82% population of the country (FAO, 2010). Thus, agriculture is not only an economic activity but also a way of life for the Ethiopian nations, in turn; agricultural land is also the critical resource and the basis for survival of the vast majority of the population of the country.

Land degradation in the form of soil erosion is a serious global problem which affects 33% of the land surface; with consequences for more than 2.5 billion people, and about 40% of the world's agricultural land is seriously degraded, where 80% of this degradation is caused by soil erosion and nutrient depletion (Angima, *etal*, 2003; Graaff *etal*, 2009). Soil erosion refers to the wearing away of the land surface by water and/or wind as well as to the reduction in soil productivity due to physical loss of topsoil and removal of plant nutrients (Keith, 2006). This signifies that soil erosion is just one form of land degradation (Hudson and Ayala 2006).

In Ethiopia, the problem of land resources degradation due to soil erosion is well known and considered as one of the major problems constraining the development of the agricultural sector in the country (Berhane *et al*., 2011; Meseret M. and Dawit D., 2019). The problem is particularly severe on cultivated and sloping lands because such area generally susceptible to soil erosion (Kassa *et al*., 2004). The estimated costs of land degradation range from 2 to 3% of agricultural gross domestic product (GDP) of the country per annual (FDRE, 2015, Tesfaye *et al*., 2014; Haregeweyn *et al.*, 2015). The excessive dependence of the Ethiopian rural population on natural resources, particularly land, as a means of livelihood is an underlying cause for land and other natural resources degradation (EPA, 2004). The immediate consequence of soil erosion is reducing crop yields, which leads to economic decline and increasing social stress. According to Wagayehu Bekele (2003) soil erosion is considered to be among the major factors responsible for the recurrent malnutrition and famine problems in the country as it reduces yield and income and poses a threat to household food security.

Ethiopia's highlands, more than 2 million hectares of land have been degraded beyond rehabilitation, and additional 14 million hectares severely degraded, which is reflected in cereal yield reduction averaging less than 1.2 tons per hectare in most of the highland areas of the country (IJEMA, 2013).This indicated that the problem is particularly much more severe on sloping cultivated lands and the highland areas of the country where, 85% of the human and 77% of livestock population are living (Gete, 2000, Million and Belay, 2004). As a result of this soil erosion, which in turn are caused, ultimately reducing the land size and low level of productivity and agricultural production has not been able to meet the food requirements of the growing population of the country, and thereby requiring external aid every year for their survival (Gete *et al*.,2006).

Similarly, the problem of soil erosion is severe in East Harerghe Zone of Oromia Regional State where, the land resources are under extreme stress to support the ever increasing population, and soil erosion combined with climate change is one of the major constraints affecting the livelihoods of the smallholder farmers in the Zone (EHZECO, 2018). The problem is aggravated by overgrazing, expansion of cultivated land into marginal and steeply sloping terrains and continuous use of the land. This leads to sever land degradation that causes huge losses of the top soil to erosion through runoff and floods, and gully formation in the study area.

As any part of the country, the government of Ethiopia has made multiple efforts to overcome the soil erosion problem in the stud area. As a result, different soil and water conservation measures have been widely implemented on farmlands and closure area through community based participatory watershed development mainly through community participation for the past seven years. The intervention was aimed at rehabilitating the degraded lands and improving the livelihoods of smallholder farmers through promotion of integrated SWC practices in the study area. However, studies focusing on impact of SWC practices on farm household income and farmers' perceptions toward the intervention were not conducted so far in the study area. Meanwhile major constraints existed in relation to implementation of SWC practices have not been thoroughly examined in the study area. Therefore, this study was proposed to assess the impact of SWC practices on farm household income, and farmers' perceptions toward the SWC interventions in the study area.

Objectives of the study

The study had the following specific objectives

- To assess the impact of soil and water conservation practices on farm household' income in the study area,
- To assess farmers' perceptions towards the soil and water conservation intervention, and
- To identify constraints and opportunities existed in relation to implementation of soil and water conservation practices in the study area.

Methodology

Description of study area

The East Harerghe Zone is located in the eastern part of the country. The Zone lies between $7^0 32^1$N to $9^0 44^1$Nand 41^0 10^1E to $43^0 16^1$E and demarcated by West Hararge Zone from the west, Bale Zone from the south, Somali regional state from the East and Southeast, and Dire Dawa administrative council from the North. East Hararge Zone has three major agro-ecologies namely lowland, midland and high land. The lowland accounts (67.76%) followed by midland (24.57%) and highland (7.67%) agro-ecologies.

The East Hararghe zone lies within altitude of 500 to 3405 meter above sea level. The annual rainfall of the zone is ranges between 400 to 1010 mm, and the annual temperature also ranges between 14 ^{o}c to 25^{o}c (EHZ FEDO, 2018). The Zone has a total of 26,308.60 km^2 of land. From the total land, 22.9% is cultivated land, 34.16% forest and wood land, 28.33% degraded land, 4.12% grazing land, 4.22% shrub and bush land, and 6.18% land used for social purposes.

The total population in the Zone was 3,490,222of which 50.80% are male and 49.20% are female (EHZ FEDO, 2018).The major source of livelihoods for the population of the Zone is agriculture. It is characterized by smallholder mixed farming system where crop production and livestock rearing are simultaneously practiced.

Sampling procedure and sample size

Multi-stage sampling procedure was applied to select representative districts, kebeles and sample farm households in East Hararghe Zone. Representative districts, Kebeles and sample farm households were selected on the basis of SWC intervention. Initially, three districts namely Deder, Kersa and Fadis districts were selected purposively based on the existence of SWC practices on farmland and communal lands through community's participation for the past seven years.

Next, kebeles in the selected districts were categorized as SWC intervention and non-intervention kebeles. Then from SWC intervention kebeles, four kebeles were selected purposively based on implementation of SWC practices. Meanwhile from sampled districts, four kebeles were chosen purposively as non intervention kebeles based on their close similarity to the SWC intervention kebeles in their agro-climatic, topography and socioeconomic characteristics. Finally, a total of 283 farm households (133 participant and 150 non-participant farm households) were selected for the household survey by using systematic random sampling technique and based on probability proportional to size. In addition, four focus group discussions were held with a group of 15-20 farmers.

Method of data collection

In this study, both qualitative and quantitative data types were collected from primary and secondary sources. Primary data were collected from farm households and key informants who are participants and non- participants in the SWC intervention through household survey using semi-structured questionnaire. In addition to this, primary data were collected from key informants and communities through group discussions using checklists. Field observations also conducted to supplement primary data collected through individual interviews and group discussion in the study area. Secondary data were collected from Zone and districts agricultural and natural resource offices working in the areas, and different published and un published reports on soil and water conservation intervention in the area.

Methods of data analysis

Based on the objectives of this study, both descriptive analysis and econometric models were employed to analyze data and come up with the results. As statistical tools, STATA version 11 was used for data analysis both for descriptive and econometric models.

Descriptive statistics

By applying descriptive statistics, one can compare and contrast different categories of sample units with respect to the desired characteristics. It is used to explain the different socio-economic, institutional and other characteristics of the sample households. Accordingly, in this study the collected data were analyzed using descriptive statistics like mean, standard deviations, percentage, frequency, chi square test and t-test to test whether there is significant difference between the SWC participant (treated group) and non-participant (non-treated group) farm households participants in terms of the selected variables in the study area. The statistical significance of the variables was tested for both dummy and continuous variables using chi-square and t-tests, respectively. In addition, the qualitative data such as farmers' perceptions collected through group discussions were analyzed by ranking and narrating methods.

Econometrics analysis

In this study, Logit model was used to analyze the determinants of farmers' participation in SWC and to estimate propensity scores using a composite of pre- intervention characteristics of the sampled households, and matching was performed using propensity scores. In estimating the logit model, the dependent variable for participation, which takes the value of 1 if a household participated in the SWC and 0 otherwise. Following Liao (1994), Gujarati (2003) and Aldrich and Nelson (1984) the logistic distribution function for farm households participating in SWC practices mathematically as follows:-

$$P_i = \frac{1}{1+e^{-Zi}} = \frac{e^{Zi}}{1+e^{Zi}} \quad (1)$$

Where, Pi = is the probability of participation in SWC for the i^{th} farmer and it ranges from 0-1.

e^{zi} = stands for the irrational number e to the power of Zi.

Zi = a function of n-explanatory variables which is also expressed as:

$$Zi = B_0+B_1X_1+B_2X_2+\ldots+B_nX_n \quad (2)$$

Where, X_1, X_2… X_n are explanatory variables.

B_0- is the intercept, B_1, B_2 … B_n are the logit parameters (slopes) of the equation in the model.

The slopes tell how the log-odds ratio in favour of participating in SWCchanges as an independent variable changes. The unobservable stimulus index Zi assumes any values and is actually a linear function of factors influencing decision of farm households participating in SWC. If Pi is the probability of participating in SWC then (1-Pi), the probability of not participating inSWC, can be written as:

$$1\text{-}Pi = \frac{1}{1 + e^{Zi}} \quad (3)$$

Therefore, the odds ratio can be written as:

$$\frac{Pi}{1-Pi} = \frac{1+e^{Zi}}{1+e^{-Zi}} = e^{Zi} \quad (4)$$

Now $\frac{Pi}{1-Pi}$is simply the odds ratio in favour of participating in SWC intervention. It is the ratio of the probability that the farmer would participate in SWC to the probability that he/she would not participate in it. Finally, taking the natural log of equation 4, the log of odds ratio can be written as:

$$Li = \ln\left(\frac{Pi}{1-Pi}\right) = ln\left(e^{Bo+\sum_{i=1}^{n} BiXi}\right) = Zi = Bo + \sum_{i=1}^{n} BiXi \quad (5)$$

Where, Li is log of the odds ratio in favour of farm households participating in SWC, which is not only linear in Xi, but also linear in the parameters. Thus, if the stochastic disturbance term, (Ui),is introduced, the logit model becomes:

$$Zi = B_0 + B_1X_1 + B_2X_2 + \ldots + B_nX_n + U_i \quad (6)$$

This model can be estimated using the iterative maximum likelihood (ML) estimation procedure.

In reality, the significant explanatory variables do not have the same level of impact on the participation in SWC. The relative effect of a given quantitative explanatory variable on the participation is measured by examining practice elasticity, defined as the percentage change in probabilities that would result from a percentage change in the value of these variables. To calculate the elasticity, one needs to select a variable of interest, compute the associated Pi, vary the Xi of interest by some small amount and re-compute the Pi, and then measure the rate of change as $\frac{dX_i}{dP_i}$ where dXi and dPi stand for percentage changes in the continuous explanatory variable (Xi) and in the associated probability level (Pi), respectively.

When dXi is very small, this rate of change is simply the derivative of Pi with respect to Xi and is expressed as follows (Aldrich and Nelson, 1984):

$$\frac{dX_i}{dP_i} = \frac{e^{Zi}}{(1+e^{Zi}).^2}B_i = P_{i(1-P_i)B_i} \quad (7)$$

Impact evaluation methods using Propensity Score Matching (PSM)

The first step in Propensity Score Matching (PSM) method is to estimate the propensity scores. In this study, a logistic model was used to estimate propensity scores using a composite of pre-participation characteristics of the sampled households (Rosenbaum and Robin, 1983) and matching is then performed using propensity scores of each observation. To analyze the factor affecting SWC practices practice, dependent variable is dichotomous in nature and represents the observed SWC practices. It was represented in the model as treated group =1 for a household that had participated in SWC intervention and non-treated=0 for a household that do not participated in SWC intervention.

The fundamental problem of such an impact evaluation is a missing data problem. Hence, in this study applies a propensity score matching technique, which is a widely applied impact evaluation instrument in the absence of baseline survey data for impact evaluation was used. According to Caliendo and Kopeinig (2005), there are steps in implementing PSM. These are estimation of the propensity scores, choosing a matching algorism, checking on common support condition and testing the matching quality. Imposing a common support condition ensures that any combination of characteristics observed in the treatment group can also be observed among the control group (Bryson *et al*., 2002). The common support region is the area which contains the minimum and maximum propensity scores of treatment and control group households, respectively.

For any SWC practices practicing household, there should be non-participating household with closest propensity score as the match. To accomplish the match, the nearest neighbour (equal weights version) was tested. The nearest neighbour method simply identifies for each household the closest twin in the opposite participating group. Caliper matching which means that an individual from the comparison (non-treated) group was also tested as a matching partner for a treated individual that lies within a given caliper (propensity score range) and is closest in terms of propensity score and kernel matching estimators was also

tested. However, for this specific study kernel matching was used to evaluate impact of SWC intervention on farm household income in study area. This is matching method whereby all treated units are matched with a weighted average of all controls with weights which are inversely proportional to the distance between the propensity scores of treated and controls Becker and Ichino (2002) Venetoklis (2004).

It then computes an estimate of the SWC practices effect as the average difference in households' outcome variable between each pair of matched households. The impact of SWC intervention for an individual *i*, noted δ_i, is defined as the difference between the potential outcome in case of farm households participate in SWC and the potential outcome in absence of participation in SWC using PSM.

$$\delta_i = Y_{1i} - Y_{0i} \quad (8)$$

In general, an evaluation seeks to estimate the mean impact of the SWC intervention is obtained by averaging the impact across all the individuals in the population. This parameter is known as Average Treatment Effect or ATE:

$$ATE = E(\delta) = E(Y_1 - Y_0) \quad (9)$$

Where $E(.)$ represents the average (or expected value). Another quantity of interest is the Average treatment effect on the treated or ATT, which measures the impact of the treatment on those individuals who participated in SWC intervention:

$$ATT = E(Y_1 - Y_0 | D = 1) \quad (10)$$

Finally, the Average Treatment Effect on the Untreated (ATU) measures the impact that the treatment would have had on those who did not participating in SWC intervention:

$$ATU = E(Y_1 - Y_0 | D = 0) \quad (11)$$

The problem is that, all of these parameters are not observable, since they depend on counterfactual outcomes. For instance, using the fact that the average of a difference is the difference of the averages, the ATT can be rewritten as:

$$ATT = E(Y_1 | D = 1) - E(Y_0 | D = 1) \quad (12)$$

The second term, $E(Y_0 \mid D=1)$ is the average outcome that the treated individuals would have obtained in absence of treatment, which is not observed. However, we do observe the term $E(Y_0 \mid D=0)$ that is, the value of Y_0 for the untreated individuals.

$$ATT = E(Y_1 \mid D=1) - E(Y_0 \mid D=0) \quad (13)$$

Results and discussion

Descriptive statistics results

Socioeconomics characteristics of sample households (continuous variables)

The survey result indicated that that the mean age of the total sample farm households was 41.20years with the minimum and maximum ages of 20 and 75 years (Table 1).The mean age of SWC participant households were 42.68 years compared to 40.24 years for non-participate households with mean age difference between the two groups being statistically significant at 5 percent significance level (Table 1). The study showed that, there was statistically significant difference in age between the two groups and related positively with implementation of soil and water conservation practices in the study area. This trend has significant implication for as elderly farmers might be high interested in the use of SWC practices. The result in line with the finding of Abebe (2015) who indicated that age of respondent may not be important in influencing decision of soil and water conservation practices.

The survey result showed that the mean educational level of SWC participant households was 4.37 years of schooling while that of non-participant households was 3.26 years of schooling (Table 1). The mean difference of the two groups is statistically significant at less than 5 percent of probability level. It shows that, on average participant households have more years of formal schooling years as compared to that of non-participants in SWC in the study area. The result reported by the finding of Addisu (2011) revealed that technology adoption increased with the educational level of the farm household heads. Rezvanfar *et al*. (2009) also observed that educational level correlates positively with the use of conservation measures.

The mean family size of the total sample households was 6.52 persons ranging from 2 to 13 persons, which is higher than the national average of 5 persons (CSA, 2007). The survey result indicated the mean family size of SWC participant and non-participant

households were 6.74and 6.32 persons respectively in the study area (Table 1). The study result showed that the SWC participant households have relatively larger family sizes than non-participant households with mean difference being statistically significant at 10 percent level of significance. The results of this study is in line with the findings of Kebede and Mesele (2014) showing that large families can provide more practicing that help in maintaining and repairing damaged SWC structures.

The mean of land holding of the households were 0.37 ha for total sample households in the study area. The result is in line with prior study by Mengistu Ketema *et al.* (2016) that average land holding in the study area is 0.51 ha which is very low as compared to the holdings in other parts of the country.The mean of land holding of the sample households were 0.41ha for SWC participant and0.35 ha for non-participant households in the study area. The mean difference of landholding between participant and non-participant households found to be statistically significant at 5 percent level of significance (Table 1). This indicated that farmers with large land holding were the SWC practices than who had small land holding. This result agreed with the finding of Mushir and Kedru (2012) and Debebe *et al*. (2013) indicated that household farmers having smaller land holding were less likely to practices in SWC measures.

Regarding farming experience, on average SWC participant households have more number of years of farming experience (23.06 years) than non-participant households (20.47 years) with statistically significant mean difference at 5% level (Table 1). This might be positively contributing to participation and use of improved SWC practices in the study area because long experienced farmers understands the problem of soil erosion on his /her farmlands. This result was synonymous with the findings of Alemayehu (2014) and which showed that the older household heads had, the higher the probability of conserving and using soil and water conservation technologies and experienced farmers are capable of detecting soil erosion problem more than inexperienced farmers.

Livestock holding is very important asset and indicator of wealth for farm households in the study areas. As a result all of the sample households reared livestock, which constituted cattle, small ruminants, pack animals and chickens in the study area. On average, the sample households kept about 2.56 in TLU. The minimum number of livestock kept was 0.92 in TLU

whereas the maximum was 3.84 in TLU in the study area (Table 1). This is relatively large in mixed farming system where land holdings are very small, shortage of grazing areas and shortage of feed resources are challenging the livestock holdings of the farm households in the study area. The participant households owned relatively larger number of livestock (2.90 TLU) than non-participants in integrated soil and water conservation practices (1.72 TLU), with a statistically significant mean difference at 1 percent level of significance.

Table 1. Socioeconomic characteristics of the sample households in the study area

Variables	Total sample HHs (N=283)		Participants HHs(N=133)		Non-participants (N=150)		t-value
	Mean	SD	Mean	SD	Mean	SD	
Age of household heads	41.20	10.20	42.68	10.13	40.14	10.16	2.36**
Educational level	3.72	3.46	4.21	3.52	3.26	3.35	2.32**
Family size	6.52	2.11	6.44	2.24	6.35	1.97	1.29
Farming experience	21.33	10.60	23.06	9.56	20.47	10.89	2.53**
Land holding (ha)	0.37	0.22	0.41	0.24	0.35	0.15	0.92
Number of farm plots	2.62	1.30	3.68	2.13	2.58	1.88	2.58**
Livestock ownership (TLU)	2.56	1.24	2.90	1.37	1.72	1.03	4.63***

Source: Household survey result, 2019
** and *** indicate the level of significance at 5 and 1 percent, respectively

Sex of the household head is an important variable that may influence the participation of the households in soil and water conservation practices. The survey result indicated that from the total sample households, about 88.3 of the sample households were male headed households (Table 2). The survey result also shows that from the participant households, about 92.5 percent participants are male and 7.5 percent participants are female, while out of the non participant households, about 84.7 percent of the non participant households are male and the remaining 15.3 percent of non participant households are female households in the study area. With regard to marital status, the survey result shows that out the total respondents, about 96.7 percent of the sample respondents were married while about 2.66 percent and 0.66 percent were single and divorced, respectively.

Table 2. Demographic characteristics of the sample households (dummy variables)

Variables	Category	Total sample HHs (N=283)		Participants (N=133)		Non-participants (N=150)	
		N	%	N	%	N	%
Sex of household head	Male	250	88.3	123	92.5	127	84.7
	Female	33	11.7	10	7.5	23	15.3
	Married	271	95.8	126	94.7	145	96.7
Marital status of HH	Single	10	3.5	6	4.5	4	2.7
	Widowed	2	0.7	1	0.8	1	0.7

Source: Household survey result, 2019

Institutional support services

Availability of effiecient institutional services play a crucial role to increase agricultural production and productivity. Such institutions and institutional support services include extension services, market services, credit facilities and farmers organizations. The result of the survey indicated that the average frequency of extension contact per year on soil and water conservation was 5.34 and 3.20 for the participant and non-participant households respectively with a statistically significant mean difference at 1 percent level of significance (Table 3). This implies that farm households who have close contact with development agents and experts are more likely to participate in SWC intervention than those who has no or less contact with natural resource development agents and experts in the study area.The result indicated that the farmers have low extension contact with development agents and experts on use of improve soil and water conservation prtactices in the study area. The farmers got extension advices from government organizations through development agents and experts and NGOs, but it needs to be strengthnen the extension services on use of soil and water conservation prtactices in the study areas.

Regarding access to training on implementation of SWC practices, according to the survey results, about 86.50% of the participant farm households have got training on the importance and implementation of improved soil and water conservation practices while the remaining 13.5% did not receive any types of trainings. Frequent training on the importance of soil and water conservation practices is paramount important to maximize agricultural production. Moreover, accessing of information about SWC from different sources is also important for their implementation of improved SWC practices. Accordingly, about 83.7% of

the participant households accessed information from govermnent and non-governmental organizations in the study area. Previous studies indicated, contact with local extension workers, and access to training on soil conservation technologies improve farmers participation in soil conservation practices (Birhanu and Meseret 2013; Atnafe *et al*. 2015; Sinore *et al*. 2018).

Market service is another institutional factor that affects agricultural production and the benefit generated from the sector in general. Access to market is one of the key constraints in successful participation of smallholder farmers in market oriented agricultural production. Proximity to the market is one of those key institutional variables that must be taken in to account in actions targeting to improve marketing, and productivity of smallholder framers. The survey result showed that the average walking distanceto the main market place was 131.72 minutes for participants while non participants had to walk for 148.60 minutes to sell their product to the nearest market place. The walking times to the main market for participants and non participants are statistically significantly different at 5 percent. This implies that farmers who are close to markets are more likely to participate in SWC intervention than those who reside far from the main market in the study area.

Table 3. Institutional characteristics of sample households in the study area

Institutional services	Total sample HHs (N=283)		Participants (N=133)		Non-participants (N=150)		t-value
	Mean	SD	Mean	SD	Mean	SD	
Extension contact per year	4.23	3.70	5.34	3.87	3.20	3.18	5.21***
Distance to the market (minutes)	140.27	96.57	131.72	75.30	148.60	82.14	2.37**
Distance to cooperative (minutes)	41.82	24.75	40.67	20.56	42.83	29.18	0.73

Source: Household survey result, 2019

Regarding to credit services, the survey result further indicated that from the total sample households, the majority of the sample houseeholds (97.88%) did not get credit services for thier implementation of SWC practices on thier farmlands in the study area (Table 4). Few farmers had access to credit for fattening practices in the study area. The major credit

providers in thestudy areas were microfinance institutions and t non-governmental organizations.

Table 4. Institutional characteristics of sample households in the study area

Institutional services	Total sample HHs (N=283)		Participant HHs (N=133)		Non-participant HHs (N=150)	
	Frequency	%	Frequency	%	Frequency	%
Access to credit service (no)	277	97.88	129	96.99	148	98.66
Access to market information(yes)	250	88.34	127	95.49	123	82

Source: Household survey result, 2019

Income of sample households

The average farm income realized by the SWC participant and non-participant households were 43,390 and 28622 Birr, respectively, with mean difference being statistically significant at less 1% level (Table 5). The highest portion of the cash income is earned from crops, which constitutes 62.62 and 57% of the total income for participants and non-participants, respectively. This difference is due mainly to the fact that the participant farmers in the areas produce and sell high-value cash crops in the study area. The study was supported by the finding of Tesfaye (2011) indicated that watershed management practices improve the household incomes at different level. The result was in line with prior study by Mengistu Ketema *et al*. (2016) that farm household generates annual farm income of about 28,125 birr.

Table 5. Annual farm income of sample householdsin the study area

Income types	Total sample HHs (N=283)		Participants (N=133)		Non-participants (N=150)		t-value
	Mean	SD	Mean	SD	Mean	SD	
Value of crop production (Birr)	22653.5	14008	26909	15292	18398	11241	3.36***
Sales of animals, and products (Birr)	10624	8150	12695	10624	8553	10675	2.05**
Off/non-farm income(Birr)	3728.5	6816	3786	8409	3671	4919	1.14
Household income (Birr)	37006	16020	43390	15483	28622	13109	5.36***

Farmers' perception of soil erosion problem

The survey result indicated that the majority of the SWC participant farmers were perceived erosion as sever problem on their farmland (Table 6)**.** Similarly, farmers during focus group discussion, the participants reported that erosion was main problem, and results land degradation and gulley formation was common problem before intervention in the area.

The survey result shows that higher proportions of the total sampled households were aware about the problem of soil erosion on thier farm lands in the study area. The result of the study showed that the majority of thetotal farm households (79.8%) perceived soil erosion on their farm land assevere problem in the area before the soil and water conservation intervention in the study area. Analysis of responses of participants and non participant households on the severity ofsoil erosion problem on their farm land shows that about 54.9% perceived very severe, 34.6% sever and 10.5% less severe problem where as for non participant householdsthe severity ofsoil erosion problem on their farm land shows that about 25.3% perceived very severe, 46.1% sever, 15.3% less severe and 13.3% no erosion problem in the areas (Table 6).

As a result of erosion, out of the total sample households, the majority of the sample households, 95% reported that befoere SWC intervention soil erosion was brought sever depletion of soil fertility and land productivity decline, and 92% suggested that soil erosion results that gully formation which reduces farm size, and 82% sedimentation of water sources at down streams which reduces water resources in the area.The result of this study agrees with Tesfaye and Kasahun (2015), and Gebre *et al*. (2013) they reported, most farmers easily identify the problem of soil erosion in their crop land, and the farmers understanding on soil erosion problems determine their engagement in soil and water conservation practices. Shimeles (2013) also reported that the farmers perception and understanding about the degree of erosion problem on their land govern their willingness and participation in soil and water conservation activities.

Table 6. Farmers' perception of soil erosion problem in the study area

Severity of soil erosion problem	Total sample (N=283)		Participants HHs (N=133)		Non-participants (N=150)		χ^2-value
	N	%	N	%	N	%	
Very severe	111	39.2	73	54.9	38	25.3	
Severe	115	40.6	46	34.6	69	46.1	
Less severe	37	13.1	14	10.5	23	15.3	19.32***
No erosion	20	7.1	-	-	20	13.3	

Source: Survey result, 2019 *** means significant at less than 1% probability level

Major causes of soil erosion in the study area

Regarding the perception of the households to the main causes of soil erosion on their farm lands, the sample households reported that, deforestation, cultivation of steep slopes, high runoff, limited use of improved agricultural practices, and limited use of soil and water conservation practices were report**e**d as the main causes for land degradation in the study area. The survey result also indicates that the households ranked deforestation, runoff, and cultivation of steep slopesand limited use of improved agricultural practices as the first, second, third and fourth reasons for soil erosion in the study area. The result of focus group discussions conducted with the farmers in the area also confirmed that before intervention in the area, soil erosion is a sever problem areas due to high deforestation, cultivation of sloping lands, high runoff and overgrazingwhich leads to sever soil erosion and uncontrolled rainfall run-off in the area.

Farm households who have farm lands in areas which are more prone to soil erosion such as steep slopes, are expected to experience more soil erosion and therefore recognize the impact of top soil loss and loss of plots due to gully formation than households with farm lands located on flat and gentle areas. Hence, the slope of farm lands was highly related to the degree of involvement in SWC conservation practices in a given area. As to the farmers' view, from the total sample households, majority of their lands (62.8%) were found on steep slopes in the study area. The remaining, 13% and 24.20% were their lands located on flat and gentle sloping lands, respectively. Theresult was supported by the finding of Akalu *et al*. (2014) who indicated that farmers who had farm land in steeply sloping areas were

more adapted to stone and soil bunds. Atnafe *et al.* (2015) also reported as the slope gradient of cropland increases the probability of farmers use soil and water conservation practices.

Major soil and water conservation practices in the study area

Group discussion and survey farmers reported that since 2001 E.C different types of soil and water conservation practices were introduced to the area through government soil and water conservation programsto the area.The survey result showed that the sample farm households used different SWC practices in their farmland for the purpose of conserving soil and water resources. Among these SWC practices, soil bund, stone bund, stone faced soil bund, check dam,grass strips and agroforestry were the most commonly used by sample farm households in the study area.Accordingly, majority(86.45%) of the SWC particpants practiced soil bunds followed by stone bund(71.43%), stone faced soil bund (69%) and soil/stone bund with grasses (48.87%) (Table 7).

Table 7. SWCpractices implementing by sample households in the study area

Type of SWC practices	Frequency (%)
Stone bund	95 (71.43%)
Soil bund	117 (86.45%)
Stone faced soil bund	92(69%)
Soil/stone bund with grass strip	65(48.87%)
Cut-off drain	46 (35.59%)
Check-dam	11 (8.27%)
Agro forestry	42 (31.58%)
Integrated SWCP	13(9.77%)

Source: Survey result, 2019, Note that there are multiple responses

The group discussions partcipant farmers mentioned that different terraces and gully treatment structures were the main SWC interventions in the area.The partcipant farmers mentioned thatdifferent gully treatment structures such as stone check dam, gabion check dam,soil filled sack check dam,trenches, hillside terrace, diffenet pits and tree planting has been implementedon hilly and communal lands since 2001 E.Cthrough community participation in the study area.

During group discussions the participants mentioned that the major practices implemented on communal lands and area closures through community participation includestrenches, terrace,stone check dam and gabion for gully treatment has been implemented during the intervention, and structures such as eye borrow basin, half moon, micro basin, trench and traceswere constructed in the area closure,and planting of different multipurpose trees in the closure area.From the field observations through transect walk, the farmers maintained and use the SWC practices implemented through community participation and food for work in the area.

The farmers also practicing traditional SWC practicesfor the purpose of reduce runoff, soil conservation and water harvesting on thier farmland in the study area.The result shows that about 94% of the non-participant farmers were using traditional conservation practices on their farmland for the same purpose in study area.The result also shows that traditional earth/soil bund (94%), stone bund (42%), ridgies (58%)and stone check-dam (8.4%)were the most widely used traditional structures by the non participant households in study area.

Farmers' perception to soil erosion problem after SWC intervention

The survey result indicated that majority of participants households (94.74%) reported that the problem of soil erosion was reduced after intervention of SWC practices in the area (Table 8).Results from the group discussions also indicated the communities were practiced SWC practices both on farm lands and closures area, as a result soil erosion, runoff water and flood is receded after SWC intervention in area.

Table 8. Farmers perception to soil erosion problem after SWC intervention

Soil erosion problem	Frequency (%)
Reduced	126 (94.74%)
Aggravated	2(1.5%)
No change	5(3.76%)

Source: Survey result, 2019

The survey result indicated that majority of participants households (54.9%) reported that retained the SWC practices built by community participation on their farmlands in the area (Table 9).Results from the group discussions also indicated the communities are practiced

SWC practices both on farm lands and communal closures area, as a result soil erosion, runoff water and flood is reduced after SWC intervention in area.

Table 9. Participant households' responses to the current condition of SWC structures

Condition of the structures	Frequency (%)
Partially removed	10 (7.5%)
Completely removed	-
Reconstructed	50 (37.59%)
Retained	73 (54.9%)

Source: Household survey result, 2019

Farmers' perception toward effect of soil and water conservation intervention

Soil erosion reduction: the household survey result indicates that the majority of the participant households were strongly agreed that (58.65%) in reduced runoff and soil erosion due to SWC intervention in the area (Table 10). According to results in the group discussion the participant farmers are perceived and noted that high runoff and soil erosion has been decreased as compared to before intervention in the area, soil erosion is reducing gradually from year to year related to developed conservation structures. Result from field observation shows that farm lands and communal lands are treated with different SWC structures in the study area. The communal lands are closed from free grazing; and gullies are treated with different SWC practices in the study area. The result of the study supported by the findings of Fikir *et al*. (2009) and Sisay (2017) indicated that the major observed changes after the implementation of SWC measures are reduced of soil erosion.

Water resource availability: one of the major effects of SWC intervention was improving water resource availability in a given area. Increased water availability increased the household income, improve the crop production and also used for irrigation purpose. The household survey result indicates that the majority sample households (58.87%) agreed and perceived that SWC intervention was improved water resource availability in the area (Table 10).The group discussion participant farm households also reported that that the SWC activities improved springs and groundwater resources, and the farmers used it for irrigation and domestic purposes and resulted in improve the crop production and household income in the study area. This indicated that SWC practices improved the availability and use of water

resources in the study area. Previous study also showed that (Tireza *et al*. (2013) SWC intervention improved groundwater availability in the downstream.

Livestock feed resource availability: the survey result showed that that the households were also asked to suggest their views about the contribution of SWC intervention in improving animal feed availability in the area. Accordingly, majority the farm households (63.16%) perceived and agreed that the SWC intervention improved feed availability (Table 10).The result of different group discussions conducted with the farmers in the area also confirmed that the grasses and bushes regenerated in the area due to intervention, and the farmers were also grown different forage grasses on their farmlands so as to facilitate bund stabilization, and the grasses used as animal fodders which improved animal fodder availability in the study area.

Vegetation growth and coverage:-household results indicated that the participant households were asked to suggest their views about the contribution of SWC intervention in improving vegetation coverage in the watershed areas, majority of the participant households (54.89%) strongly agree that the SWC intervention improved vegetative coverage in the area (Table 10). The group discussion participant farmers also reported that degraded in the past were brought under area closures where various SWC practices were implemented, and result in vegetativegrowth of different trees and grasses becomes improved in the study area.

Land use: the survey results indicated that the participant households were also asked to suggest their views about the contribution of SWC intervention in improving degraded land rehabilitation and land use in the areas, majority of the participant households (80.45%) strongly agree that the SWC intervention improved land use by rehabilitation of degraded land in the areas (Table 10). The survey result further showed that 68.42% and 31.58% of the participant households were strongly agreed and agreed that the intervention of SWC practices increased the crop yield, respectively in study area. Therefore, implementing of effective SWC measures, protecting soil erosion and has potential to improved land use.

Table 10. Farmers' perceptions toward due to SWC intervention in the study area

Indicators	Perception extent		
	Strongly agree	Agree	Disagree
	Frequency (%)	Frequency (%)	Frequency (%)
Reduced soil erosion	46 (27.07)	97 (72.93)	-
Runoff reduced	92 (69.17)	41(30.83)	-
Water availability increased	44 (33.08)	75 (58.87)	14(18.05)
Soil fertility improved	98(73.68)	35 (26.32)	-
Vegetation coverage increased	31(23.32)	73(54.89)	28 (21.05)
Crop yield increased	91 (68.42)	42 (31.58)	-
Animal feed availability improved	49 (8.27)	84(63.16)	-
Land use improved	107 (80.45)	23 (19.55)	-

Source: household survey result, 2019

Community participation in implementation of SWC intervention

The participation of the local community is essential for successful implementation of the SWC intervention, and for sustainable managementand use in a given area. During household survey sampled farmers were asked to judge the level of local community involvement and participation in implementation and management of SWC activities in the area, and the result indicated that the majority (47.9%)of sampled farm households perceived that the local community participation were low in implementation and management of SWC activities in the study area, and the remaining 22.1% and30% of sampled households perceived that the community participation in any activities of SWC practices were medium and high, respectively. The analysis of community participation in SWC practices shows that the participation of nearly the half of the community menbers in any activities of SWC practices was low in the stdu area.

The group discussions farmers and key informants mentioned that the local communities are actively participated in the implementation of SWC practices though community campaign since 2001 E.C, but all community members are not equally involvedin all stages of SWC activities. The result of group discussions farmers and key informants showed that the participation status of the local communities in the SWC activities was low.The group discusion farmers and key informantsloudly noted that the reason behind forlow participation of the community in the implementation and management SWC activitiesincludes the community perceived that the SWC programe launched from top govermnement body and

they perceived it has own mission, lack of community involvment before launching of the SWC progarme, the implementation of the programme was not centered the community,instead it was centerd the government bodies, and lack of local institutions that enforce rules and regulations for sustainable management and protection of SWC activities. As a result, the motivation of the govermnet was to secure thier polital interst rather than ensuring the sustainability of the SWC activities in the area.

Moreover, the result of group discussion farmers indicated that the community members were not participated by their own interest instead they participated by forcing them and punishment, and the rest community members were participated and received incentives in the form of food for work in the study area.The group discussion farmers also reported that the community members are not equally benefited as expected from SWC interventions, particularly from area closures, and resulted in the participation of the local communities in SWC activities was discuaraged through timein the area.

Econometric analysis

Impact of soil and water conservation intervention on household income

The predicted probability values of participation in the SWC practices (propensity scores) were estimated using the logit model for participants of the SWC practices (treated) and non-participants of SWC practices (control) households. The dependent variable is participation in SWC practices, takes the value of 1 for participants and 0 otherwise considered. But, before proceeding to the estimation process, appropriate diagnostic measures were used on the data and the hypothesized variables. Accordingly, multicollinearity and heteroscedasticity tests were conducted using variance inflation factor (VIF) and Breusch-Pagan , respectively, Results of multicollinearity test using the values of the variance inflation factor (VIF) showed that there was no serious problem of multicollinearity (VIF value <10). Similarly, heteroscedasticity test was done using Breusch-Pagan and the P-value was 0.352 which is insignificant indicating the absence of the problem of heteroscedasticity,

The logistic regression model was done to identify the explanatory variables (socioeconomics and institutional characteristics of the farm households) that explain participation in SWC practices, and estimate propensity scores for matching treatment/participant households with

control/non-participant households in the study area. The main purpose of the propensity score estimation is not to obtain a precise prediction of selection into treatment or to participation, but rather to balance the distributions of relevant variables in both groups. The logit estimated results were presented in Table 12.

Table 12. Logit estimates of the propensity scores in the study area

Variables	Coef.	Std. Err	Z
Age of the household head	-0.168	0.275	2.58**
Sex (=1 if male)	0.172	0.530	1.31
Education (year of formal school)	0.325	0.082	3.3***
Total family size	0.014	0.710	0.950
Land holding (ha)	0.014	0.540	1.14
Farming experience (years)	0.137	0.037	2.53**
Livestock holding (TLU)	0.169	0.206	3.86***
Extension contact(freq contact/year)	0.475	0.063	4.52***
Distance from main market (minutes)	0.214	0.509	3.43***
Perceived erosion problem	1.230	0.605	5.99 ***
_cons |	3.322	1.804	3.50 ***
Number of obs =283	Prob > chi2 = 0.0000		
LRChi2=281.94	Pseudo R2 = 0.204		
Log likelihood = -54.68105			

Own survey and model result, 2019

Logistic regression results indicate that farm households' participation in SWC practices was significantly influenced by six explanatory variables (Table 12) includes age of household head, educational level of household heads, farming experience (years), extension contact (frequency of contact per year),distance from main market and perceived erosion problem in the study area. These variables are significant variables which affect the participation of the farm households in implementation of SWC practices in the study area.

The common support region is the area which contains the minimum and maximum propensity scores of participants and non-participants households, respectively. It requires deleting of all observations whose propensity scores is smaller than the minimum and larger than the maximum of participant and non-participant groups, respectively (Caliendo and Kopeinig, 2005). For this study, the common support region would lie between 0 .072961 and 0.897420. This implied that the sampled households whose estimated propensity scores is less than 0.072961 and larger than 0.897420 is not considered for the matching. As a result of

this restriction, 10 households (3 participant and 7 non-participant households) were discarded from estimation process.

Matching participant and non-participant households

Choice of matching algorithms

Balancing test was conducted to know whether there is statistically significant difference in mean value of the two groups, and preferred when there is no significant difference after matched. In line with this, balancing test was conducted using the following matching estimators Nearest Neighbor, Caliper and Kernel Matching for this study. Accordingly, matching estimators were evaluated with matching the participant and non-participant households in common support region. Therefore, a matching estimator having insignificant mean differences in all explanatory variables, low pseudo- R^2 value and large matched sample size was preferred for matching. Based on these criteria, kernel matching with 0.5 band width was resulted in relatively low pseudo-R^2= (0.013) with best balancing test (all explanatory variables insignificant=10) and large matched sample size (273) as indicated in Table 12. Hence, kernel matching was selected as a best fit matching estimator for this study.

Table 12. Performance measures of matching estimators

Matching Estimator	Performance Criteria		
	Balancing test*	Pseudo-R^2	Matched sample size
Nearest Neighbor			
Neighbor=1	7	0.141	273
Neighbor=2	8	0.049	273
Neighbor=3	8	0.073	273
Neighbor =4	6	0.064	273
Caliper			
=0.01	6	0.148	273
=0.1	7	0.173	273
=0.25	9	0.143	273
=0.5	9	0.143	273
Kernel Matching			
With no band width	7	0.064	273
Band width of 0.1	8	0.046	273
Band width of 0.25	9	0.050	273
Band width of 0.5	10	0.013	273

Source: Household survey and model results, 2019, * indicates number of explanatory variables

Balancing test for propensity score and covariates

After matching algorithms were conducted and select the fitted one, the next step is check the balancing test for propensity scores and covariates using kernel matching. The result of balancing test shows that, before matching more than half of the variables exhibited statistically significant differences while after matching all of the covariates were balanced and become statistically insignificant (Table 13).

Table 13. Balancing test for propensity scores and covariates

Variables	Samples	Mean		% reduce		t-test	
		Treated	Control	%bias	/bias/	t	p >/t/
_pscore	Unmatched	0.7157	0.36854	145.7		8.03	0
	Matched	0.6302	0.58629	18.4	87.4	1.02	0.311
Age of HHs	Unmatched	37.329	41.481	40.9		2.25	0.026
	Matched	38.137	7.992	1.4	96.5	0.07	0.943
Education HHs	Unmatched	4.213	3.260	43		2.31	0.021
	Matched	3.533	3.494	12.60	80.6	0.67	0.531
Family size	Unmatched	6.457	6.459	3.6		0.08	1.24
	Matched	7.348	7.291	5.70	105.2	-0.44	0.720
Land holding (ha)	Unmatched	0.375	0.351	47.90		2.06	0.05
	Matched	0.368	0.372	12.4	79.3	0.57	0.7141
Sex of hhs	Unmatched	0.271	0.248	18.5		1.30	0.351
	Matched	0.268	0.269	5.6	72.4	0.74	0.951
Farming experience	Unmatched	23.17	20.52	12.9		2.32	0.04
	Matched	22.937	23.416	4.7	41.2	0.79	0.43
Livestock (TLU)	Unmatched	2.837	1.732	37.5		2.34	0.041
	Matched	2.230	2.185	11.2	89.2	0.21	0.837
Extension contact	Unmatched	5.442	3.890	40.7		5.57	0.001
	Matched	4.041	3.973	16.5	68.4	0.36	0.719
Distance from main market(minutes)	Unmatched	0.0230	0.0216	-20.8		-2.33	0.04
	Matched	0.0221	0.0220	5.4	70.9	0.021	0.836
Perceived erosion problem	Unmatched	0.916	0.642	40.7		4.09	0.001
	Matched	0.752	0.674	18.5	52.6	0.33	0.744

Own survey and model results, 2019

From chi-square test, low pseudo-R^2value and the insignificant likelihood ratio tests shows that both groups have the same distribution in covariates after matching (Table 14). The results show that the matching procedure is able to balance the characteristics in the SWC participants (treated) and the matched comparison groups (non-participants). Therefore,

evaluate the impact of SWC intervention on outcome variables among groups of households having similar observed characteristics. Now we can compare observed outcomes for participants with those of comparison/non-participants households sharing a common support.

Table 14. Chi-square test for the joint significance of variables

Sample	Pseudo-R^2	LR chi^2	p>chi^2
Unmatched	0.207	82.64	0
Matched	0.013	2.96	0.994

Household survey and model results, 2019

Average Treatment Effect on the Treated

This sub-section presents the PSM model result that provide evidence as to whether or not the SWC intervention has a significant impact on farm households' income in the study area. The PSM model using the kernel matching estimator result presented in Table 15 indicates the existence of statistically significant effect of the SWC intervention on farm household income in the study area. The PSM model using the kernel matching estimator result showed the existence of additional significant crop production value birr 11,085 per hectare for SWC participant farm households as compared to non-participant households in the study area.

The PSM model also indicated that the SWC intervention has increased annual income of the participating households by Birr 14,933.24 than that of non participating households (Table 15). This indicated that SWC intervention has a positive and significant effect on crop value and annual income for participant households as compared to non-participant households in the study area. This result is line with other findings such as Yenealem, 2014, Temesgen, 2012, Gerbe-Mariam *et al*. (2015) and Yenealem *et al* (2013) reported that that SWC intervention has positive and significant impact on crop production value and gross household income.

Table 15. Average treatment effect of SWC intervention on outcome variables

Outcome variables	Treated	Controls	Difference	SE	t-value
Crop production value(Birr)	28,649	17,564	11,085	864.75	3.36***
Annual income(Birr)	46,265	29,331.76	14,933.24	936.19	6.93***

Source: Household survey and model results, 2019, *** indicates the level of significance at 1%

Major constraints for sustainable implementation of SWC practices

In the study area, availability of traditional SWC practices, soil fertility decline with soil erosion and cultivation of steep slopes were identified as an opportunity to promote improved soil and water conservation practices in the study area. During the survey the farmers noted that SWC measures have multiple benefits, but multiple constraints hindering sustainable use of SWC practices in study area. The group discussion participants farmers reported that the major problems that constraining sustainable use of the SWC intervention in the study area are limited SWC based extension service, lack of frequent follow up and protection, low participation of the community, lack of organizational support, limited effort on integrating bio-physical SWC practices, late supply of inputs such as seedlings and design materials, lack of infrastructures like nursery and as the group discussion farmers and key informants raised during the survey in area (Table 11).

These constraints were identified by group discussion participant farmers and they ranked according to their importance. Accordingly, the group discussion participant farmers lack of frequent follow up and protection of SWC intervention was ranked fist followed by limited organizational/ institutional support, low participation of the community, availability of limited extension services and limited effort on integrating bio-physical practices (Table 11).This result agrees with the findings of Birtukan (2016), and Kassaye (2019) reported that sustainability of SWC works has been threatened by institutional, attitudinal and biophysical factors.

Table 11. Major constraints of SWC intervention in the study area

Major constraints of SWC	**Rank**
Limited SWC based extension services	4
Lack of frequent follow up and protection	1
Low participation of the community	3
Limited organizational/institutional support	2
Limited effort on integrating bio-physical SWC practices	5
Shortage and late supply of inputs (seedlings, materials)	7
Lack of infrastructures like road, nursery	6
Limited knowledge on use of SWC structures	8

Source: Household survey, 2019

Conclusion and Recommendations

This study was conducted in East Harerghe Zone of Oromia Region, with the objectives of assessing the impact of SWC interventions on farm household income and farmers' perception towards implementation of SWC practices in the study area. As sampling procedure, multi-stage sampling procedures were employed to selected a total of 283 sample households, consisting 133 SWC participant and 150 non- participant households. Primary data were collected from sampled households through household survey. The collected data were analyzed using descriptive statistics and econometric models for this study.

In the study area, different SWC practices implemented on farmland and communal lands through community participation. The descriptive results revealed that age, education, farming experience, number of farm plots owned, livestock ownership, extension contact and distance to market showed significant differences between SWC participant and non-participant households in the study area.The analysis of farmers' perceiption on soil erosion problem showed that the majority of the sampled households (79.8%) perceived that soil erosion as severe problem before the SWC intervention in the study area. Analysis of farmers' perception revealed that majority of the participant households strongly agreed that SWC intervention on farm plots and communal lands was reduce high runoff and soil erosion as compared to before intervention in the area.

The PSM model result also indicated that the SWC intervention has increased crop production value and annual income of the SWC participant farmers by Birr 11,085 and 14,933.24 than that of non-participantfarmers, respectively. This implies that SWC intervention is vital in improving the income and livelihoods of smallholder farmers. The result of logistic model showed that farmers participation in SWC practices were significantly influenced by age of household head, educational level, livestock ownership, farming experience, extension contact, distance to main market and perceived erosion problem in the study area.

The household survey and group discussion participant farmers were prioritized and ranked major constraints that hindering sustainability of SWC practices in study area. Accordingly, lack of frequent follow up and protection, limited institutional support, low participation of the community, limited extension services, farmers missed attitude and poor infrastructures

were prioritized as major constraints hindering the sustainability of SWC practicesin the study area. Therefore, based on the findings of the study, it can be recommended that the SWC intervention is need to be increased farmers participation and awareness toward soil and water conservation intervention through the provision training and demostration of improved SWc technologies. It is very important to make the extension system as efficient as possible through various means including capacity building interventions in relation to use of SWC practices, and institutional support such as capacity building, training and demonstration should be strengthened. In addition, for sustainable use SWC practices, it needs to be designed and implemented through multi-sectoral type of community based organizations, and any SWC interventions which aim at improving the productivity of the smallholder farmers through implementation of SWC practices should consider heterogeneity factors during implementation. Moreover, for sustainable use of SWC intervention, it need to be support by income generating activities coupled with community based organizations for wider dissemination and ensure sustainability. Furthermore, rresearch and extension services for wider promotion improved soil and water conservation measures (physical and biological conservations) should be strengthened.

References

Lakew Desta, Carucci, V., Asrat Wendem-Ageňehu and Yitayew Abebe (eds). 2005. Community Based Participatory Watershed Development: A Guideline. Ministry of Agriculture and Rural Development, Addis Ababa, Ethiopia

Meseret Melilo and Dawit Dalga, 2019 "Farmers` Perception of Soil and Water Conservation Measures on Rehabilitation of Two Watersheds in Humbo District, Southern Ethiopia" International Journal of Research in Agriculture and Forestry, 6(2),pp 8-17

Nanpham T., D. Yang, S. Kanae, T. OKI , and K. Musiakt, 2001. Application of RUSLE Medel on Global Soil Erosion Estimate. Annual Journal of Hydraulic Engineering, JSCE, Vol.45

Angima, S. D., Stott, D. E., O'Neill, M. K., Ong, C.K., and Weesies, G. A, 2003. Soil erosion Prediction Using RUSLE for Central Kenya Highland Conditions. Agriculture Ecosystem and Environment, 21: 295-308

Graaff de. J., C.J. Ritsema and L. Stroosnijder, 2009. Land Degradation and Development Group. Wagningen University, Environmental Service Group

Bruutrup M., and R. Zimmermann, 2009. Agriculture as the Potential Engine for African Growth and the Role of NEPAD. CESifo Forum. 29p.

Gete Z., 2000. Landscape Dynamics and Soil Erosion Process Modeling in the Northwestern Ethiopian Highlands. African Studies Series A16. University of Berne Switzerland. Geographica Bernensia

Caliendo M, Kopeinig S (2005). Some Practical Guidance for the Implementation of Propensity Score Matching, Discussion Paper No. 1588, University of Cologne.

CSA (Central Statistics Authority, 2016). Agricultural sample survey . Report on area and production for major crops (private peasant holdings, main season). Statistical Bulletin Vlo.1. Addis Ababa, Ethiopia

Fikir Alemayehu, Nurhussen Taha, Nyssen, J., Atkilt Girma, Amanuel Zenebe, Mintesinot

Behailu, Deckers, S. and Poesen, J. 2009. The impacts of watershed management on land use and land cover dynamics in Eastern Tigray, Ethiopia. Resources, Conservation and Recycling, 53: 192-198.

Temesgen Zewde. 2012. Factors influencing land degradation in the Bilatte Watershed: The Case of Dimtu and Shelo Sub-Watersheds, Southern Ethiopia. MSc Thesis, Hawassa University, Hawasa, Ethiopia

Tireza Negusse, Eyasu Yazew and Nata Tadesse. 2013. Quantification of the impact of integrated soil and water conservation measures on groundwater availability in Mendae Catchment, Abraha We-Atsebaha, eastern Tigray, Ethiopia. Momona Ethiopian Journal of Science, 5(2): 117-136

Yenealem Kassa, Fekadu Beyene, Jema Haji and Belaineh Legesse. 2013. Impact of Integrated Soil and Water Conservation Program on Crop Production and Income in West Harerghe Zone, Ethiopia. International Journal of Environmental Monitoring and Analysis, 1(4): 111-120.

Gerbe-mariam Yaebiyo, Yayneshet Tesfay and Dereje Assefan. 2015b. Socio-economic impact assessment of integrated watershed management in Sheka Watershed, Ethiopia. Journal of Economics and Sustainable Development, 6(9): 202-212

Analysis of Small-ruminant Value Chain in Eastern Hararghe Zone of Oromia Region, Ethiopia

Jafer Mume Ahmed
Agri-Economics, Oromia Agricultural Research Institute, Fadis Agricultural Research Center
P.O. Box 904, Harar, Ethiopia
Corresponding authors E-mail: mjafer2012@gmail.com

Abstract

At the household level, livestock plays a critical economic and social role in the lives of pastoralists, agro-pastoralists, and smallholder farm households. This study was undertaken in Babile, Fadis, Kurfa Calle and Kersa districts of East Hararghe Zone, with the objective of analyzing sheep and goat value chain of East Hararghe Zone. Both primary and secondary data were collected for the study. The data were collected using a semi-structured questionnaire from 134 sample respondents and Farmers group discussion during the period of April 20, 2019 to May 20, 2019. The main value chain actors identified by the study were producers, collectors, traders, butchers, local consumers and exporters. Important marketing channels of sheep marketing were identified. Marketing margins and costs were calculated for selected channels using data collected during the surveys. Total of 234 farm household and 10 small traders, 4 Exporters, 6 big traders and 7 local assemblers were interviewed. To analysis the data, percentage, mean, standard devotion and gross margin were used. The major problems facing Sheep and goat production were shortage of feed especially during dry season, poor quality and declining productivity of grazing lands in wet season and expansion of crop cultivation on grazing areas.

Key words: *Sheep and Goat; Value chain; Market margin; Mapping*

Introduction

Ethiopia is one of the African countries with the largest small ruminant population in the continent containing about 27.35 million sheep and 28.16 million goats in the country (CSA, 2014). Small ruminant production is a major component of the livestock sector in Ethiopia, farmers and pastoralists depend on small ruminants for much of their livelihood, often to a greater extent than on cattle, because sheep and goats are generally owned by the poorer sectors of the community (Gizaw, 2013). According to IRLI (2012), small ruminants account on average for 40% of the cash income and 19% of the total value of subsistence food derived from all livestock production. They also contribute a quarter of the domestic meat consumption; about half of the domestic wool requirements; about 40% of fresh skins and 92% of the value of semi-processed skin and hide export trade (Mengesha,2012). In arid and semi-arid regions of Ethiopia, goats are more populated than other livestock (CSA, 2008) and

are the most important animals for milk next to camel (Baars, 2000). It was also reported that goats are the most common animals sold by pastoral households for immediate cash income, and slaughtered at home to be consumed by family (Baars, 2000).

Goats (*Capra hircus*) as a species have a long history of domestication and use for human consumption. Goats were domesticated from the wild version of *Capra aegarus* about 10,000-11,000 years ago, by Neolithic farmers in the Near East (Hirst, 2008). Today, there are nearly 500 breeds of goats and 600-700 million of goats in the world (Hirst, 2008) living in climates ranging from high altitude mountains to deserts (Bagley, 2006). Goats have wide acceptance and recognition worldwide because of their multiple benefits to human. Goats have high reproductive rate, ability to produce milk and meat (Tilahun and Goestseh, 2005). Goats can inhabit a wide range of climates (Bangley, 2006), and have a huge socio-economic importance. For their small body size, goats have physical and bio-physical advantages over large ruminants.

In Ethiopia, the agricultural sector accounts for about 44.1% of the total gross domestic product (GDP) of the year 2007/08 while the livestock sub-sector accounts for about11.8% of the GDP and about 26.5% of the agricultural GDP (MoFED, 2009). Livestockrelated exports accounts for ~15% of the total export revenue of the country, third inimportance after coffee and khat (*Catha edulis*) (MEDaC, 2000).

The term value chain describes ‘all activities that are requisite for bringing a product or service from conception, through the different phases of production (involving a combination of physical transformation and the input of various producer services), delivery to final consumers, and final disposal after use’ (Kaplinsky and Morris 2000). Whereas the flow of goods is crucial in value chains, other determinants of value chain participation such as credit/financial flows, changes in ownership rights and markets need to be considered (Coles and Mitchell 2011). The value chain concept was articulated and popularized in 1985 by Michael Porter in the ‘competitive advantage’, a seminal work on the implementation of competitive strategy to achieve superior business performance.

Rubin et al. (2008) described value chain analysis (VCA) as ‘the process of documenting and analyzing the operation of a value chain, and usually involves mapping the chain actors and calculating the value added along its different links’. It is a holistic approach because it pays

attention to the complex interactions of income, value added across the chain and how these are distributed within particular points of the chain and across the different levels of the chain.

Njuki et al. (2011) defined gender as 'the socially constructed roles and status of women and men, girls and boys. It is a set of culturally specific characteristics defining the social behavior of women and men, and the relationship between them. Gender roles, status and relations vary according to place (countries, regions, and villages), groups (class, ethnic, religious, caste). Gender is, thus, not about women but about the relationship between women and men.' A gendered VCA is a methodology that describes existing gender relations in a particular environment, ranging from within households or firms to a larger scale of community.

Value chains exist and operate within a given social context that affects the distribution of resources, benefits and opportunities. Gender relations affect and are affected by the ways in which value chains function. Gender is thus an important aspect of value chain analysis. Access to financial services is especially critical for women in terms of enhancing their ability to participate in value chains (Fletschner and Kenney 2011). Analysis of how differential access to productive assets constrains women from participating in value chains are essential prerequisites to the success of all agricultural value chain development projects.

At the household, the level to which women engage with a value chain is not only affected by men but also affects men. Thus, gender relations at the household level play a key role in determining the extent to which men and women interact within a value chain. Gendered patterns of resource allocation quite often imply gender differences in participation as well as in the sharing of benefits based upon participation. Furthermore, women often carry a much heavier work burden then men as they are responsible for housework, childcare, subsistence food production and sometimes also paid employment (Momsen, 2004). In most places, women work longer hours than men, but because their work is within the household it is often not recognized (Momsen, 2004). Such gender analysis and integration of gender issues is usually however the weakest point in most value chain analyses and largely ignored in most value chains (Njuki et al. 2012).

Gender roles have a significant impact on men and women's roles and participation in the value chain (Terrillon, 2011). Gender determines what stages in the chain women and men are likely to be involved in. It is now widely acknowledge that women play essential part in agriculture in the developing world. Gender roles, "the household tasks and types of employment socially assigned to women and men"(Momsen, 2004) are not based on biological or physical traits, but "result from stereotypes and presumptions about what men and women can and should do" (Terrillon, 2011)

Generally, its contribution to subsistence and cash income generation, goat and sheep in hararghe zone are owned by smallholder farmers as an integral part of the livestock sub-sector. There is limited information on goat and sheep value chain and how the markets are functioning. Gender roles have a significant impact on men and women's roles and participation in the value chain. There is not quantified role of gender in goat and sheep value chain in eastern Hararghe. Thus, the objectives of this study is to characterize the Hararghe goat and sheep value chain by identifying major marketing routes, value chain actors and distribution of costs and margin of goat value chain and analysis the role of gender in goat value chain in eastern Hararghe zone.

Objective of the study

The study was conducted to address the following objectives

- To characterize the Hararghe goat and sheep value chain by identifying major marketing routes, chain mapping and value chain actors
- To analysis gender role in goat and sheep value chain in the study area of eastern Hararghe
- To identify major constraints and opportunity in goat value chain

Methodology

Study area

The study was conducted in Oromia National Regional State, East Harerghe Zone. Eastern Hararghe zone is one of the 17 zones of the Oromia National Regional State. It is located in the eastern part of the country. It divided into 19 districts and Harar is the capital town of the

zone and is located at the distance of 525 kms from Addis Ababa. The agro climatic range of Zone includes lowland (*kolla*, 30-40%), midland (*weyna dega*, 35-45%) and highland areas (*dega*, 15-20%), with lowest elevations at around 1,000 m a.s.l, culminating at 3,405 m, at the top of Gara Muleta mountain. There are two rainy seasons, the small *belg* and the main *meher*. *Belg* production is limited within the *dega* zone and part of the wetter *weyna dega*, but *belg* rains are widely used for land preparation and seeding of long cycle *meher* crops (sorghum & maize). Annual rainfall averages range from below 700 mm for the lower *kolla* to nearly 1,200 mm for the higher elevations of *weyna dega* &*dega* zones. The variability of rainfall from year to year and it's often uneven distribution during the growing seasons give place to a wide range of climatic hazards which farmers have to deal with (EHZAO, 2011).

Based on the 2007 Census conducted by the Central Statistical Agency of Ethiopia (CSA), this Zone had a total population of 2,723,850, which is increased by 48.79% over the 1994 census, of whom 1,383,198 are male and 1,340,652 are female. Within the area of 17,935.40 square kilometers, it has a population density of 151.87, while 216,943 or 8.27% are urban inhabitants, a further 30,215 or 1.11% are pastoralists. A total of 580,735 households were counted in this Zone.

The main socio-economic activities in the Zone districts are mixed farming (crop production and animal husbandry) non/off-farming. Moreover, the main crops grown in the area include maize, sorghum, groundnut, *khat*, coffee, haricot bean, sweet potatoes and pepper. Livestock husbandry includes cattle, sheep, goats, chicken camel and donkey.

Sample size and sampling technique

Mult-stage sampling techniques were employed for this study. At the first stage four districts of zone were selected purposively from zone based on their production potentiality and presence of goat and sheep. In consultation with respective agriculture and rural development offices, potential kebeles having a goat and sheep production and marketing were listed. In the second stage, the two kebeles were selected randomly from each selected districts. At the third stage, farmers who take part in goat and sheep production and marketing in the year were listed out. Finally, based on the list of goat and sheep producers from the sampled

kebeles, the intended sample size was selected by employing Probability Proportional to Size (PPS).

Types of data and method of data collection

Both primary and secondary sources of data were used. Secondary data collected from zonal and woredas office published and unpublished material. Primary data was gathered from goat producers, traders (exporter and local traders), brokers, slaughter and consumers (Sex and Age). All socio-economic variables were gathered using questionnaire. Focus Group Discussions (FGD), key informant interviews and visual observations was used. Focus group discussion was the main method of data collection in this study. Individual interview was employed for both producers and traders of goat and sheep.

Data analysis

Depending on gathered information and objectives of study, both descriptive statistics with graphs and econometric models may be used to analyze qualitative and quantitative data. To analysis, the gathered data STATA .11 Software version was used.Descriptive analysis used to analysis characteristics of sample respondents. Costs and margins along the value chains was analyzed.

Value chain mapping: Value chain mapping is the process of developing a visual depiction of the basic structure of the value chain. A marketing margin measures the share of the final selling price that is captured by a particular agent in the marketing chain

Results and discussions

Demographic and Socio-economic Characteristics

As mentioned in the methodology parts the descriptive parts of the analysis is used to describe characteristics of the sample respondent. Both continuous and discrete variables were used in order to describe the sample households included in this study. Table 1 shows, the percentage of the sample respondents based on household head sex in selected survey districts.

Table 1. Sex of sample respondents in the study area

Districts		Sex of household head		Total
		Female	Male	
Babile	Count	8	21	29
	% within Survey district	27.6	72.4	100
Kersa	Count	11	50	61
	% within Survey district	18	82	100
K/callee	Count	3	10	13
	% within Survey district	23.1	76.9	100
Fadis/midhaga	Count	2	29	31
	% within Survey district	6.5	93.5	100
Total	Count	24	110	134
	% within Survey district	17.9	82.1	100
	% of Total	17.9	82.1	100

Source: Own survey results

Sex of household head: Out of 134 sample respondent, 17.9% were female household head where as 82.1% of them were male headed household. In Babile District, 27.6 % were female and 72.4% were also male headed household. In Kersa district out of 62 respondents 18% were female while 82% were found to be male headed household. In the case of Fadis/Midhaga districts out of 32 respondents 6.5 % were female headed while 93.5% were male headed household. In Kurfa-Cale districts 23% were female while around 80% were male headed household head.

Table 2. Description of demographic characters for continuous variable

Variables	Babile (N=29)	Kersa (N=61)	Ku/Cale (N=13)	Fadis/Midaga (N=31)	Overall (N=134)	P-value
	Mean(SD)	Mean(SD)	Mean(SD)	Mean(SD)	Mean(SD)	
Male in Family	4.2(1.6)	3.3(1.4)	3.4(1.2)	3.7(1.7)	3.6(1.5)	0.059
Female in Family	3.4(1.8)	3.4(1.7)	3.8(1.5)	3.7(1.9)	3.5(1.8)	0.813
Total Family size	7.6(2.5)	6.7(2.3)	7.2(2.4)	7.4(2.6)	7.1(2.4)	0.319
Male 15-64years	1.7(1.1)	1.7(0.9)	1.7(1.0)	2.0(2.4)	1.8(1.4)	0.756
Female 15-64 years	1.8(1.5)	1.8(1.1)	1.8(1.2)	1.5(0.9)	1.7(1.2)	0.807
Family size 15-64 years	3.3(1.9)	3.4(1.7)	3.5(2.1)	3.1(1.3)	3.3(1.7)	0.815
Labor Force	3.2(1.7)	3.4(1.7)	3.5(2.1)	3.1(1.3)	3.3(1.6)	0.825

Source: Own survey result

Family size: The average family size of the sample respondents was found to be 7 person in the study area. The average male member in the sampled household was around 4 person. In

Babile District it was 4 person, in Kersa district 3 person, in K/calle district 3 person and in Fadis- Midhaga district was around 4 person. The significance value of the F-test shows rejection of hypothesis that the average number of male in household is equal across the districts. So the average number of male in household is significantly different across the study districts at 10 percent of significant level (Table 2).

Table 3. Description of demographic and socio-economic characters of sample respondents

Variables	Babile (N=29)	Kersa (N=61)	Ku/Cale (N=13)	Fadis/Midaga (N=31)	Overall (N=134)	P-value
	Mean(SD)	Mean(SD)	Mean(SD)	Mean(SD)	Mean(SD)	
Age of HH	35(6.66)	35.(9.4)	36.5(7.4)	36.2(8.3)	35.8(8.4)	0.939
Education level HH	2.1(2.4)	4.0(3.2)	4(3.5)	2.2(1.9)	3.2(2.9)	0.004
Farm size	1(0.6)	0.4(0.4)	0.3(0.1)	0.8(0.4)	0.6(0.5)	0.000
Livestock in TLU	3.5(3.3)	4(2.9)	2.9(1.2)	2.8(3.4)	3.5(3)	0.275
Sheep-goat owned	3.9(2.8)	9.9(9.3)	3.9(2.1)	5.5(5.2)	7(7.4)	0.000
Sheep & goat sold	0.9(1.4)	2(2.6)	0.9(1.3)	1.3(2.2)	1.5(2.2)	0.069
Sheep product exper	7.8(6.1)	10.8(9.7)	10.1(7.9)	9.4(7.3)	9.8(8.3)	0.445

Source: Own survey results

Education of household head: Education equips individuals with the necessary knowledge of how to make living decision. Literate individuals are very ambitious to get information and use it**.** As agriculture is a dynamic occupation the conservation practices and agricultural production technologies are always coming up with better knowledge. The average year of formal schooling of total sample respondent is grade 3.The average year of formal schooling is grade 2, grade 4,grade 4, grade 2 in Babile, Kersa, K/calle and Fadis districts respectively .The mean difference of the groups is statistically significant at 10 percent of probability level. It shows that, on average sample respondents has significance mean difference across all districts at 1 percent of probability level.

Farm Size: On average sample respondents' have 0.6 ha of farm size for farm production in the study area. The average farm size of respondents is 1 ha, 0.4ha, 0.3 and 0.8ha in Babile, Kersa, K/calle and Fadis districts respectively. The mean difference for between all groups was found to be significant at 1% probability level. This shows that the average land holding of sample households across all districts is not equal.

Sheep and goat owned: In the study area the average number of sheep and goat owned by respondent was found to be 7 while that of Babile, Kersa, K/callee and Fadis Districts was around 4, 10, 4 and 5 small ruminants respectively. It showed that the mean difference between the all groups is significant at 1% of probability level showing that average number of sheep and goat owned in all district is not equal. Similarly, in the study area the average number of sheep and goat sold by respondent was found to be around 2 while that of Babile, Kersa, K/callee and Fadis districts was around 1, 2 , 1 and 1 small ruminants respectively. It showed that the mean difference between the all groups is significant at 1% of probability level showing that average number of sheep and goat sold in all district is not equal (see Table 3).

Small-ruminants value chain and gender roles

Goat and sheep value chains include all activities starting from live sheep and goat production through transporting, processing and marketing of outputs, creation of added value products such as meat and consumption of the animal source foods and related products. Value chains also include the institutional and governance arrangements that enable these systems to function. The study on goat and sheep value chains has identified the core functions, actors, market channels, constraints and existing opportunities. Gender role also presented in all section of the value chain as described in the following section.

Main functions and actors in value chain of small-ruminants in study area

The main functions in the sheep and Goat value chain in Eastern Hararghe zone includes: input supply, production, marketing, processing and consumption, thus different activities were performed by the different actors.

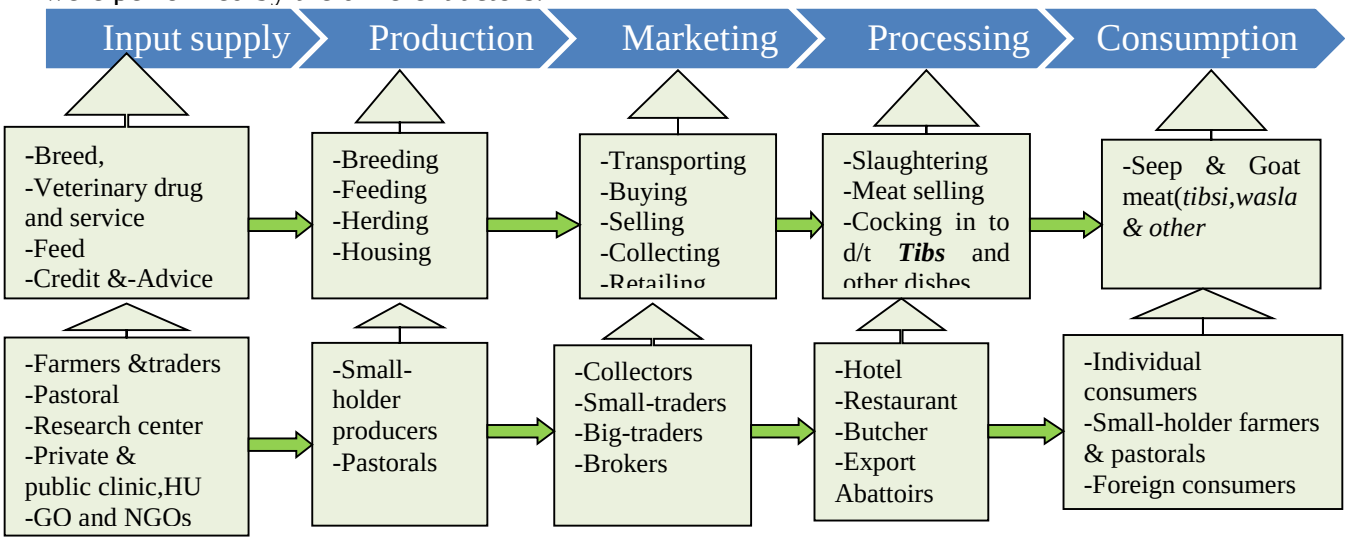


Figure A. Main value chain function and Actors

Input supply

It includes selection and distribution of breeding, provision of veterinary services and improved management skills (through training) and best practices in the areas. Feeds and feeding management, housing management and animal health management are some of service delivered. Both men and women can access breeding stock from the community in different ways. Community can get breed mainly from the livestock market. Some of them can obtain through relative gift. They also buy from collectors and small traders. Farmers and pastoralists can buy either in the market or in their villages depending on their convenience and preference.

Thus, a farmer has to go to the market in order to get sheep and goat breeding for production. Regarding the time of purchases, farmers usually buy animals after crop harvesting. This is mainly because of two important reasons. The first is they get cash by selling grains and cash crop then can easily buy sheep and goats at this time. The other important reason is availability of grazing pasture and crop residue in this time of the year. Since the crop land will be free until the next rainy season, farmers want to make use of the available natural pasture. They rarely sell their animals by this time since it adds value by grazing the available natural pasture. The price of sheep and goats rises at this time of the year.

Feeds*:* Feeding system is almost entirely dependent on grazing of natural pasture. In other way sheep and goat feeding is grazing supplemented by industrial by-product was observed in the study area while other use cut and carry system for feeding. Grazing was the common feeding practice in the area and both men and women grazed on their own farm and communal area. It shows that 41percent was replied as grazing as main feeding, 27.6 percent of sample respondent replied as grazing supplemented by industrial by-product is as source of feeding for production of sheep and goat while 31.3 percent of them replied as cut and carry system is main feeding system. Men and women also used supplementary feed such as wheat bran (Fureshka) for sheep and goat feeding. As indicated in the study report, 41 percent of respondents replied as women are more responsible for feeding sheep and goat at home while 39.9 percent of respondents replied as husband and wife are responsible for feeding sheep and goat at home. Both men and women are responsible for taking sheep and goat at grazing area.

During the rainy season and dry season communal hill land was the major feed resource for farmers in Kersa and Kurfa Calle districts. Natural pasture from farmers grazing lands was the predominant source of feed for sheep and goat during the main rainy season. Women were also responsible for feeding at home, watering and cleaning and providing shade at home area.

Table 4. Sheep and Goat feeding system in the study area

		Feeding system for sheep and goat			Total
		Grazing only	Grazing supplemented by by-product	Cut and carry feeding	
Babile	Count	14_a	7_a	8_a	29
	% within district	48.3	24.1	27.6	100
Kersa	Count	24_a	16_a	21_a	61
	% within district	39.3	26.2	34.4	100
K/callee	Count	7_a	3_a	3_a	13
	% within district	53.8	23.1	23.1	100
Fadis/midhaga	Count	10_a	11_a	10_a	31
	% within district	32.3	35.5	32.3	100
Total	Count	55	37	42	134
	% within district	41	27.6	31.3	100
	% of Total	41	27.6	31.3	100
	$Chi^2 = 3.08$,	p value = 0.79,		DF=6	

Source: Own survey results

Each similar subscript letter denotes a subset of Feeding system of producers of sheep and goat categories whose column proportions do not differ significantly from each other at the .05 level.

In the study area of Hararghe zone, farmers are using different way feeding for their sheep and goat in their area. The descriptive result presented in table 4 above revealed that, out of total respondents in Babile districts, sample respondents that replied grazing is main feeding system for sheep and goat production account for 48.3 percent while other group account for 24.1 percent and 27.6 percent as grazing supplement with industrial by-products and cut-carry system for feeding of sheep and goat in the study area respectively. The descriptive result also revealed that, out of total respondents in Kersa districts, sample respondents that replied grazing is main feeding system for sheep and goat production account for 39.3 percent while other group account for 26.2 percent and 34.4 percent as grazing supplement with industrial by-products and cut-carry system for feeding of sheep and goat in the study area, respectively. It was revealed that, comparison of the groups depicted that proportion of respondents that use different feeding system and that of different group of districts are

almost equal. This difference is shown by cross tabulation chi-square test that is found to be insignificant and the association between main feeding system and group of districts was found to be insignificant by probability level.

As indicated from descriptive analysis 49.4 percent of respondents replied as boys are responsible for taking to grazing area 16 percent as women and 14.1 percent replied as husband and wife are responsible for taking sheep and goat to grazing area.Women were more participated in sheep and goat feeding and managing at home than men who were able to bring bigger sheep and goats to the market.

Veterinary services*:* Veterinary service is provided by the government but the coverage was very limited as replied during discussion. Both men and women were participating in supplying veterinary service for community. Regarding credit facility, the Government safety net program had provided breeding stock on credit to a few women farmers hence only a few women were benefiting from the program.

Production of Sheep and Goat

Eastern hararghe zone is a high potential area for sheep and Goat production and is an integral part of the mixed crop livestock system. Sheep and goat producers are smallholder farmers and pastoralists living in different parts of the study area. Pastoralists and farmers usually buy animals for breeding purposes. Their preferred sources of animals are farmers/pastoralists from known locations since they want to make sure whether the animal will adapt to their situation.

Table 5. Reason for production of sheep and goat in the study area by respondents

Reasons		Survey district				Total
		Babile	Kersa	K/callee	Fadis/midhaga	
Its higher price	Count	3_a	10_a	4_a	6_a	23
	% within reason	13	43.5	17.4	26.1	100
Adaptability in stress area	Count	16_a	19_a	3_a	8_a	46
	% within reason	34.8	41.3	6.5	17.4	100
It require simple management	Count	6_a	30_a	6_a	12_a	54
	% within reason	11.1	55.6	11.1	22.2	100
Other	Count	4_a	2_a	0_a	5_a	11
	% within reason	36.4	18.2	0	45.5	100
Total	Count	29	61	13	31	134
	% within reason	21.6	45.5	9.7	23.1	100
	$Chi^2 = 17.72$, , p-value = 0.039				DF =9	

Source: Own survey results,

Respondents were also asked to list the reasons for which they kept small ruminants, in order of priority. Sheep and goat were reared mainly for immediate cash needs and household members' consumption milk and meet. However, farmers rarely consumed meat, mostly during big holidays (such as Arefa, Meskel and other holidays).Sheep and goat production and decision-making on sheep production were area-specific. In low land area farmers produce sheep and goat for its adoptability in moisture stress area.

Regarding reason for which farmers select sheep and goat production, respondents replied that 13 percent of sample respondents in Babile District replied that they select sheep and goat production due to its higher price while 43.5percent of respondent in Kersa district, 17.4percent in K/Callee district and 21.7 percent of sample respondents in Fadis districts has chosen for its higher price. Similarly, around 34.8 percent of respondents in Babile district, 41.3 percent in Kersa,6.5 percent in K/Calee and 17.4 percent in Fadis District have selected sheep and goat production for its adaptability in moisture stress area . In addition, around 11.1 percent of respondents in Babile district, 55.6 percent in Kersa, 11.1 percent in K/Calee and 22.2 percent in Fadis District have selected sheep and goat production for its management simplicity.

Marketing and gender roles in goat and sheep value chain

Farmers replied during discussion that major factor influencing supply of sheep and goat to the market in the study areas is rainfall and household need. In rainy season farm land may occupy by crop and grazing area is reduced to hill and mountain area like Gara-mulata and others. Most of the producers sell their sheep and goat during main rainy season while their price becomes lower. Both women and men are participant in goat sheep production and trading in the study area. Marketing was mainly dominated by men, while women were rarely involved in marketing. Women in Fedis/Midaga and Babile districts buy sheep and goat brought young sheep and goat to the district market and Harar market for sale to small traders and big traders. Producers usually sell their animals to any buyer in the market. Sheep and goat producers sell animals mainly in the market places. Sheep and goats in all the study areas were sold in market places, while the rest are sold either in the villages or on the road to the market. Both men and women sold their sheep and goats when they were shortage of cash to purchase inputs like fertilizer, improved seeds, for school fees and other expenses related

to school and family consumption. Farmers also sold sheep and goats during big holidays to small traders, big traders and hotels and sometimes to individual consumers.

Table 6. Proportion of producers who sold sheep and goat for different chain actors

		To whom do you sell sheep and goat						
		Small-traders	Larger-traders	Individual Farm/Cosu	Exporter	Local collector	Hotel & Butchers	Total
Babile	Count	6_a	2_a	$3_{a, b}$	8_b	4_a	$6_{a, b}$	29
	% within district	20.7	6.9	10.3	27.6	13.8	20.7	100
Kersa	Count	$18_{a, b}$	$12_{a, b}$	10_b	4_a	$10_{a, b}$	7_a	61
	% within district	29.5	19.7	16.4	6.6	16.4	11.5	100
K/callee	Count	2_a	5_a	0_a	0_a	4_a	2_a	13
	% within district	15.4	38.5	0	0	30.8	15.4	100
Fadis/Mida	Count	7_a	4_a	2_a	3_a	7_a	8_a	31
	% within district	22.6	12.9	6.5	9.7	22.6	25.8	100
Total	Count	33	23	15	15	25	23	134
	% within district	24.6	17.2	11.2	11.2	18.7	17.2	100

Source :Own survey result

Each similar subscript letter denotes a subset of Feeding system of producers of sheep and goat categories whose column proportions do not differ significantly from each other at the .05 level.

Local collectors

Collectors are those marketing agents that buy up to 20-30 sheep and goat per market day from producers and hand over to small traders or big traders and hotels. These types of actors have limited capital for potential participation. Thus they rely on small and big traders as sources of capital and get commission based up on the quality of animal they supply. Sheep and goat marketing involves collection of animals, transportation and distribution to end users. In the study areas, collection of small ruminants is carried out mainly by farmers who do have sheep and goat trading as a side line activity. Live sheep and goat are collected from producers and transported to nearby markets. The number of sheep and goat collected by different collectors depends on the amount of money they have. Market demand for different classes of animals (age and sex) is different in the different time. Male sheep are demanded in the market more during Arafa (Eid Adha) followed by male goat both in Ethiopia and Soudi-Arabia as observed from discussion with traders and brokers. Goats are also demanded in Christian -holidays in the area.

Table 7. Percentage of sheep and goat sold to different value chain actors

Main Chain Actors	Percentage
Individual Farmers/Consumers	17.2
Small-traders	28.4
Exporters	11.3
Larger-traders	28.9
Hotel and Butchers	3.9
Local collectors	10.3
Total	100.0

Source: Own survey result

Result revealed that around 18.7 percent of producers were found to sell their animal to local collector while 10.3 percent of small ruminants were found to be sold to local collectors. Number of sheep and goat collected by different collectors depends on the amount of money they have.

Brokers in the study area

Brokers mediate transaction between buyers and sellers. Brokering activities in sheep and goat markets depends on the mode of transaction. In weight based transactions of sheep and goats where price per live weight kg of animals is known to everybody, their task is to channel more sellers to a buyer. However, in Babile Districts brokers buy sheep and goat themselves then send to owner of the money that is big traders in Mojo and Finfine Abattoir. These big traders pay brokers commission 15ETB per head. In such cases they do not influence the price of live weights of animals for individual sellers due to transaction is based on weight which is determined by big traders in Mojo to brokers that buy small ruminants in Babile.

On the other hand, they help price setting when animals are sold based on visual estimation and negotiation. In this case, there is an information asymmetry where brokers can make use of their knowledge about prices, quality and quantity of animals demanded to influence sellers. They simply provide either too low or too high prices to sellers so they will use this price as a reference and will not come to an understanding with other buyers. In this case they obtain 30-50ETB per head from traders and individual buyers. Brokers do not compete with each other and no other broker mediates the animal that another broker started.

Most of producers sell their animals only through a broker who has recognized place to sell small ruminants. Producers bring the animal to the market and hand it over to the broker. The broker has full responsibility to sell the animal at the prevailing market price discussing with animal owners. Though the known commission per sold animal is ETB 50/animal from producers, the broker can agree with the buyer not to disclose the real price and tell the producer that his animal is sold at a lower price than what it was actually sold. So, broker hinders fair price of animal and reduce benefit of farmers from their animals. Only male were participating in the market as brokers while women were constrained from being broker.

Small-traders

Small traders supply hundreds of animals every week to large traders as well as to hotels, butchers and live animal retailers in woreda market, Harar city other urban centres as well. They have their own network of collectors. There are fewer small traders than collectors but more than large traders. They usually operate using their own capital and sometimes receive advance payments from buyers (large scale traders). Most small traders do sheep and goat trading as a sideline and are involved in cattle trading or other businesses. They go to village and woreda livestock markets and buy from producers and collectors. These traders truck number of animal to big traders that truck anima to Mojo, Burayu and Finfine to sell animal to big traders and exporters. They collect animals from their village and respective district market days then supply to secondary market. Both male and female were involved as small traders. However, women were constrained from tracking and selling sheep and goat to big traders in Mojo and Finfine due to challenge in this type of trading activity. Result revealed that around 24.4 percent of producers were found to sell their animal to small traders while 28.4 percent of small ruminants were found to be sold to small traders

Big traders

Big traders in this context are those traders that buy at least one truck load (a minimum of 120 heads) of sheep and goat in a week. They usually buy sheep and goat from small traders, producers and collectors. These traders supply at least 120 animals either to exporter in Somalia or other markets such as Finfine, Mojo and Burayu. In Sometime Big traders collect animals on credit basis from small traders and pay them after sell. Traders in Babile market replied that there is much risk associated with credit basis. There are the number of small traders, producer and collectors that lost their animals and money for their animal sent to big

traders on credit basis as traders and brokers in Babile replied during discussion made for data collection. They can also provide them with money in advance for buying activity.

The Big traders in such cases simply stay in a central place, communicate with small scale traders and Brokers in case like in Babile where transaction is based on weight, transfer money to their suppliers, receive animals from all over the country, let them rest for two to three days, and hand them over to the abattoirs in Mojo and Finfine. In Kersa(Water) market traders order their brokers to evaluate and collect sheep and goat. These traders collect from all market day and supply to Burayu, Mojo and Finfine each week. Big traders have their own network of collectors that reach producers in village markets, farm gate areas. These traders have sheep and goat collection networks in all corners of the region. They go to district markets in order to coordinate the activity of their suppliers. They provide information about the prevailing market price, type of animals and number required to their respective suppliers. Big trades are male only because trading and managing large number of animal is challenging for female. Result revealed that around 17.2 percent of producers were found to sell their animal to Big traders and 11.2 sell to exporter while 28.8 percent and 11.3 percent of small ruminants were found to be sold to Big traders and Exporter respectively.

Exporters

Live animal exporters export live sheep and goats mainly to Saudi Arabia during the Arefa season for sacrifice at the Haji ceremony. They need male, uncastrated sheep and goats for Haji ceremony. Unlike the export abattoirs, live animal exporters need animals of larger live weight quality one as explained by traders during data collection. They collect such animals from all corners of the country and export them mainly through Djibouti and Somalia.

Traders and Brokers in Babile and Kersa district that buy and send them to big traders inform us major suppliers of live sheep and goats to export abattoirs is at Bishoftu, Mojo and Burayu towns. The major sources of slaughter animals for these export abattoirs are smallholder farmers and pastoralists product bought from respective District livestock market. Since they are buying at the factory gate, export abattoirs in Bishoftu and Mojo areas get animals mainly through traders that collect animals through their own networks. Big trader's supplies to export abattoirs buy young, male, uncastrated sheep and goats weighing 14–28Kgs. Hence, there is no competition between traders buying for export abattoirs and those buying for local hotels as replied during data collection.

Processing

Slaughtering or different food preparation was the only processing activity carried out in the area, and mainly done in municipal slaughtering houses and individual houses by men. Men had better knowledge than the women on quality measures. Women were responsible for cooking and sharing whatever was cooked in the house. Both men and women were found to be responsible in processing of small ruminants at home and hotel.

Individual consumers

Consumers are the customers who buy goat meat either as raw or already cooked from the different outlets which include hotel, restaurant and butchery. A goat can be slaughtered at any time of the year although this is most frequent during family gatherings where two or more goats are slaughtered per household. Individual consumers are livestock market actors that buy either live animals or meat for their own household consumption. They buy live sheep and goats from traders, collectors and producers depending on where they are. They also buy raw meat from butchers and cooked meat from restaurant and hotel on a kilogram basis. Individual consumers buy live sheep and goats to slaughter for religious festivals and special occasions. Individual consumers in rural areas usually buy from producers.

Hotel and Butchers

Hotels and butcher are important actors in sheep and goat value chain. The two actors have different criteria in selecting animals. Hotel owners and butchers buy animals either from producers and collectors in the market or they have customers (small scale traders) that supply animals a week. Hotels use sheep and goat meat to prepare different types of dishes like Tibsi meat, boiled meat flavoured with different spices and 'dulet' and other dishes. Butcher pay attention to body condition and body size, but not coat colour when buying sheep and goats. The preference for male and female animals varies with their location. Since they are selling meat on a kilogram basis, the fatty meat from such female sheep and goats is very light and it is not profitable for them. Butchers retail meat on a kilogram basis as take away. Though transactions are carried out based on the visual inspection of the quality of animals, sheep and goat traders can estimate how much meat could be produced from animals of a given size with reasonable accuracy. They consider carcass weight by estimating live weight of animals ahead of buying. For instance, based on information from a butcher at Harar city, Babile and Kersa a mature sheep and goat weighing about 28 kg can yield a carcass of 17 kg (9 kg flesh and 8.0 kg bone). Offals, skin, legs and the head of the same

animal are about 3.5, 0.75, 1.5, 1.75 and 3.50 kg, respectively. At the household level it was the women who cooked meat after the men slaughtered the sheep and goats. In hotels both women and men were involved in processing. It was only the slaughtering that the women were not involved in the area.

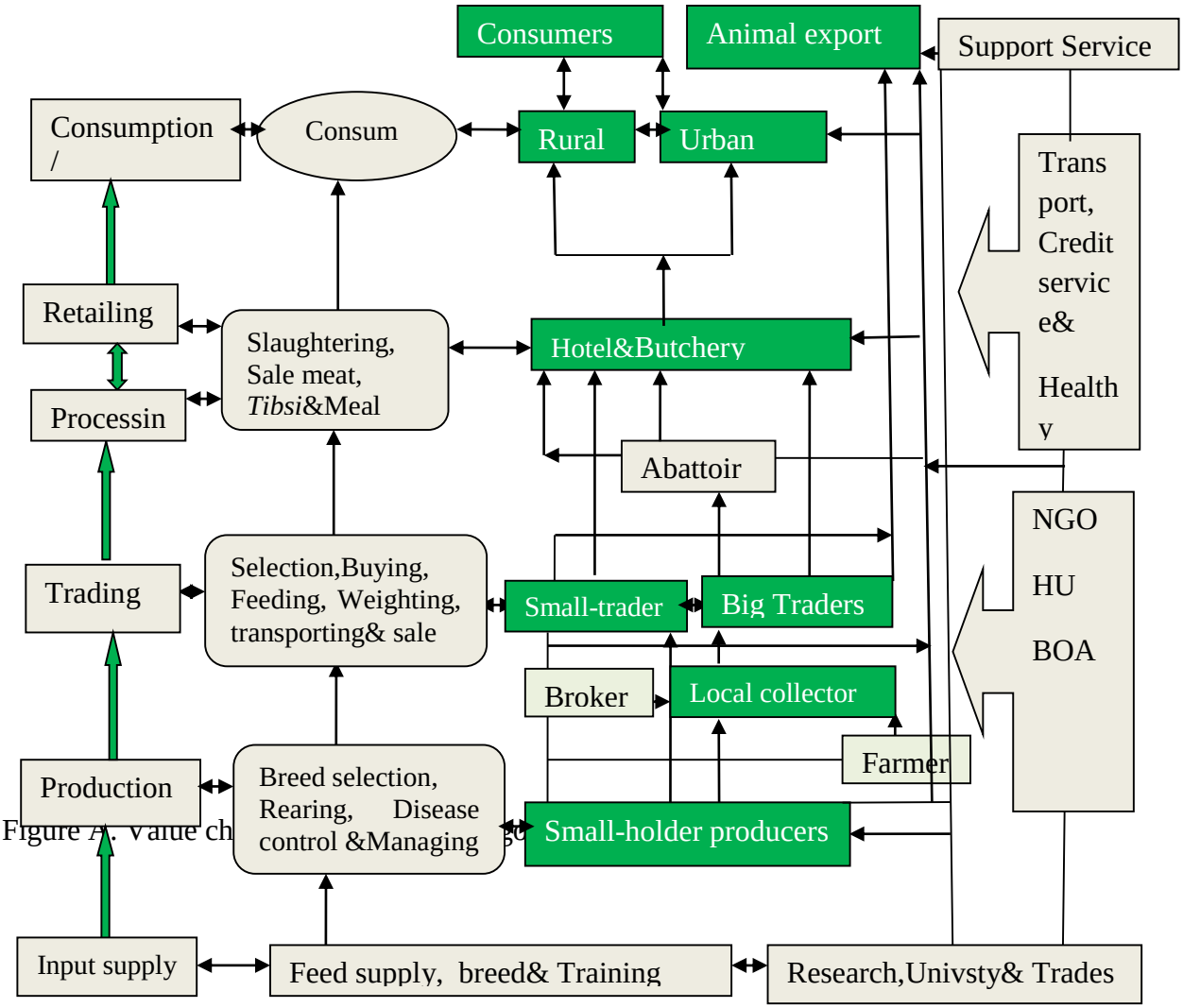


Figure A. Value ch[illegible]g[illegible]

Distribution of marketing cost and margin in sheep and goat value chain

Costs of production and marketing

These are total costs for production of small or yearling sheep and goat head. Sheep and goat producers may use different inputs to rear sheep and goat. This inputs that needed to grow sheep and goat may include labor, feed and medication. Marketing costs are those variable costs involved in product marketing by every actor. These costs are transportation cost, tax payments etc. incurred during product marketing. In a competitive and efficient market,

marketing costs determine the size of returns to farmers and all marketing actors in a value chain.

Table 8. Production and marketing cost of sheep and goat

	Producer	small trader	Big traders	Exporters	Hotel & butcher	Collector	Mojo/Burayu Finfine(Big)
Rope	2	-	-	-	-	1	1
Feed	252.32		5	5	3	2	5
Slaughtering	-	-	-	-	50	-	-
Veterinary cost	22.74	-	-	-	-	-	-
Processing	-	-	-	-	50/days	-	-
Load/unloading	-	-	4	4	-	-	5
Labor(combiner)	50	-	6.7	6.7	-	-	6.7
Food and transport	-	4	5	8	50	3	10
Tax	5	10	10	10	-	5	4.16
Trekking cost	-	-	-	-	5	5	-
Trucking cost	-	-	29.16	29.16	-	-	29.16 by car
Brokers fee	-	15	15	15	5	-	15
Other cost	5	-	1.66	1.6	-	-	10
Total cost	**345.1**	**29**	**76.52**	**79.46**	**168**	**16**	**86.02**

Source: computed from survey costs

As indicated in Table 8 above, the highest marketing cost was incurred by hotels and Butcher followed by Big trader (Exporters). The major cost item for hotels and Butcher is cost of processing (slaughtering, oil, pepper, injera and labor) whereas cost of trucking and broker fee for big traders. Hotels and butcher sell either roasted meat for consumption at their place or raw meat that could be in the take-away form or consumption. Data collected from the surveyed markets and from discussions made with key informants were used to analyze marketing costs. The major costs for sheep and goat producers are high due to feed costs and labor costs as indicated in (Table 8). However, sheep and goat producers marketing cost is considered as minimum since they are trekking their animals to the nearby markets by themselves or using family labor.

There are additional costs such as combiner's cost. 'Combiner' is the name given to the individual at the back of the truck whose primary function is to make sure that animals do not fall in the truck and get trampled and do not jump from the truck. As result revealed, big traders pays labor (combiners) 1000 EB per truck to Finfine,Mojo and wucale in Somalia for

managing animal on car. They pay 3500 ETB/trck for Isusu and 4500ETB/truck for FSR to Burayu, Mojo and Finfine. They pay feed cost to animal, guards, commission, loading/unloading tax and etc. Telephone calls are search costs used to communicate with suppliers.

Margin and Value addition

As revealed in Table 9, the value of sheep and goat increases from the lower end of the chain to the upper ends (end users). As an indicator of the efficiency of the channel, net marketing margins of a particular marketing agent are estimated as a residual of the gross marketing margin after paying marketing costs. The value-added of a sector is defined as the difference between its gross output (total production value of the sector) and its intermediary inputs (costs of production inputs). It measures the amount of value created by the sector, to be then shared between labor, capital and taxes. The estimation of market actors' net marketing margin was estimated following Mendoza (1995) as indicated below.

Net Marketing Margin(Value Added) = Gross Marketing Margin – Total Cost

Gross Marketing Margin = Selling Price – Buying Price

Total cost = Standard Marketing Cost + Transaction Costs

Table 9. Marketing for value chain Actors

	Costs			Revenue	Profit		Margin	
Actors	Unit total Cost	Added UC	% Added cost	Unit price	Unit profit (v- add)	Total profit %	Unit Margin	Retail price (%)share
Producer	345.1	-	54.38	1300	954.9	27.4	1300	**31.55**
Local collector	1316	16	2.52	1500	184	5.3	200	4.85
Small trader	1529	29	4.57	1650 or 54Birr/kg	121	3.5	150	3.64
Big trader	1726.5	76.5	12.05	135Bir/Kg or 2500	773.5	22.2	850	20.63
Exporter	2579.5	79.5	12.53	2754Birr	174.5	5.0	254	6.16
Hotel & butcher	2922	168	26.47	320Birr/Kg or 4120	1198	34.4	1366	68.4
Total	-	634.6	-	-	3485.4	100	4120	-

Source: Own survey result,

As we are interested in the total costs of marketing, the percentage total gross margins can be obtained by the formula. Total gross Margin (%)= Retail price –Farm gate price/Retail price*100

Similarly, the value-added of a sector is defined as the difference between its gross output (total production value of the sector) and its intermediary inputs (costs of production inputs). It measures the amount of value created by the sector, to be then shared between labor, capital and taxes. Value-added of a sector is a good proxy for its economic importance and its evolution provides insights on the sector's economic health. As revealed in the above table 9,the amount of farmers' share in consumers' price depends on the market prices which are flexible over time depending on the availability of sheep and goat in the market on one hand and bargaining power of the middlemen on the other. As revealed the amount of farmers' share in consumers' price was found to be 31.6 percent. An increase in the share is taken as an evidence of increase in the efficiency of the marketing system in favor of the farmer, while a decrease in the farmer's share is taken as evidence of the fact that middlemen retain a larger share. So, the result revealed that the farmers producers were not benefited from production and marketing of sheep and goat due to constraints and problem of Brokers.

Identified Market Channels

The major marketing channels linking producers with end users were identified and presented according to the following figure in this study. These different market channels represent the full range of available outlets through which sheep and goats move from the different collection points in major production areas to terminal markets to meet end-users needs.

Smallholder producers –Local Collectors- Big traders- Animal exporters

Smallholder Producers – Local Collectors–Small traders –Hotel and Butcher-consumers

Smallholder Producers-Small traders-consumers

Smallholder Producers - Hotel and Butcher –consumers

Constraints and opportunity in small-ruminants Value chain

Sheep and goat production constraints and opportunity

The identification of major constraints for sheep and goat production system in a given area is a prerequisite to plan appropriate intervention strategies for improving productivity. Accordingly major constraints faced by sheep and goat production system, based on

interview of respondents, in the study areas were identified and are presented in the following table. In the study area shortage of grazing land, disease problem, shortage of water and feed shortage are found to be main constraints for sheep and goat production.

Table 10. Sheep and goat production constraints in the study area

Constraints		Survey district				Total
		Babile	Kersa	K/callee	Fadis/midhaga	
Shortage of grazing land	Count	11_a	20_a	5_a	3_a	39
	% within count	28.2	51.3	12.8	7.7	100
Feed shortage	Count	8_a	$8_{a, b}$	$0_{a, b}$	0_b	16
	% within count	50	50	0	0	100
Shortage of veterinary	Count	0_a	$6_{a, b}$	3_b	$1_{a, b}$	10
	% within count	0	60	30	10	100
Disease problem	Count	4_a	13_a	2_a	12_a	31
	% within count	12.9	41.9	6.5	38.7	100
Shortage of water	Count	$3_{a, b}$	5_b	$2_{a, b}$	11_a	21
	% within count	14.3	23.8	9.5	52.4	100
Shortage other input	Count	1_a	2_a	0_a	3_a	6
	% within count	16.7	33.3	0	50	100
Poor management	Count	0_a	3_a	0_a	1_a	4
	% within count	0	75	0	25	100
Other	Count	2_a	4_a	1_a	0_a	7
	% within count	28.6	57.1	14.3	0	100
Total	Count	29	61	13	31	134
	% within count	21.6	45.5	9.7	23.1	100

Source: Own survey results,
Each subscript letter denotes a subset of Survey district categories whose column proportions do not differ significantly from each other at the .05 level.

The results in Table 10 above showed that shortage of grazing land was found to be the first production constraints, shortage of veterinary service as second constraints, disease problem as third production constraints for sheep and goat production and shortage of water was ranked as forth constraint for sheep and goat production.

Farmers replied during group discussion that men and women also lacked knowledge of the quality requirements/standards for export. Factors such as poor technical skills in animal care, limited veterinary services, limited access to markets and poor marketing skills, limited access to financial and extension services, high illiteracy levels and constraining tend to limit women's opportunities to access, control and expand their small ruminants stock and production. With regard to input supply, the major constraints were accessibility to breeding and the high price of supplementary feed is where women were more constrained then male.

These findings show that women and men equitably access inputs along the sheep and goat value chain. However women were more constrained in input supply as observed from group discussion. Both men and women farmers were constrained by lack of improved sheep and goat management practices.

Main constraints highlighted by veterinary medicine suppliers include limited farmer skills and knowledge, low prices charged for goats and sheep which then prevent farmers from buying veterinary drugs, and poor access to goat and sheep markets by farmers. These constraints have a negative impact on their production activity.

Table 11. Goat and sheep production opportunities

Opportunities		Survey district				Total
		Babile	Kersa	K/callee	Fadis/midhaga	
Grazing area	Count	$5_{a, b}$	6_{b}	0_{b}	13_{a}	24
	% within Count	20.8	25	0	54.2	100
Feed availability	Count	2_{a}	1_{a}	1_{a}	2_{a}	6
	% within Count	33.3	16.7	16.7	33.3	100
Communal hill area	Count	5_{a}	14_{a}	3_{a}	6_{a}	28
	% within Count	17.9	50	10.7	21.4	100
Favorable climate	Count	17_{a}	37_{a}	9_{a}	10_{a}	73
	% within Count	23.3	50.7	12.3	13.7	100
Other	Count	0_{a}	3_{a}	0_{a}	0_{a}	3
	% within Count	0	100	0	0	100
Total	Count	29	61	13	31	134
	% within Count	21.6	45.5	9.7	23.1	100
$Chi^2 = 24.40$, , p-value = 0.018						DF =12

Source: Own survey results,

The opportunities of sheep and goat production in the four woreda**,** based on respondent interview, are presented in table 11 above. The result revealed that the respondents listed three main production opportunity for sheep and goat production and these were favorable climate condition for sheep and goat production, presence of communal hill area of various tree specious, grazing area. There were opportunities available such as an increasing interest of farmers to rear sheep and goat, increasing trend in sheep and goat demand.

Marketing constraints and opportunity in small ruminant value chain

Almost all sheep and goat producer farmers responded that there were market problems in their area. The major sheep and goat marketing constraints are related with lack market

information, brokers hinder fair pricing, low price of animals and price fluctuation for sheep and goat. Brokers also cause a problem to farmers by hiding price information before them entering the market. Because broker most of the time buy the sheep and goat from the farmers in the village, on the road and remote place to hide information.

Table 12. Market constraints for sheep and goat marketing

Constrainrs		Survey district				Total
		Babile	Kersa	K/callee	Fadis/midhaga	
Low price	Count	5_a	10_a	3_a	7_a	25
	% within Market constraints	20	40	12	28	100
No market info	Count	8_a	16_a	4_a	3_a	31
	% within Market constraints	25.8	51.6	12.9	9.7	100
High input cost	Count	2_a	1_a	1_a	3_a	7
	% within Market constraints	28.6	14.3	14.3	42.9	100
Price fluctuation	Count	4_a	11_a	1_a	2_a	18
	% within Market constraints	22.2	61.1	5.6	11.1	100
Lack of infrastructure	Count	2_a	7_a	2_a	2_a	13
	% within Market constraints	15.4	53.8	15.4	15.4	100
Broker Problm.	Count	6_a	11_a	1_a	8_a	26
	% within Market constraints	23.1	42.3	3.8	30.8	100
Market distanc.	Count	2_a	5_a	1_a	6_a	14
	% within Market constraints	14.3	35.7	7.1	42.9	100
Total	Count	29	61	13	31	134
	% within Market constraints	21.6	45.5	9.7	23.1	100
$Chi^2 = 15.19$, , p-value = 0.68 DF =18						

Source: own survey results,

As mentioned previously, women were not actively involved in marketing. Market information is also more accessible for men rather than women since men had more personal contacts with market operators than women. This is because of women's limited mobility due to demanding household chores and other responsibilities. Traders replied that low quality of sheep and goat production was the major constraint related to sheep and goat marketing. Traders' women were replied that as lack of working capital is the main challenging for

potential trading. Limited women's participation in marketing was observed during survey data collection. Lack of establishing and strengthening of farmers' groups, cooperatives and associations to build social and economic empowerment as well as boost their bargaining power.

Constraints that the traders face include high purchase prices and high transport costs, competition from large scale traders, poor access to market information and limited trader skills and information. However, to improve income from livestock, traders indicated that they need to have own transport rather than using hired as it is expensive, they will need to embark on livestock feeding then market them.

Conclusions and Recommendations

This study was conducted in Eastern Hararghe Zone of Oromia region of Ethiopia to analysis value chain of sheep and goat based on agro ecology (high, mid and lowland) of the area. The survey study was implemented by interviewing selected individual small ruminant producer, key informants and focus group discussion. Eastern Hararghe zone districts of Oromia region were selected for this study purposively based on potential for small ruminant production.
The main value chain actors identified by the study were producers, collectors, traders, butchers, local consumers and exporter. Important marketing channels of sheep marketing were identified. Marketing margins and costs were calculated for selected channels using data collected during the surveys. The production costs to rear yearlings were also identified.

Sheep and goat production are faced by the shortage feed especially during dry season, poor in quality and decreasing its productivity for grazing and in wet season expansion of crop cultivation on grazing areas are the majors' problems identified. In addition the result showed that the major constraint sheep and goat production were disease and parasite, feed and shortage of grazing land, shortage of water and drought. Women play a significant role in overall management of sheep and goat value chain across all sites. They gather feed and provide feed to the animals, water, take care of the sick and young animals, contribute to cleaning the animal shelter and contribute to sale of the products. Men are specifically involved in herding, cutting forage, marketing and taking sheep and goats to health centers.

Traders' women were replied that as lack of working capital is the main challenging for potential trading. Thus women should be supported with the necessary credit and training

facility to raise their sheep and goat to the required standards participation in income generation from small ruminates. Constraints that the traders face include high purchase prices and transport costs, competition from large scale traders, poor access to market information and limited trader skills and information. However, to improve income from livestock, traders indicated that they need to have own transport rather than using hired as it is expensive, they will need to embark on livestock feeding then market them.

Recommendations

There is need for use of modern technologies such as mobile phones for communication and sharing information. To increase farmers benefit from sheep and goat production, improved breed should be identified and introduced to the community. Farmers should be cooperated to minimize broker problem and increase farmers share in consumers' price. Constraints that the traders face include high purchase prices and transport costs, competition from large scale traders, poor access to market information and limited trader skills and information. However, to improve income from sheep and goat, traders indicated that they need to have own transport rather than using hired as it is expensive.

Encouraging, facilitating the establishment and strengthening of farmers' groups, cooperatives, producers' organizations and associations was found to be most important to enhance empowerment as well as boost their bargaining power. Encourage participation of women in trainings aimed at improving women's marketing, trading and business skills. Identify and build market information systems that target the information channels used by men and women. Organization of women and male farmers into mixed groups to build social capital and enhance information flow. Thus women should be supported with the necessary credit and training facility to raise participation in income generation from sheep and goat. So, the result revealed that producers should cooperate to minimize constraints and problem of Brokers.

References

Baars, R.M.T. (2000). Costs and returns of camels, cattle and small ruminants in pastoral herds in Eastern Ethiopia. *Tropical Animal Health and Production.***32:**113-126.

Bagley, M.N. (2006). Meat Goat Breeds, Breeding Management, and 4-H Market Goat Management.

http://www.extension.umn.edu/meatgoats/components/pdfs/producerworkshop06/DougThompson.pdf

Coles, C. and Mitchell, J. 2011. Gender and agricultural value chains: A review of current knowledge and practice and their policy implications. FAO, ESA Working Paper No. 11. Rome, Italy: FAO.

CSA (Central Statistical Authority - Ethiopia) (2008). *Summary and Statistical Report of the 2007 Population and Housing Census. Population Size by Age and Sex*. FederalDemocratic Republic of Ethiopia Central Statistical Agency Population CencusCommission. Addis Ababa, Ethiopia.

CSA (Central Statistical Agency). 2014. Summary and statistical report of the2013/2014 survey on Livestock and livestock characteristics,, Volume II Addis Ababa, Ethiopia

Fletschner, D. and Kenney, L. 2011. Rural women's access to financial services: Credit savings and insurance. ESA working paper No. 11–07. Rome, Italy: Agricultural Development Economics Division, Food and Agriculture Organization of the United Nations.

Gizaw, S., Abegaz, S., Rischkowsky, B., Haile, A., Mwai, A.O. and Dessie, T. 2013. Review of sheep research and development projects in Ethiopia. Nairobi, Kenya: International Livestock Research Institute (ILRI).

GTZ (Deutsche Gesellschaft für Technische Zusammenarbeit GmbH). 2007. Value Links Manual: The Methodology of Value Chain Promotion, First Edition. Found at Internet address http://www.valuelinks. de/manual/distributor.html

Hirst, K.Kris. (2008). The history of domestication of goats.
http://archaeology.about.com/od/domestications/qt/goats.htm

Kaplinsky, R. and Morris, M. 2000. A handbook for value chain research. Ottawa, Canada: IDRC.

MEDaC (Ministry of Economic Development and Cooperation) (2000). Ethiopian Economy in figures: selected indicators. Department of Macroeconomic Planning and Policy Analysis. Addis Ababa, Ethiopia.

MoFED, 2009 MoFED, 2009. http://www.mofaed.org. archived 17 February, 2009.

Momsen, J. H. (2004). Gender and Development. New York: Routledge.

Njuki, J., Kaaria, S., Chamunorwa, A. and Chiuri, W. 2011a. Linking smallholder farmers to markets, gender and intra-household dynamics: Does the choice of commodity matter? European Journal of Development Research 23(3):426.

Rubin, D., Manfre, C. and Barrett, K. 2009. Promoting gender equitable opportunities in agricultural value chains. Washington, DC, USA: USAID.

Terrillon, J. (2011). Gender Mainstreaming in Value Chain Development: Corporate Network

Agriculture SNV

Tilahun Sahlu, & Goetsch, A. (2005). A foresight on goat research. *Small Ruminant Research***60**: 7-12.

Assessment of Rural Energy Sources and Energy Consumption Pattern: The Case of Jimma and Ilubabor South-Western Oromia

Mengistu Jifara
Oromia Agricultural Research Institute, Jimma Agricultural Engineering Research Center, P.O. Box 386, Jimma, Ethiopia
**Corresponding Author: jifaramenge@gmail.com*

Abstract

The study has tried to identify rural energy sources, existing cooking stoves and energy consumption pattern so as to generate essential information for further research and development interventions. The analysis of the result indicates that almost the entire household energy consumption is met by fuel wood and very insignificant of free and renewable energy sources are used. Leaving rural inhabitants to continue on with the current use pattern of traditional energy sources will have negative impact on the rural economy at large and the environment and the ecosystem balance. Based on results, the study recommended extensive utilization of alternative energy sources, provision of improved rural energy technologies that run by renewable energy resources in subsidized prices, importing equipment of rural energy technologies, establishment and expansion of rural energy fund at local levels in order to create enabling environment to attract private sector in the development and dissemination of rural energy technologies such as improved fuel saving cooking and baking stoves and also strengthening communication and collaborative work between rural energy technology promoting agents.

***Keywords**: Consumption Pattern; Rural; Energy; Sources*

Introduction

Access to efficient and modern energy is extremely crucial for the developing nations to counter the economic and health issues and at the same time with the productive use of energy increase the economic growth and life standard of the deprived people. A well performing energy system can provide these people with income generating opportunities as well as to escape them from the awful impacts of poverty. Unfortunately this has not been made possible due to financial issues, lack of resources, effective energy policies and energy systems in the developing nations (Dawit, 2012).

Dependency of the people on traditional biomass for catering their cooking and lighting energy demands in the developing nations still prevails especially in rural areas. Poverty, lack of availability of modern energy and lack of education are the main causes of this phenomenon. Abundant use of biomass for meeting the demands also brings the scarcity of these resources like fuel wood. Another detriment side of utilizing biomass in inefficient way

is higher consumption of energy than usually required with disastrous health effects due to smoke (Cecelski, E. 2004).

Access to modern and clean energy like electricity and efficient cooking technologies to the rural areas in developing world not only provide improved and healthy life style but would also help in reducing harmful environmental effects. Efforts on the all levels are required to counter this situation with effective projects and policies on government level as well as awareness of the uneducated masses in the rural developing world (FAO, 2010).

Energy is vital to any economic development, to improve societal comfort and wellbeing. Fast economic growth and social transition in western countries are directly attributed to progressive invention and improvement of modern energy services. Currently fossil fuel accounts for more than 90% of overall energy supply of western countries resulting in their share of 80% of the global fossil fuel energy consumption. However, since the mid-20th century, the concern over diminishing reserves of fossil fuel and greenhouse gas emissions arose as new global environmental challenges.

The poorest countries in the world were unable to benefit from the cheap fossil fuel era and the associated modern energy services. About 45% of those deprived of modern energy services are living in Sub-Saharan African countries where traditional biomass accounts for more than 90%of their overall energy uses. Biomass is a carbon neutral renewable source based on photosynthesis. Its current use though is associated with burning in inefficient stoves, possibly leading to scarcity of firewood, deforestation and impaired health. Fossil fuel is less likely to provide a solution for poor countries relying on foreign oil imports due to its surging prices and related greenhouse gas emissions Adusei L. A. (2012).

Access to efficient and modern energy is extremely crucial for the developing nations to counter the economic and health issues and at the same time with the productive use of energy increase the economic growth and life standard of the poor people (Clancy, J 2003). A well performing energy system can provide these people with income generating opportunities as well as to escape them from the awful impacts of poverty. Unfortunately this has not been made possible due to financial issues, lack of resources, effective energy policies and energy systems in the developing nations.

Dependency of the people on traditional energy for catering their cooking and lighting energy demands in the developing nations still prevails especially in rural areas. Poverty, lack of availability of modern energy and lack of education are the main causes of this phenomenon. Abundant use of biomass for meeting the demands also brings the scarcity of these resources like fuel wood.

Another detriment side of utilizing energy in inefficient way is higher consumption of energy than usually required with disastrous health effects due to smoke. Access to modern and clean energy like electricity and efficient cooking technologies to the rural areas in developing world not only provide improved and healthy life style but would also help in reducing harmful environmental effects. Efforts on the all levels are required to counter this situation with effective projects and policies on government level as well as awareness of the uneducated masses in the rural developing world.

Objectives of the study

- The main objective of this study was to assess and analyze the existing energy resources in the area.

The specific objectives of the study were:

- To characterize and analyze the existing energy resources of the Jimma and Ilubabor,
- To identify and prioritize challenges and constraints of the energy resources of the study area
- To identify and prioritize potential opportunities of the energy resources of the study area

Methodology

Description of the Study Area

This study was conducted in Ilubabor (Gore, Bure and Metu) and Jimma zones (Dedo, Gera and Tiro Afata) in SW Oromia regional state of Ethiopia. Jimma zone is located in the south-west .It is geographically located between 7^0 45' 00" N latitude and 36^0 47' 00" longitude. The minimum and maximum temperature of the zone is 13℃ and 25℃, respectively and also the average annual rainfall is 1800mm. Nitosols and Orthic Acrisols are the dominant soil types with slightly acidic PH, which is suitable for coffee and fruit production (ORG, 2003).

Iluu Abba Bora is situated in southwestern part of Oromia Regional State as well as the country. It is bounded by East Wellega and Jimma zones in the east. Iluu Abba Bora also shares a border with West and East Wellega in the North; SNNPR in the south and with Gambella Regional State in the west.It is located between 8^0 2'42"N and 8^0 31' 18"N and 35^0 37' 48"E and 36^0 05' 18"E

Method of data collection and data sources

In this study the researcher used multiple research approaches from different angles. Based on the nature of enquiry, the researcher applied quasi-quantitative research approach. By applying quantitative principles, the researcher attempted to answer a research question that seeks to describe the existing situations in relation to the patterns and determinants of household energy among selected farmers, specifically, to describe the shortage of energy and how to cope with this shortage of energy. Through qualitative research approach, the researcher collected the opinion of respondents about patterns and determinants of household energy consumption.

The major sources of data include both primary and secondary source at different levels. Primary data was generated through focus group discussion, individual interviews, and formal and informal discussions with farmers, DAs and experts. Focus group discussions, key informant interview and informal discussion were among the employed tools to collect primary data using checklist and semi-structured questionnaire.

Sampling Techniques

Multi-stage sampling techniques were employed for data collection. At the first stage, six districts were selected randomly from the two zones. In the second stage, three kebeles were selected randomly. The number of the respondents involved in the study from each kebele was determined based on probability proportional to size.

Table 1. Distribution of sample households

Zone	Districts	Number of respondent	Percent
Jimma	Dedo	30	16.30
	Gera	26	14.13
	Tiro Afata	35	19.02
Ilubabor	Gore	32	17.39
	Metu	32	17.39
	Bure	29	15.76
Total		184	100

Source: own data

On the basis of agro-ecology diversity, representative Woredas, Kebeles and participant farmers were selected using systematic sampling technique. Then, from the identified Kebeles/villages, representative farmers were randomly selected for group discussion and interviews using systematic sampling procedure. The sampling method is taking into consideration the age, sex composition, educational status, roles and responsibilities in the community. A multi-disciplinary team will be established to conduct the survey using different PRA tools.

Different PRA tools was employed to collect information on different aspects of existing biomass fuel resource of the study area including semi-structured interviews, focus group discussions and personal observations was employed to generate primary data pertaining to the existing biomass fuel resource in the study area. Focus group discussions were employed to get about the existing biomass fuel resource, prevailing opportunities and constraints, with key informants (farmers, DAs, community leaders).

The collected data was analyzed using statistical tools to fulfill the objectives of the study. The quantitative data was analyzed using descriptive statistics like mean, standard deviations frequency and t-test using Statistical Package for Social Sciences (SPSS) for analysis.

Results and discussion

Households' Input and Utilization of Energy Consumption

This part discusses households' total input energy consumption and the amount of energy effectively utilized. The analysis of the data on patterns of energy consumption can be expressed either in terms of expenditure (ETB) or as the amount of energy consumed in terms of heat value of energy. The amount of energy consumed from each specific energy source can be estimated by converting its expenditure into heat value.

Households' Input Energy Utilization

Biomass fuel, which consists of fuel wood, charcoal, sawdust, dung and crop residues, constitutes the highest share of the total household energy consumption. The most important of all the domestic biomass energy resources is fire wood. Out of the 184 sample households who completed and responded to the questionnaire, almost three fourth of the participants (75.38%) use fire wood and only 24.6% indicated that they are using different energy sources

for household purposes. Fuel wood is, therefore, vital sources of domestic energy in the study area besides the need for construction and household furniture.

With regard to the availability of fire wood, 92.18 percent of sample households obtain it by collecting. Fire wood sellers are both male and female sellers who carry the firewood by their heads and backs, respectively. Households buy mainly of stems from male- sellers and branches from female sellers. 3.82 percent of the households bought firewood from the local market and the remaining percent of the households collect by their own.

The rest 7.82 percent go for buying and collecting. Over half of those surveyed households (57.40%) are able to obtain regular supplies within one km of their residence. The frequency of purchase generally lower among low-income households, they often purchase fire wood less in a year. Location of households has direct impact on the access to collect fuel wood, i.e. the nearer the kebeleis to the periphery; the more the fire wood is collected.

Fire wood consumption is often measured in head loads. Enumerators would need to weight a typical head load. Results from questionnaire surveys show that most households in the area consume between five and ten bundles of Fire wood per month. Each bundle of wood fuel ranges in weight from 15 to 30 kg. Although fire wood are usually sold in bundles along the highway with no actual weight measurements, human loads of better quantity of fuel wood are purchased at the outskirt of the town when these vendors are on their way towards the center.

Demographic and Socioeconomic Characteristics of Respondent Households

Demographic characteristics of sampled households, the total sample of the study are composed of different class household categories (model farmers, middle farmers and resource poor farmers). This result is clearly shows that model farmers use improved stove. Discussion with sample respondents revealed that the lower users of improved stove in the study area are mainly due to lack of awareness, shortage of income and access to adequate improved stove in the study area. The result in table also indicated that there is significant difference between the numbers of improved stove user across different villages.

Table 2. Demographic and geographic characteristics of the study districts in Jimma and Ilubabor zone

Districts	Population		Total
	Men	Women	
Ale	32,034	32,232	64,266
Dedo	143,935	144,522	288,457
Metu	30,982	30,972	61,954
Gera	56,488	55,907	112,395
Bure	25,312	25,529	50,841
Xiro afata	65,341	66,195	131,536

Age of the household head

Out of the selected 184 sample households, the maximum age observed from the sample respondents was above 45 while the minimum is less than 25 years. However, the majority of the respondents were found to be above 45 years. A vast majority of these households directly or indirectly depend on traditional energy sources.

Sex composition of the household head

Out of the total respondent s 184 (71 %) were males.

Marital status

Out of the total respondents, the majority (178) or 96.8 % were married and only 3 (1.6 %),2 (1.1%) and 1 (0.5 %) were Divorced, single and widowed respectively. A large number of households of each group use crop residue, electricity, fire wood, charcoal, cow dung and kerosene as energy sources.

Table 3. Marital status of the respondent households

Marital	Status No of Respondent	Percent
Single	2	1.10
Married	178	96.80
Divorce	3	1.6
Widowed	1	0.5
Total	184	100.00

Table 4. Educational background of the respondents

Level of education	No of Respondent	Percent
illiterate	23	12.5
Can read and write	70	38
Elementary	91	44.5
High school, Diploma	-	-
Total	184	100

Data source: Own survey 2016 - 2018

About 23 (12.5 percent) of the respondents are found illiterate and 70 (38 percent) could read and write, 91 (44.5 percent) elementary school. Almost 95 of the households have only elementary or below elementary level of education. Due to their educational backgroundhave no good opportunity to find better job and live a good life. They have no opportunity to afford the high price and shortage of means of energy.

Housing Conditions and Tenure

Regarding housing conditions, the majority of the residential units are poorly constructed and of low standard. This is an indicator to the low living conditions of the sample households. The majority of the housing units (91%) is made of mud, wood and corrugated sheets while only a small share (9%) of the residential units built using hollow blocks or concretes. The major materials used for the construction of wall in the study area are wood and mud (85.2%), stone and cement (10.4%) and hollow blocks (4.4%). It was also observed that most residential units are of standalone types (83.1%) while 16.9 percent of the dwelling units are attached row houses.

Gender Difference in Energy Expenses and Consumption

The minimum and maximum expenditures were 25.66 ETB and 210 ETB for MHHs while they are 37.44 ETB and 347.68 ETB for FHHs, respectively. The mean monthly per capital expenditure ranges from 43.40 ETB for the MHHs to as high as 83.53 ETB for the FHHs. The average monthly expenditure made on energy per household was 86.30ETB for the MHHs and ETB 56.9 for the FHHs. That means MHHs and FHHs are spending 9.64 percent and 15.95 percent of their average incomes, respectively. This shows that FHHs use a higher average income than MHHs for purchasing energy

Table 5. Mean Monthly Income and Fuel Expenditures for Households Headed by Males and Females (ETB)

Gender	Household Income (ETB)			Energy Expense (ETB)			Percentage of income
	Mean	SD	CV	Mean	SD	CV	
MHHs	490.30	148.38	32	86.3	17.4	12.5	9.64
FHHs	171.80	89.50	19	56.90	13.6	8.20	15.95

SD: standard deviation CV: coefficient of variation, MHHs: male household, FHHs: female household

Table 6. Percentage of households consuming a particular energy sources

Districts	Charcoal	Firewood	Crop residue	Kerosene	Cow dung	Solar/ electricity
Gore	19	60	5	9	2	5
Metu	16	54	6	11	1	12
Bure	5	63	23	3	4	2
Dedo	15	65	13	3	-	4
Gera	11	68	9	10	-	2
Tiro Afata	9	59	20	8	-	4
Average	12.50	61.50	12.67	7.33	1.17	4.83

Source: own data

Spatial Patterns of Biomass Energy Consumption

The highest fire wood use occur inJimma and Ilubabor zone. High amount of fire wood use are found along the highlands and either side of the low lands of both zones.The Jimma and Ilubabor Zones are of Oromia regional state is a renowned coffee producing area located along the south- western.The main charcoal consuming areas are in Gore, Dedo (high land) Gera, Metu (mid highland) and Bure, Xiro Afata in the lowlands.Crop residues are used as fuel almost totally in the highlands although the amounts in Jimma and Ilubabor arerelatively low.The main areas of high dung use as fuel are the highlands (Gore and Dedo).

Table 7. Percentage (%) of household consuming a particular energy sources

Districts	Charcoal	Firewood	Crop residue	Kerosene	Cow dung	Solar /electricity
Gore	19	60	5	9	2	5
Metu	16	54	6	11	1	12
Bure	5	63	23	3	4	2
Dedo	15	65	13	3	-	4
Gera	11	68	9	10	-	2
Tiro Afata	9	59	20	8	-	4
Average	12.50	61.50	12.67	7.33	1.17	4.83

The largest percentage of (average) household consuming is firewood in all districts of sampled area. Furthermore, the percentage of household consuming is the highest followed by crop residue, charcoal, kerosene, solar and cow dung.

Useful Household Energy Consumption

Useful energy represents for energy services in the form of effective energy that a household obtains. The amount of useful energy differs from one type of energy to another depend on

the quality of energy and how it is efficiently consumed. Energy efficiency is a measure of the energy used in providing a particular energy service end and defined as the ratio of the useable energy output to the energy input.

The households in the village get lesser energy services owing to large dependence on traditional fuels that are used at very low efficiency. The rest parts of village are depend on collecting refuse and by making cow dung to survive the shortage and the high price of energy consumption. However, some of households in the village are dependent on modern fuels for the same amount of expenditure.

The amount of useful energy received per household rises with a rise in household income. This shows that with a rise in a household income, there is a corresponding increase for useful energy and there is a need for household energy and there is a need for households to use more fuels that are used at high. The amount of useful energy received at higher income groups are high mainly due to consumption of better fuels and modern appliances/stoves, mirt and gonze whose efficiency levels are relatively much better.

Baking injera is by far the most important domestic function in many of the households of then village. It dominates the end uses of fire wood, leaves refuse and sawdust. The most important of all types of fuels used for injera baking 152 (82.6 percent) is fire wood. It is used for baking injera among majority of the users. Fire wood and crop residue is the other source of energy used for baking injera among households. The proportion of household using fire wood for baking injera declines with a rise in household income and shortage of fire wood supply. While the proportion of fuel consumers for the same propose increases. The proportion of using fire wood and crop residue for baking injera were 152 (82.6percent) to 15 (8.18 percent) respectively form the whole sampled household.

Table 8. Proportion of households using various types of energy in the domestic function of baking injera

Sources of energy	No of respondent	Percent
Fire wood	152	82.6
Leaves and sawdust	10	5.4
Crop residue	15	8.15
Cow dug	3	1.63
Electricity	2	1.09
Others/ mixed	5	2.72
Total	184	100.00

Data: own survey

Fire wood is used mainly for cooking purposes rather than for baking. Fire wood is the most important energy source, which is used by 146 (79.35percent) households for cooking wot. The remaining proportion was occupied by households, which use charcoal23 (12.5 percent) and kerosene15 (8.15percent). The use of charcoal for cooking purposes was predominance among majority of the high and medium income groups, whereas, fire wood and kerosene use among low and none income group. Fire wood is used mainly for both baking purposes and it is also used for cooking wot in the lower income group wot cooking is frequently cooked almost in all households.

Table 9. Proportion of households using various types of energy in domestic function of cooking Wot

Source of energy	No of Respondent	Percentage
Fire wood	146	79.35
Charcoal	23	12.5
Kerosene	15	8.15
Total	184	100.00

Data: own survey

Charcoal and fire wood are used for making coffee. Fire wood is the most important energy source, which is used by 167 (90.76 percent) of sample households for making coffee. The use of charcoal for making coffee was predominance among majority of the high income groups, whereas, fire wood are used among many households in the low income group.

Table 10. Proportion of households using various types of energy in domestic function of cooking coffee

Source of energy	No of Respondent	Percentage
Fire wood	167	90.76
Charcoal	17	9.24
Total	184	100.00

Data: own survey

Table 11 Summary of Households Expenditure Sampled Districts

Districts	Monthly Average Expenditure (in Birr)	Monthly Average Energy Expenditure (in Birr)	Expenditure Share of Energy (%)	Average Household Size
Gore	430	50	10.5	6
Metu	540	49	9.5	6
Bure	350	42	8.4	4
Dedo	290	45	7.3	6
Gera	260	30	5	4
Tiro Afata	380	59	12.5	5
Average	375	45.83	8.87	5

Data: own survey

Tiro Afata is the leader in terms of average monthly energy expenditure and its share in the overall monthly household budget. The maximum monthly energy cost is Birr 59 whereas the lowest is Br 30 in Gera. Energy expenditure in all districts other than Metu and gore lie between Birr 30 and Birr 49 whereas the figures for Tiro Afata and gore are Birr 59 and Birr 50 respectively.

In terms of expenditure share, Tiro Afata stands out as an outlier with the share being as high as 12.5 percent, closely followed by Gore (10.5 percent). The lowest expenditure share is observed in Gera5 percent. In conformity with the general prescription that expenditure share of energy decreases with increases in overall income, the largest expenditure share (12.5 percent) was observed in Tiro Afata where the overall average household income.

Household energy consumption trend

The household fuels of Jimma and Ilubabor zone can be categorized as traditional and modern. Charcoal, fuel wood, sawdust, and dung make up the traditional fuels while kerosene, Liquid Petroleum Gas (LPG) and electricity from hydropower make up the modern fuels. In 2017/18, the per capital household energy consumption of Jimma and Ilubabor was about 2 GJ; traditional fuel shared 92% of the primary energy.

Closer look at traditional fuel consumption trends reveals that in 2017/18, fuel wood accounted for 74%, followed by sawdust and charcoal, which account for 4% and 3% of the share, respectively. Dung had the lowest share (1%). In 2017/18 fuel wood consumption declined by 22%, but it continued to supply 56% of the household fuel. The decline in fuel wood consumption was somehow compensated with a rise in sawdust and dung consumption, which exhibited increases of 473% and 832%, respectively, together constituting 5% of the total consumption, higher than that of charcoal (3%). Charcoal consumption declined by 7% during the decade, but the net traditional fuel consumption increased by 6%.

With regards to types of stoves, the three stone fire place is single most important types of stoves or cooking technique adopted by all rural households. However, few households in wood scarce areas (e.g. Tiro Afata) had mirt biomass injera stoves in their kitchen. Also in most of the area stoves remained largely uninstalled for more than a year in many household in the vicinity of Metu. With few exceptions in wood scarce areas, all rural households freely collect their supplies fire wood and BLT are the two most important energy source among the

household. Leaves and crop residue are also used commonly, though seasonally in wood scarce areas, very few rural areas household have been using charcoal for cooking. As one would expect it, the majority of households in wood scarce area from 60 to 70% reported that a single round trip (including collection time) to collect fire wood takes them three to four hours. In one another hand the majority of households in the sampled area with relative biomass abundance collect fire wood between one to two hours. It should be noted that all households irrespective of Woody biomass endowment levels, perceived increase in fire wood collection time over the year and the increase is due to growing scarcity of supplies.

Results of the rural household survey should that well over half of the households use their living rooms both for baking and cooking. However, more than 80% of rural households in wood scarce area use separate kitchen to cook food. Only five household out of 263 rural households reported that they are engaged in preparing food and drinking for sale.

Energy demand

The main source of cooking energy of rural households in Jimma and Ilubabor zones are biomass. Nearly 80 percent of the energy used for lighting in rural of the study area comes from kerosene and 20 percent from solar/electricity. However people prefer to use electricity in the electrified areas but almost 100 percent of the people in rural areas use kerosene for lighting.

To find out the total cooking and energy source and demand were an imperative part of the survey. It was very important for the study and to know the amount of energy utilized by household for cooking and lighting. It was a challenging part to know the correct amount of consumption of a particular type of fuel as most of the people do not pay any attention while cooking about the amount of biomass used. Secondly very few households buy fuel wood or charcoal on a monthly or yearly basis, as most of the people have their own resources or they collect. But as the kerosene is major fuel used for lighting and majority of the households buy kerosene from the market.

Cooking Energy Demand

In the study areas surveyed in our case is also considerably poor so we see that all households use biomass for cooking. Depending upon the availability and ability to get hold of a particular fuel, households use a mix of different biomass resources for cooking. In this

particular study areas the biomass used for cooking consists of Cow dung, Fuel wood, Agricultural waste (including tree leaves) and Tree branches

The main source of income of 80 percent of the households is agriculture and 20 percent of the households have their first source of income as daily labor and different sources. The study areas who are working as daily labor are actually associated with agriculture. A few households who own cultivable land but are not directly involved in cultivating crops, they either give the land on rent out or hire someone as labor to grow crops. So directly or indirectly most of the households are associated with agriculture, which makes the agricultural waste to be available for the people to use for cooking throughout the year. But as the study area is not very big and the annual production of crops in the study area is not great, so agriculture residue is not the only biomass that is used but rather there is a mix of different biomass resources that is shown in figure 1.

Utilization of Cooking Devices and Kitchen Characteristics

The study has particularly stressed on those baking and cooking stoves which are widely in use by rural households. Households were asked if they possess and frequently use the major types of baking and cooking devices. Every household owns different types of stoves. As the survey data shows there are three types of stoves used for Injera baking. About 94.89 percent of households own traditional Injera baking stove(open earthen stove placed on three stones) and the Mirt stove, which burn fuel wood more efficiently, are used by 5.11 percent of households. The study also reveals that about 6.75 percent of households use efficient Lakech stove. Inefficient traditional metal charcoal stoves are also still used by 9.57 percent of the sample households. Simple biogas burners are also used by limited number of rural households (1.58%). It was found that all the sample households own more than one stove and only 11.72 percent of the sample households own all the stated kinds of traditional and modern stoves.

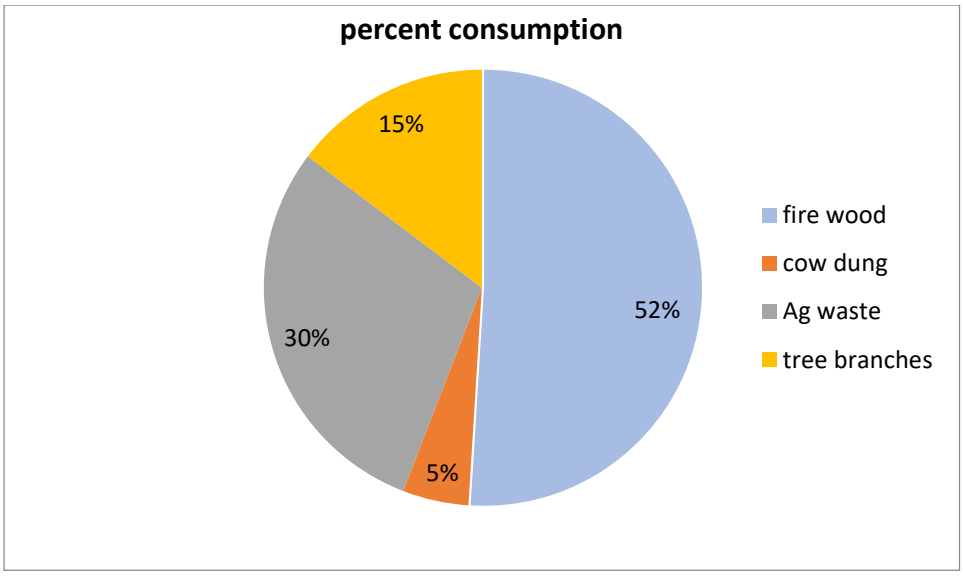


Figure 1 share of biomass in cooking energy consumption

As shown in figure 1, the major share of biomass consumed in the study area as energy is fire wood followed by agricultural waste, tree branches and cow dung. Fire wood constitutes 52 percent of the total biomass in which amount of agricultural waste used for cooking have also been included.

Gender Role and Household Energy Controlling

To know gender roles of energy administration, it is important to know the individual's participation in baking and cooking foods. The study focused on the views of women as they had primary responsibility for cooking within the household. It may have beenuseful to include male heads as they are often in charge of the household's finances, and hence likely to be influential in household decisions to fund new cooking methods. The results have shown that women have the highest experience to indoor air pollution and suffer from negative health effects especially their eyes since they devote considerable time around cooking fires in a kitchen. Women have all the obligation of baking and cooking activities at home. It shows baking Injera and cooking foods are traditionally a women's job in the area. Females take the lion's share of baking and cooking responsibility. Most actively involved groups in cooking were usually female; Daughters and female servants are usually responsible in preparing, cooking foods and drinks.

Women involved in cooking frequently for making wot (99.23%), baking Injera (100 %) and for cooking local foods (78.90%). Female servants are regularly make cooking to prepare Wot (28.15%), baking Injera (24.35%). Moreover, daughters are also chief cooks to prepare Wot (29.78%), Injera (10.73%) and local foods (10.45%). While, housewives, female heads and daughters are the chief cooks, at the same time, they are also always taken the effort of giving a hand in the main baking and cooking activities. Nearly all of males in rural sampled households are not at all involved in baking and cooking. Despite fact that boy children sometimes take the effort of giving a hand in cooking local foods, women take on the responsibility of cooking. Families believe that male involvement on cooking is not cultural; males occupy most of the time outside home to fulfill the households' demands in all the study area.

Women are basically responsible for meal preparation in the household using traditional fuels. Cooking is not only women's most time and effort-consuming energy need; it is also a very large share of household energy consumption. Since cooking is often conducted in indoor kitchen areas the biomass burning exposes women to high quantities of indoor air pollution which results in poor health conditions for women. Thus, the responsibility for household energy provision affects women's health disproportionately to men's. When communities gain access to energy services, it can have a marked effect on their lives, particularly with respect to release up their time, improving their health and well-being, and opening up opportunities such as enabling them to improve their incomes to improve their living situations.

Usually, amount of energy consumption with traditional cooking systems and the time consumed has been an issue for all concerned. As women were always occupied with household responsibilities including the management of household energy resources, they have very little time for other economic and social activities that could enable them to be empowered socially and economically.

It is a widely held view that managing biomass energy for cooking has a significant impact on women's workload and their health, which have hindered their capabilities and opportunities for participating in economic and other social activities. Therefore, to minimize

the workload of women, the dissemination of efficient, modern and appropriate improved stoves is inevitable.

Conclusions and Recommendations

The study reveals that despite the fact that a majority of sample households used fire wood at home, wood fuels (wood and charcoal) remain to be dominant sources of energy for baking and cooking purposes. Charcoal is most preferred rural cooking fuel and is still very important in the energy mix of all households. The results show that majority of the households regardless of their economic status combine the use of charcoal with other source of energy in their household.

Traditional household energy sources are renewable, but the rate of consumption is much greater than the rate of production. Furthermore, the efficiency of the stoves used to process these sources is very low. Evidently, traditional energy is not sustainable. Traditional energy use increases the rate of deforestation and land degradation, which in turn can lead to excess soil erosion and loss of soil fertility. This further contributes to the decline of agricultural productivity and production, perpetuating the vicious cycle of rural poverty. Indoor air pollution associated with kerosene and traditional fuel use is a major health concern, especially for women and children.

Households in Jimma and Ilubabor zone consume more than half of forest wood in the form of fuel wood and charcoal, as well as many of crop residues. Doing away with traditional fuels, therefore, would save more hectares of forest per annum, help recycle soil nutrients more effectively, and minimize deforestation and land degradation. As such, this triple-win scenario could contribute to an increase in agriculture productivity, helping to break the cycle of rural poverty while also combating global climate change.

The efforts of the local government in promoting fuel-efficient technology and alternative fuels have been inadequate. To mitigate energy related problems policy-makers must understand the links between national policy and the real local level effects on poor people if they are to develop effective evidence-based policy. The energy planning and related policy should be implemented at disaggregated level in line with local realities. Current national and local level programmes clearly need to involve communities in the planning process, to

ensure that energy services are appropriate, socially acceptable and sustainable (both economically and environmentally). Considering the energy needs of the whole community when planning energy supply can result in solutions that meet energy demand more efficiently and cost-effectively.

The policy options could be envisaged to redress the rural fuel problem and reduce the pressure of rural centers on neighborhoods. To tackle household level energy problem, the government should develop policies and regulations that are directly targeted at reducing the upfront cost of access to energy-saving devices hence making it affordable accessible and affordable. Through disseminating fuel-efficient stove with a much higher level of energy efficiency such as the Mirte mitad and gonze and better energy alternatives, the pressure on forest and soil resources could be alleviated and the demand for more supply of fuels could easily be met. Households largely dependent on biomass fuels should be encouraged to make fuel substitutions that will result in more efficient energy use and less adverse environmental, social and health impacts, a subsidization of modern fuel price should be effective instruments. Innovative financing mechanism and credit arrangements or subsidies should be created and targeted directly to the poor, to make energy equipment affordable and to enable households.

One of the most appropriate strategies to provide a sustainable energy source for the rural households is to give a considerable focus to alternative sources of energy that can alleviate the energy problem. The policy should direct to alternative sources of energy like utilization of solar energy and biogas rather than still giving more emphasis on biomass fuels as a major source of energy for the majority. These alternative fuels help to reduce demand for biomass and increase efficiency of energy use to improve their economic wellbeing and utilization of their time properly for economically productive activities.

The findings revealed a considerable potential for reducing the pressure on local forest resources by substituting or switching from fuel wood to biogas. Awareness within communities will be created and promoted so as to encourage more installations. The participation of people should be ensured for convincing people to adopt biogas technology and encourage local production of biogas installation using local materials for the widespread

adoption of the innovation. Dissemination and promotion of bio-gas digesters would be advisable and the private sector should be encouraged to intervene in the field.

References

Adusei L. A. (2012). Energy Poverty: Exploring Households Energy Constraints and Coping Strategies. Master Thesis 30 HEC, Uppsala 2012 Rural Development and Natural Resource Management Master's Programme Department of Urban and Rural Development

Clancy, J. (2006). Urban poor livelihoods: Understanding the role of energy services Department for Technology and Sustainable Development, Centre for Clean Technology and Environmental Policy, University of Twenty Enscheda, The Netherlands. DFID kar project R8348

Clancy, J, Skutsch, M., and Batchelor, S. (2003), 'the Gender-Energy-Poverty Nexus: Finding
the Energy to Address Gender Concerns in Development', Paper prepared for the UK Department for International Development (DFID), London. DFID Project CNTR998521, London.

Cecelski, E. (2004). Re-thinking Gender and Energy: Old and New directions, Energy, Environment and Development (EED), ENERGIA/EASE Discussion Paper.

Dawit, D. (2012), Assessment of Biomass Fuel Resource Potential and Utilization in Ethiopia:
Sourcing Strategies for Renewable Energies, international journal of renewable energy research, Department of Economics and Technological Change, Centre for development Research (ZEF),University of Bonn.

FAO (2008), Climate Change and Food Security: A Framework Document. Food and Agriculture Organization, United Nations, Rome

Assessment of Gender Roles in Agricultural Production in West Hararghe Zone, Oromia National Regional State, Ethiopia

Birhanu Angasu, Gosa Alemu, Jima Degagaand Temesgen Sime
Oromia Agricultural Research Institute, Mechara Agricultural Research Center, P.O.Box 19, Mechara, Ethiopia
Corresponding author e-mail: Birhanu.angasu@gmail.com

Abstract

The study was conducted to identify gender roles and responsibilities in agricultural production and assess constraints that influence gender division of labor in agricultural production in Gemmechis, Oda Bultum and Daro Lebu Districts of West Hararghe Zone. The study used a multi stage sampling method. Secondary data were collected from relevant sources; from published and unpublished documents of district and zone offices of agriculture and natural resources. Primary data were collected from a total of 142 household heads using semi-structured questionnaires. Descriptive statistics was used to analyze the collected data. Garett ranking techniques was used to examine factors affecting women participation in agricultural activities. The result of the study indicated that both men and women were participating in agricultural activities including land preparation, sowing seed, fertilizer application, weeding, harvesting, threshing, transporting grain to market, storing, poultry production, milking, barn cleaning, herding, supplying water and fodder to livestock. Most of these activities were performed jointly except ploughing which was done by men and milking of cow which was mostly done by women. In all livestock categories the roles of women were higher than men in feeding, milking, barn cleaning, management and marketing. Women workload at home, social factor that restricts women to reproductive and men on productive work and shortage of land were the major constraints of both men and women not to fully participate in agricultural activities. Women's double burdens in the household chores limited their participation in decision making pertaining to farming related issues, meeting and attending training program on agriculture. Therefore, ithere should be massive awareness creation program to raise awareness of the community on the benefit of women's empowerment in agricultural production.There should also be special institutional supports as an affirmative actions to womens to increase their level of participation in agricultural activities and decision making process.

Key words: gender, agriculture, activities, women, men, role

Introduction

Gender inequalities limit agricultural productivity and efficiency and in so doing, undermine development agendas. Failure to recognize the different roles of men and women is costly because it results in misguided projects and programs, forgone agricultural output and incomes, and food and nutrition insecurity. Considering the role of women in agricultural production into account and increasing concerted efforts to enable women to move beyond

production for subsistence and into higher-value, market-oriented production is significantly important (World Bank, 2009).

According to Lorber and Susan (1991) cited in Dereje (2013) gender is not stable and unchanging. Instead, they consider it as something that is being produced with a given social and historical context consisting of potential for change. Thus, every community has its own peculiar and specific gender issues so that it is appropriate to see them in its own context.

In the world, women contribute to do more than two-thirds (67%) of the world's work hours done, produce 50 percent of the world's food supplies, earn only 10% of the world's income and own only 1% of the world's property. The value of unremunerated work was estimated at about $16 billion, from which $11 billion represents the invisible contribution of women. Women work in fields, take care of families and manage household. Despite the services rendered by women in the family and work place, they make up for nearly 70 percent of the world's poor and more than 65 percent of the illiterates (Venkatesha, 2015).

Agriculture production in rural areas is often undermined by gender-related constraints and unequal access to productive resources. In order to achieve substantial growth and poverty reduction through agriculture, there is a need to effectively address the constraints that women face both in production and market participation. Women's productivity in agriculture is therefore highly dependent on their opportunity to having access to productive resources such as land, credit, extension, and other agricultural technologies (Ragasa, 2012).

In developing countries three out of every four poor people live in rural areas, and most of them depend directly or indirectly on agriculture for their livelihoods (World Bank, 2008). As reported by FAO(2011) if women had the same access to productive resources and services as men, they could increase production on their farms by 20-30 percent. This increase could raise total agricultural outputs in developing countries by 2.5-4.0% and reduce the number of hungry people in the world by 12-17%. According to USAID (2011) cited in Huria (2014), when women's productivity and incomes increase. The benefits amplify across families and generations, because women are known to devote a larger fraction of their income for their children's health and nutrition.

In agriculture, there is substantial interest in investigating how agricultural policies can promote more gender equitable outcomes, for both social and economic gains (Seymour *et. al,* 2016). In these men and women play distinct roles. Although the perceived tasks of women and men in agriculture may differ considerably from region to region, it can generally be stated that women's tasks include land preparation, weeding, harvesting, threshing and storing, production of subsistence crops in the home-garden, and small animal husbandry (EARO, 2000 cited in Huria, 2014).

In many parts of Africa, for instance, where women's participation in farm work is traditional and well recognized, and there are female crops (i.e., cassava and other roots and tubers) and male crops (maize and cotton). However, the division of farm tasks is more rigid in cultural convention than in reality. It breaks down easily in response to changes in demand for farm wage labor and household labor. Rural poverty and the shortage of farm labor expand women's participation into male ascribed farm tasks (Mayra B. and Rekha M., 1990).

Gender division of labor among farming communities of Ethiopia has also been common. Ethiopia is a country where more than 85% of its population depend on rain fed agriculture. Agriculture is the back bone of the national economy. Both men and women have been playing a significant role in the development of agricultural production. The role and the contribution of both male and female, in the agricultural activities, is not necessarily the same in all parts of the country. Since Ethiopia is the country of multi-ethnic and multi-cultural groups, all ethnic and cultural groups have different gender roles in agriculture (Dereje, 2013).

The country has 111.5 million hectares of land among only 13 million hectares are being used for agricultural activities and 74 million hectares are arable (Daniel *et al.,* 2010 cited in Mengistie, 2015). Eight-three percent of the population depends directly on agriculture for their livelihoods, while many others depend on agriculture-related cottage industries such as textiles, leather, and food oil processing. Women represent approximately 50 percent of the total population and account for 70 percent of the household food production. Their share in the total agricultural labour force is considerable 48 percent of the agricultural labor force is driven from female family members (Teshale, 2014).

Ethiopia has ADLI of economic policy in the agriculture sector which gave high relevance to female farmers who are responsible for household subsistence, however, there is little attention given to mainstreaming of women farmer's concerns or the impact of gender relations in the subsistence farming sector (Teshale, 2014). Rural women in Ethiopia are engaged in laborious tasks for not less than 15-18 hours a day, often without any cash remuneration, recognition or appreciation (Deribe, 2007).

Various socio-economic activities performed by people are characterized by a certain kind of division of labor, among which the gender dimension is more apparent. In the process of social and economic development, people specialize in particular tasks and hence it is socially accepted that there are men's tasks and women's tasks. According to Melese (2011) cited in Fenet and Alemayew (2016),societies divide these activities to sexes differ from one culture to another and from time to time, a gender division of labor exists in all societies.

The different norms, values and rules dictate women and men to be had act and enjoy in certain ways in their day to day life. These are strong powers that maintain the power relations that existed in a given society. This power relation exhibits itself in the division of labour and the differential access to and control over resources between women and men (Workwoha, *et al.,* 2004 cited in Anteneh, 2008).

Female farmers are not considered and their agricultural activities and/or issues concerning them have been the last priorities in the country's agricultural research agenda, and so lacked improved extension packages and services that assist them to improve their productivity. So far the extension system in Ethiopia has not been able to address the cultural taboo against the participation of female farmers in ploughing and sowing, which subsequently reduce the rigid division of labor both at the household and field level (EARO, 2000 cited in Deribe, 2007).

It is widely demonstrated that rural women as wives, as well as men are engaged in a range of activities essential to household welfare, agricultural production and economic growth. Yet, their substantial contribution continues to be systematically marginalized and undervalued in conventional agricultural and economic analysis while men's contribution remains the central, often the sole, focus of attention (Jiggins, *et al,* 2000 cited in Anteneh, 2008).

Ethiopian rural women are making a significant contribution to agricultural production and to ensuring food security. According to Zenebe (2005) cited in Anteneh, (2008), about 87% of women in Ethiopia are engaged in agriculture, contributing about 50% of income based on subsistence agriculture.

Women in Ethiopia are engaged in various economic activities including land cultivation and harvesting, food processing, marketing, gardening, construction of housing, and animal husbandry. By doing so, women provide approximately 40% of the family labour (Habtemariam, 1996 cited in Deribe, 2007). Often it is observed that major emphasis in agriculture is given to men's activities while the role of women and children in the Ethiopian farming systems has been ignored (EARO, 2000 cited in Deribe, 2007). In West Hararghe zone, men, women, children and youth are participating in agricultural production directly or indirect. However, no study has been identified and documented their role in agricultural production in the study area. Therefore, the study was aimed to address the gap with the following objectives.

Objectives of the study

The specific objectives of this study were:

- To identify gender role and responsibility in agricultural production and
- To assess constraints that influence gender division of labor in agricultural production in the study area

Research Methodology

This chapter highlights descriptions of the study area, types and sources of data, sample size and sampling procedure, and method of data collection and analysis.

Description of the Study Area

The study was conducted in Gemmechis, Oda Bultum and Daro Lebu Districts of West Hararghe Zone. Gemmechis is located about 343 km southeast of Addis Ababa and 17 km from Chiro town, the capital town of West Hararghe Zone. Kuni town is the administrative set of the district. It shares a border with Chiro district in the West and North, Oda Bultum district in the South and Mesala district in the East directions (GDoANR, 2016). It is located at 9° 0′ 44.992″ latitude in the North and 6° 39′ 50.42″ longitude in the East.

The district covers an area of 77,785 ha and it has 35 rural Kebeles and 3 urban administrative towns. The district is found within 1300 to 3400 m above sea level (m.a.s.l). The minimum and maximum annual rainfall is 800 and 1200 mm with an average of 850 mm. The district has bi-modal distribution in nature with small rains starting from March/April to May and the main rainy season extending from June to September/October. The minimum and maximum temperature is 15 and 30°C while the average temperature is 22°C.

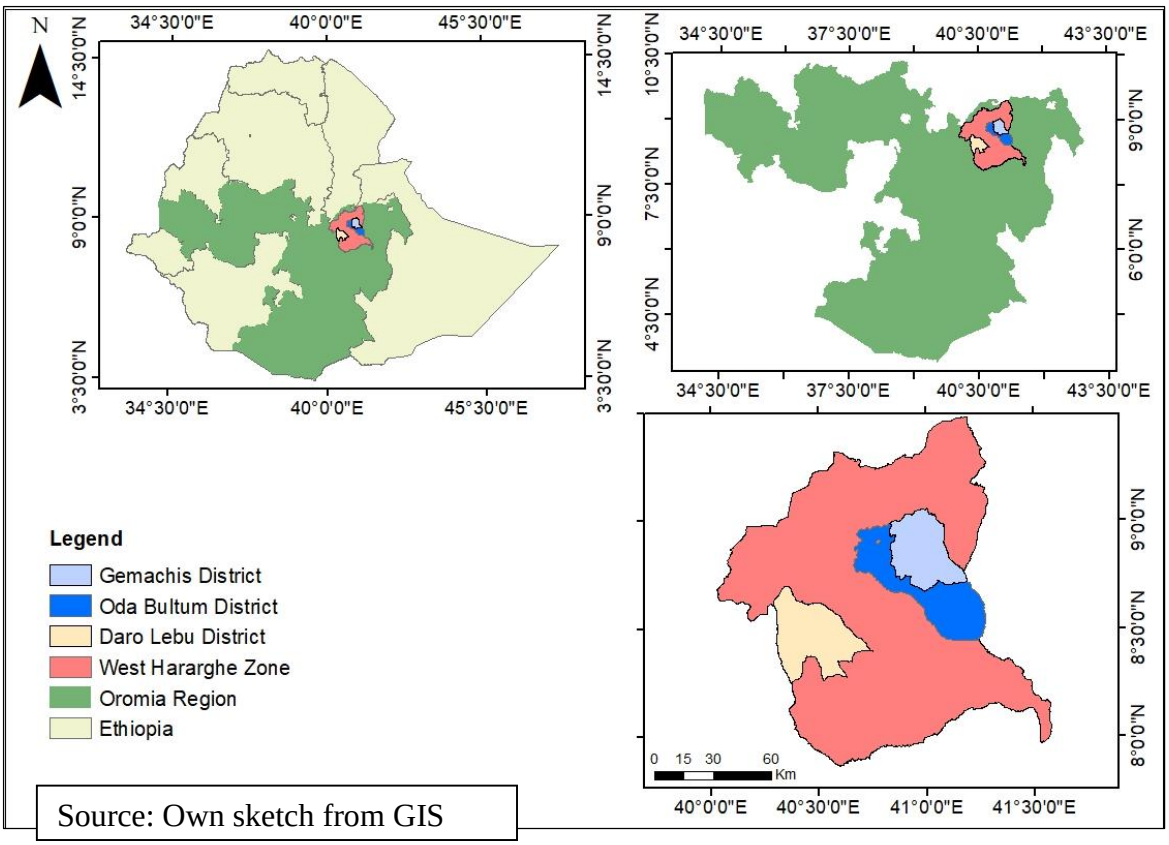
The total population of the district is 243,497 of which 124,140 are males and 119,357 are females (CSA, 2013). The number of agricultural households in the district is 42,869 with 38,057 males headed and 4,812 females headed. The soil type of the district is 75% black and 25% red soil. The district's economic activities are based on agriculture. Major crops produced in the district are cereal crops, (maize, sorghum, wheat, teff and finger millet), cash crops (coffee & chat) and vegetable crops (fruit and onion).

The average family size is estimated to be 6 and 4 per household in rural and urban areas, respectively. The district is the first most densely populated district in the zone. Of the land use pattern of the district, 32,994.5 ha is cultivable, 6185 ha is grazing land forest, bushes, and shrubs cover 1385 ha; 6603.62ha is not arable and 17,949.34 ha is used for other purposes such as encampments and infrastructure facilities.

Daro Lebu is located at 114 km to south west direction from Chiro town, the capital town of West Hararghe Zone. It is bordered by Boke District in East direction, Gololcha District in West, Hawi Gudina in South and Habro District North directions. The district has a total population of 239,222 out of which 122,386 are male and the rest 116,836 are female (CSA, 2013). Average temperature and rainfall of the district were 20^0C (14-26^0C) degree Celsius and Average1094mm (900-1300mm), respectively. Main rainy season of the district was by bimodal (February to April and June to September) and sandy loam, clay which is reddish in color was its soil type. The district is categorized in to two agro ecological zones; midland (44%) and lowland (56%). Economic activities of the district have been dependent on production of cash crops (ground nut &chat) and fattening cattle and small ruminants. Major crops produced in the district were maize, sorghum, teff and haricot bean.

Oda Bultum is located 37km to South direction from Chiro town, the capital town of West Hararghe Zone. It shares a border with Habro and Guba Koricha in the West, Burka Dimtu and Boke and in south, Gemmechis and Chiro in north, and Gemmechis district in the East directions. Total population of the district was 159,067 of which male was 81,414 and female was 77,653. There were 22,930 male Household and 4670 female Household. Total area of the district in hectares was 25,969 ha of which 32,875 ha was cultivated land, 22,757 ha was forest land, 10,015 ha was mountain land and 6,755 ha was grazing land.

The minimum and the maximum temperature of the district in degree Celsius was 22 and 28 ^{0}C respectively. Its average rainfall 900mm – 1200 mm and main rainy season was from April to September 30. Soil type of the district is 30% black soil, 25% sandy soil and 45% loam soil. Agro ecology of the district by percent is 4%highland, 31%midland and 65%lowland. Currently the farming community in the area is widely practicing mixed type of production system. In the area there are two major production system; mixed production and pastoral production system with a share of 85% and 15% respectively. Major crops produced in the district were Maize, Sorghum, Teff and Haricot bean.



Source: Own sketch from GIS

Figure 1: Map of the study area

Sources and Methods of Data Collection

Both primary and secondary types of data as well as quantitative and qualitative data were collected to fulfill the research objectives of the study. Primary data was collected from 142 sample households drawn from six PA through interview. Secondary data was collected from relevant sources, such as reports, socio-economic survey documents of the area of the district and regional agricultural office. Qualitative data was collected through Focus Group Discussion (FGD) and respondent's interview. Quantitative data was collected through administering an interview schedule to the selected respondents.

Sample Size, Sampling Technique, and Sampling procedures

The study used a multi stage sampling method. In the first stage, districts were stratified based on agro-ecology. Then, one district was selected randomly each from the highland, midland and lowland areas. In the third stage, two kebeles were selected from each district; Bedesa Guda and Bekenisa from Oda Bultum district, Sekina and Kortu from Daro Lebu district, and Welenso Defo and Sororo from Gemmechis district were selected randomly. Finally, a total of 142 respondents were selected randomly out of the three districts by considering probability proportional to population size. The simplified formula provided by Yamane, (1967) was employed to determine the required sample size with degree of variability = 0.5 and level of precision (e) = 8%.

$$n = \frac{N}{1 + N(e^2)} \quad \text{.....(1)}$$

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

Table 1. Frequency and percentage of sample households

District	Frequency	Percentage (%)
Gemmecis	54	38
Oda bultum	50	35.2
Daro lebu	38	26.8

Source: Own computation

Method of Data Analysis

The collected data was coded and entered in to SPSS version 20 software. Quantitative data was analyzed by using descriptive statistics such as mean, frequency, standard deviation and percentages. On the other hand, qualitative data was analyzed through narration and description. The constraints of gender that hinder to participate in agricultural activities was analyzed through Garret ranking techniques. In general, the data was managed and analyzed by descriptive analysis, narration and Garret ranking method.

Garret ranking techniques can be specified as;

Percent position $= \frac{100(R_{ij} - 0.5)}{N_{ij}}$ ---------- (1)

Where; R_{ij} = is the rank given to i^{th} item by j^{th} individual.

N_{ij} = is the number of items ranked by j^{th} individual.

Percent position was converted into scores by referring the table given. Then for each factor the scores of the individual respondents was added together and divided by the total number of respondents for whom scores was added. These mean scores for all the factors were arranged in descending order and the most influencing factors were identified through the ranks assigned. Therefore, Attribute with highest mean score was considered as most influencing factor.

Results and Discussions

In this chapter demographic and socio-economic characteristics, resource endowment, institutional services, gender role in livestock and crop production, level of women participation in agricultural activities and constraints of gender division of labor in agricultural activities is discussed as below.

Socio-economic and Institutional Characteristics of the Respondents

The result from Table 2 showed that 41.55% of the respondents were illiterate while 58.45% of the respondents were literate. Among the educated households, 56.63% were between grade 1 and 8, and 26.51% can read and write. The study also portrayed 32.35% of men were illiterate (had no formal education) while 65% of women were illiterate. According to CSA (2017), nearly half of women (48%) and 28% of men age 15 up to 49 in Ethiopia have no

education. This implies that illiteracy rate was below national average for male households in one hand and it was above national average for female household heads on the other hand in the study area. The test statistics result indicated that there is statistically significant difference in literacy level between men and women.

More than half (52.11%) of the respondent had participated in off/non-farm activities such as chat and small ruminant trading. Similarly, Fekede *et al.* (2016) identified majority of the communities in west hararghe zone responded to the effect of climate change through participating on non-farming activities. Dary and Kuunibe (2012) also added that rural non-farm economic activities are gaining prominence in most developing economies due to the increasing inability of the farm sector to support rural livelihoods. The finding also showed that 62.5% of women and 48.04% of men participated in off/non-farm activities respectively which implied that women had participated more than men even though there is no significant difference among them.

Table 2 depicted 83.33% of men and 75% of women had participated on training regarding agricultural production, respectively. This implied men had better participation on training than women though the difference is statistically insignificant. This is because, women's double burdens in the household (i.e., participation in both productive and reproductive activities) consumes more of their time than men which in turn limited their participation in attending training programs regarding agriculture production.

Additionally, the selection of farmers is biased for training. Kebele administration and DAs selected the farmers who are nearby and have close relationship with them. According to Sachs (1996); cited in Alemayehu and Fenet (2016), by ignoring women's role in production, governments targets information, training and credit programs to men in rural areas. But, the finding of the study indicated that 47.5% of women had access to credit. The value of chi-square test indicated that the difference in access to credit between men and women was statistically significant at 5% level of significance. In other words, women household heads were more likelihood in getting credit than men household heads. This is because credit institutions in the study area focused more on female farmers capacity building and related with women's behavior and knowledge of directly using the credit given to them effectively and efficiently for the intended goal.

Table 2. Socio-economic characteristics and access to institutional services

		Men N=102		Women N=40		Total N=142		x^2 - value
Variable	Response	N	%	N	%	N	%	
Educational status	Illiterate	33	32.35	26	65	59	41.55	13.13**
	Read and write	19	18.63	3	7.5	22	15.49	
	Grade 1-8	38	37.25	9	22.5	47	33.10	
	Grade 9-12	10	9.80	2	5	12	8.45	
	Above grade 12	2	1.96	0	0	2	1.41	
Participation in off/non-farm activities	Participated	49	48.04	25	62.5	74	52.11	2.41
	Did not participate	53	51.96	15	37.5	68	47.89	
Access to training	Had access	85	83.33	30	75	115	80.99	1.3
	Had no access	17	16.67	10	25	27	19.01	
Access to credit	Had access	30	29.41	19	47.5	49	34.51	4.16**
	Had no access	72	70.59	21	52.5	93	65.49	

Note: ** indicates significance level at 5%.
Source: Own survey result, 2019

Hoiseholds'Resource Endowment

In the study area, land belongs to the men. The sample respondents revealed that women have not access to land from their family. The mean land holding of men was 0.57 hectare while that of women was 0.41 hectare. This implies that mean land holding size of men exceeds the mean land holding size of women by 39.02%. The reason was due to shortage of land, cultural influence and norm of the society, women cannot access to land. Women respondents said that women cannot access land form their family; they obtained husband land while married. That means women obtained land of their husbands before that; nobody gives land to women. Even if the families have one son and the rest daughters, all land was transferred to the son.

In the study area the probability of access to land for women is occurred, when all children of the family are females. But, if women were ask legally they can obtained the land of their family. In the society, women made such actions were undermined. Because of this, most of women in the study area accept the norm of the society. Compared to men, women farms are smaller and more dispersed and are less likely to hold title, secure tenure, or the same rights to use, improve, or dispose of land (Mesay, 2012). Similarly, Mulema and Damtew

(2016) reported that female-headed household farm sizes are smaller compared to those of male-headed households in Ethiopia. Table 3 further depicted male household heads possessed more livestock then female household heads. The mean livestock holding in tropical livestock unit of men was 3.75 while that of women was 2.47. The t test showed there was statistically significant mean difference in total livestock owned between men and women in the study area.

Table 3. Resource endowment of the respondents

	Men		Women		Combined		t-value
Variable	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	
Land size (Ha)	0.57	0.42	0.41	0.25	0.52	0.39	2.11**
Experience (years)	16.99	12.47	18.23	10.79	17.34	12.00	0.55
Total livestock owned (TLU)	3.75	2.68	2.47	1.96	3.39	2.56	2.76***

Note: ***, ** and * indicate significance level at 1%, 5% and 10%, respectively.
Source: Own survey, 2019

Gender Role in Crop Production

Agriculture is the main livelihood system of farmers in the study area. Both men and women in the area were participated in crop production activities. But, the degree, level and stage of participation on crop production were not similar between men and women in the study area. There were different activities practiced by farmers in the area to produce crops such as fertilizer application, land preparation, sowing, weeding, harvesting, threshing, transporting, storing.

The gender division of labor in crop production by tasks is common in the study area. Almost all activities were conducted jointly except ploughing which is conducted by men. In the same way, Takele (2017) reported that demarcations of tasks among men and women are not absolute. Table 4 also indicated men and women participated in almost all crop production activities with different degrees of participation.

The respondents believe that the indirect women role in crop production was high than the direct roles/involvement in crop production. Those women respondents said that “women are the driver force of men activities unless women are delivering breakfast, lunch and dinner to men they are not forcefully implement the activities”. In the study area, women

involvement in agricultural activities was high which similar to study conducted by (Ogato et al., 2009) on crop production and management activities.

Table 4: Gender role in crop production

Activities	By whom it conducted	Gemmechis	Oda Bultum	Daro Lebu	Total
		Frequency and percentage	Frequency and percentage	Frequency and percentage	Frequency and percentage
Ploughing	Only men	45(36)	45(36)	35(28)	125(100)
Land preparation	Only Men	29(26)	21(19)	28(25)	78(69.03)
	Both men and women	13(12)	16(14)	6(5)	35(30.97)
Sowing seed	Only Men	34(27)	33(26)	28(22)	95(76)
	Both men and women	11(9)	12(10)	7(6)	30(24)
Fertilizer application	Only Men	18(15)	13(10)	15(12)	46(37.71)
	Only Women	1(1)	2(2)	1(1)	4(3.23)
	Both men and women	26(21)	30(24)	18(15)	74(59.68)
Weeding	Only Men	19(16)	16(14)	17(15)	52(44.44)
	Both men and women	25(21)	22(19)	18(15)	65(55.56)
Harvesting	Only Men	33(27)	27(22)	26(21)	86(69.35)
	Both men and women	11(9)	18(15)	9(7)	38(30.65)
Threshing	Only Men	42(34)	39(31)	30(24)	111(89.52)
	Both men and women	3(2)	6(5)	4(3)	13(10.48)
Transporting	Only Men	26(21)	21(17)	14(11)	61(50)
	Both men and women	19(16)	24(20)	18(15)	61(50)
Store in grain	Only Men	17(16)	11(10)	17(16)	45(42.86)
	Only Women	3(3)	4(4)	3(3)	10(9.52)
	Both men and women	18(17)	21(20)	11(10)	50(47.62)

Source: Own survey result, 2019

Gender Role in Livestock Production

In all livestock species the roles of women were high than men in Poultry production, milking and barn cleaning. All activities were conducted jointly except milking which was mostly undertaken by female. The involvement of women in livestock production was high than crop production in the study area.

Table 5: Gender role in livestock production

Activities	By whom it conducted	Gemmechis	OdaBultum	DaroLebu	Total
		Frequency and percentage	Frequency and percentage	Frequency and percentage	Frequency and percentage
Poultry production	Only women	31(26)	34(29)	25(28)	90(76.27)
	Both women and men	12(10)	9(8)	7(25)	28(23.73)
Milking	Only men	0(0)	0(0)	0(0)	0(0)
	Only women	34(29)	37(31)	29(24)	100(84.03)
	Both men and women	9(8)	6(5)	3(3)	18(15.13)
Barn cleaning	Only men	0(0)	0(0)	2(2)	2(1.74)
	Women	28(24)	30(26)	24(21)	82(71.3)
	Both	14(12)	11(10)	6(5)	31(26.96)
Supplying water	Only men	7(6)	7(6)	4(3)	18(14.75)
	Only women	7(6)	4(3)	6(5)	17(13.93)
	Both men and women	29(24)	34(28)	24(20)	87(71.31)
Supplying fodder	Only men	7(6)	7(6)	8(7)	22(18.8)
	Only women	5(5)	2(2)	1(1)	8(6.84)
	Both men and women	29(25)	34(29)	24(21)	87(74.36)
Herding	Only men	6(5)	5(4)	2(2)	13(10.66)
	Only women	5(4)	2(2)	2(2)	9(7.38)
	Both men and women	32(26)	38(31)	30(25)	100(81.97)

Source: Own survey, 2019

Constraints of Gender Participation in Agricultural Activities

The result of the study indicated that work load at home and social factor were the main challenges of women to participate in all agricultural activities. Women are responsible for reproductive work such as food preparation, child care and house guarding. In addition to reproductive work at home, women assisted their husband on the field. But, because of cultural influence, most of men did not support women reproductive activities at home. It was only small number of men who supported some of reproductive activities such as fetching water and firewood collection. Men fetch water in early morning before community was wake up from sleeping. The action was made to protect themselves from the influence of community attitudes. Especially, those influence highly acted by women themselves when coming together. The activity was conducted by men if firewood found around the farm, unless they did not collect firewood from communal lands. Women sample respondents revealed that men were not taken prepared food for eating.

The other factor that influences gender participation in agricultural activities was shortage of land. Table 2 portrayed that the average land holding of the household heads in the area was 0.52 hectare. Therefore, it did not require more labor and men could do all activities conducted on the farm.

Table 6: Constraints of gender participation in agricultural activities

Factors	Average score	Garrett rank
Workload at home	62.67	1
Social factor	56.33	2
Shortage of land	31	3

Source: Own survey, 2019

Summary, Conclusions and Recommendations

Summary and Conclusions

Analysis of gender division of labor in agricultural activities has indicated that women and men were participating in different farming activities. Both menand women participate in agricultural activities including land preparation, sowing seed, fertilizer application, weeding, harvesting, threshing, transporting grain to market, storing, poultry production, milking, poultry production, barn cleaning, herding, supplying water and fodder to livestock. Most of these activities were performed jointly except ploughing which was done by men and milking of cow which was mostly done by women. In all livestock species the roles of women were high than men in feeding, milking, barn cleaning, management and marketing except oxen due to prink women especially in marketing. The involvement of women in livestock production was higher than what they did in crop production in the study area.

On the other hand, regarding reproductive activities such as gathering firewood and fetching water, supplying of food to men while they are on the field, guarding child and house women were responsibletremendously. Women's double burdens in the household chores limited their participation in decision making pertaining to farming related issues, meeting and attending training program on agriculture. Therefore, it could be safe to conclude that working with all rural farmers in the study area in making men aware about the benefit of women's empowerment in agricultural production is imperative.

Workload at home, social factor (restricting women on reproductive and men on productive work) and shortage of land were some major constraints of both men and women in fully participation in agricultural activities.

Recommendations

Based on the findings, the following recommendations have been given.

- ✓ Conducting effective gender sensitization programs to encourage males to share domestic tasks,
- ✓ Strengthening and encouraging women's through improvement and generation of women-time saving technologies
- ✓ Credit facilities should be provided by the government either through various women group and co-operatives so as to enable them participate fully in agricultural activities.
- ✓ Women adult literacy education program is required to help women farmers acquire basic skills and abilities to seek and receive agricultural information through extension agents. This will make them to participate more in reading extension leaflets, bulletin, newsletter etc.

References

Anteneh Bassazenew, 2008. Gender and Agricultural Production in Ethiopia: The Case of GozamenWoreda, Amhara Region, Ethiopia.

CSA (Central Statistical Agency), 2013. Population projection of Ethiopia for all regions at wereda level. Addis Ababa, Ethiopia.

Dary, S., K. and Kuunibe, N. 2012. Participation in Rural Non-Farm Economic Activities in Ghana. *American International Journal of Contemporary Research,* 2:8

DerejeKifle, 2013. Gender role in agricultural production in some parts of Ethiopia: a brief review

DeribeKaskeKacharo, 2007. Agricultural information networks of farm women and role of agricultural extension: the case of Dale woreda, Southern Nations, Nationalities & Peoples' Region.

FAO (Food and Agriculture Organization), 2011. Agricultural Development Economics Division: The Role of Women in Agriculture. Available at www.fao.org/economic/esESA March 2011. Working Paper No. 11-02

Fekede, Gemechu (2016). Effect of Climate Change on Agricultural Production and Community Response: The Case of Daro Lebu and Miesso Districts of West Hararghe Zone, Oromia National Regional State, Ethiopia.

Fenet Belay and AlemayehuOljira, 2016. Gender Role in Agricultural Activities in Ethiopia: Country Review.

GDOANR (Gemmechis District Office of Agriculture and Natural Resources), (2016). Annual Report of 2016 of Gemmechis District Office of Agriculture and Natural Resources. Gemmechis district, West Hararghe Zone, Oromia National Regional State, Ethiopia.

Huria Ali Mahdi, 2014. An Assessment of Women Farmers' Participation in Agricultural Extension Services for Income and Nutrition Improvement in Ethiopia: The Case of Becho District, South West Oromia.

(http://www.slideshare.net/kvenkateshavenkat/role-of-farm-women-in-indian-agriculture)

K. Venkatesha, 2015. Role of farm women in India: Agriculture.

Mayra Buvinic and RekhaMehra, 1990. Women in agriculture: What development can do?

MengistieMossie, 2015. Assessment of the extent and level of participation in agricultural activities among women farmers in SarMidir District, Ethiopia.

Messay Tegegne, 2012. An Assessment on the Role of Women in Agriculture in Southern Nation Nationality People's Region: The Case of Halaba Special Woreda, Ethiopia. A Dissertation Submitted to Indira Gandhi National Open University /IGNOU/ in Partial Fulfillment of the Requirement for Master of Arts in Rural Development, New Delhi, India, June, 2012.

Mulema, A.A. and Damtew, E. 2016. Gender-based constraints and opportunities to agricultural intensification in Ethiopia: A systematic review. ILRI project report. Nairobi, Kenya: ILRI

Ogato, G. S., Boon, E. K. and Subramani, J. (2009). Gender Roles in Crop Production and Management Practices: A Case Study of Three Rural Communities in Ambo District, Ethiopia. J Hum Ecol, 27(1): 1-20

R. John Christy, 2014. Garrett's Ranking Analysis of Various Clinical Bovine Mastitis Control Constraints in Villupuram District of Tamil Nadu.Faculty of Agriculture Annamalai University.

Ragasa Catherine, 2012. Gender and Institutional Dimensions of Agricultural Technology Adoption: A Review of Literature and Synthesis of 35 Case Studies. Available at http://www.focusintl.com/GD114%20Gender%20and%20Institutional%20Dimensions%20of%20Agricultural%20Technology%20Adoption.pdf

SeymourGreg, Cheryl Doss, PaswelMarenya, Ruth Meinzen-Dick, and Simone Passarelli, 2016. A woman's Empowerment and the Adoption of Improved Maize Varieties: Evidence from Ethiopia, Kenya, and Tanzania. Selected Paper prepared for presentation at the 2016 Agricultural & Applied Economics Association Annual Meeting, Boston, Massachusetts, July 31-August 2

Takele Bekele Bayu. The Expansion of Cash Cropping; Implications on Gender Division of Roles: A Case Study from Gedeo Community - Southern Nation Nationalities and Peoples Region, Ethiopia. International Journal of Sustainable Development Research, 3 (2): 7-17. doi: 10.11648/j.ijsdr.20170302.11

Teshale Endalamaw, 2014. Women and agriculture in Ethiopia. Seminar at Hawassa university department of Agribusiness and value chain management.

USAID, 2015. Resilience through Enhanced Adaptation Action-learning, and Partnership (REAAP) Gender Analysis Report, West Hararghe.

World Bank, 2008. Ethiopia at a glance. Washington, D.C.: World Bank.

World Bank, 2009. Gender in Agriculture. The International Bank for Reconstruction and Development; Sourcebook.

Seed Dissemination Pathways of Major Improved Crop varieties and Its Related Constraints in Western Hararghe Zone, Oromia National Regional State, Ethiopia

Gosa Alemu, Jima Degaga, Birhanu Angasu and Temesgen Sime
Oromia Agricultural Research Institute, Mechara Agricultural Research Center, P.O.Box 19, Mechara, Ethiopia
Corresponding author e-mail: gosa.alex@gmail.com

Abstract

Although agriculture remains the most contributing sector for the Ethiopian economy, its performance has been unsatisfactory and unable to meet the ever increasing food demand of the increasing population due to the low use of modern agricultural inputs such as fertilizers, improved seeds and extension services which partly explain the less productivity of the sector. Considering improved seeds as one of the crucial inputs that improves agricultural productivity, this study was conducted to assess and map the seed dissemination pathway of major improved crop varieties and to identify the constraints related to the various seed dissemination pathways in west Hararghe zone. Secondary and primary data sources were used to sufficiently address the research objectives. Secondary data were collected from relevant sources; from published and unpublished documents of district and zone bureau of agriculture and natural resources. Primary data were collected from a total of 144 sample farmers using semi-structured questionnaires. One FGD consisting of model farmers, agriculture experts, DAs and elders with adequate knowledge of the farming system of the area was conducted to generate additional information. Descriptive statistics such as measures of central tendency (mean and standard deviation), frequency and percentages were employed to meet the specific objectives of the study. An index ranking method was also employed to rank constraints of improved major crop varieties seed dissemination. The survey result showed that among the released major improved crops maize, teff, finger millet, sorghum from cereal crops; chickpea, haricot bean and faba bean from pulse crops and Irish potato from horticultural crops were introduced and disseminated to smallholder farmers through different stakeholders in the study area. The result of the study also indicated that insufficient supply of improved seeds, unavailability of inputs on time, land shortage, hybrid nature of seeds of some crops, frequent occurrence of drought, lack of transportation, lack of seed storage facilities, seed quality problem, high seed price and lack of budget are the major constraints in the seed dissemination pathway. So, responsible government organizations need to give attention to capacity building of local seed enterprises and multipurpose agricultural cooperatives, improving the extension service delivery and seed quality control and certification system.

Key words: Seed, improved variety, dissemination, stakeholders, pathway

Introduction

Ethiopia is mainly an agrarian country. The agricultural sector accounts for roughly 43 percent of GDP, and 90 percent of exports. Nevertheless, food security remains a critical issue for many households and for the country as a whole (Daniel *et al*., 2010). Moreover, expansion of the cropped area to more marginal lands has led to severe land degradation in some areas (Dawit *et al.*, 2004). With a total area of about 1.13 million km2 and about 51.3 million hectares of arable land, Ethiopia has tremendous potential for agricultural

development. Only about 11.7 million hectares of land, however, are currently being cultivated; just around 20 percent of the total arable area. Nearly 55 percent of all smallholder farmers operate on one hectare or less (MoARD, 2016).

Although agriculture remains the most contributing sector for the Ethiopian economy, its performance has been unsatisfactory and unable to meet the ever increasing food demand of the increasing population. This is mainly attributed to the poor use of modern inputs such as fertilizers, improved seeds and extension services which partly explain the less productivity of the sector (Kinde, 2005).

Diffusion of improved technologies among small-scale farmers, especially where formal methods and market mechanisms are inefficient, can be enhanced through the participation of farmers (Tewodros, 2001). In the diffusion process, traditional dissemination methods have been found to be vital in technology transfer to farmers, especially for seed varieties, and improved livestock breeds that are usually introduced by the public or private sector (Mbanasor *et al.*, 2008). In addition, formal methods of disseminating seed in most African countries have not taken advantage of the farmers' traditional transfer methods (Ike *et al*., 2006).

In west Hararghe zone, both annual crops and perennial crops are produced simultaneously. The major annual crops grown in the area include sorghum, maize, teff, haricot bean, barely, chickpea and finger millet. Farmers in the zone use both a variety of local crop seeds and improved seed as well.

Even if different improved crop varieties are promoted and distributed for small-scale farmers by different agents in the zone, no research work was done to identify and map the seed dissemination path-way existing in the study area.

Therefore, this activity aimed to assess the seed dissemination path-way of improved crops varieties and identify the constraints in the dissemination path-way in the study area.

Objectives of the study

The specific objectives of this study were:

- To assess and map the seed dissemination pathway of major improved crop varieties in west Hararghe zone
- To identify the constraints in the seed dissemination pathway of major improved crops seed in the zone

Research Methodology

Description of the study Areas

The study was conducted in Tullo, Gemmechis and Habro districts of West Hararghe Zone which have potential in using major improved crop varieties. Detail descriptions about the study districts are presented as follows.

Habro district

Habro district is one of the fifteen districts of West Hararghe administrative zone of the Oromia National Regional State.It is located404 km to East of Addis Ababa, which is capital city of Ethiopia and 75 km to South of Chiro. The district is boarded by Guba Koricha district in West, Boke district in East, Daro Lebu in South and Oda Bultum in North. Gelemso town is the administrative seat of the district. According to CSA (2013), the population of the district is estimated to be 244,444 of which women account for 118,268 (48.4%) and men account for 126,176 (51.6%)of the population. The altitude of the district ranges from 1600 to 2400 masl. The annual average rainfall the district is 1010 mm & the mean temperature ranges between 16 and 32 ^{o}C (HDoANR, 2016). It has three sub-agro ecology 19% highland, 50% midland and 31% lowland. The district covers an area of 722.7square km out of which 17,767ha are farming land, 25452ha Mountain, 32256ha arable land and 8472ha protected land. The soil types found in the district are sandy loam, clay soil and silty soil. Among these soil types; sandy soil cover more percent of the area of the district while clay soil has low coverage. There are two cropping seasons in the area, Belg (short rainy season) from March to June and Meher (main rainy season) from June to September. Belg rains are mainly used for land preparation and planting long cycle crops such as maize. The Meher rains are used for planting of cereal crops like barley, teff, wheat and vegetable crops. Meher rains are also

the major source of moisture for the growth and development of perennial crops such as mango, coffee and chat. Haricot bean is grown in both of the cropping seasons.

Tullo district

Having an area of 450 km2, Tulo district is found in the north eastern part of West Hararege Administrative Zone. It is borderd by East Harerge Administrative Zone, and Mesela, Chiro and doba districts. It is located at 370km southeast of Addis Ababa and about 40 km South of Chiro, which is capital town of the Zone. Hirna town is the administrative seat of the district. Tullo district has a total population of 178,245 out of which 90,746 and 87,499 are male and female, respectively. The district is found at an average altitude of 1750 meters above sea level with mean annual rainfall of 1850ml and mean annual temperature of 23°C. Agro-ecologically, the district has three sub-climatic zone highland, midland and lowland. The most commonly available soil types are Chromic Luvisols and Rendiinas. Juniperus, podocarpus, and man-made forests are available in the district. Kara Farsho and Gara Nugus and reserved forest areas. Young, economically active and old age populations accounted for 45.9%, 50.8% and 3.3% respectively. The production system is mixed type in which extensive husbandry management of livestock have been practiced (Tulu D and Lelisa K, 2016).

Gemmechis district

Gemmechis is located at 343km East of Addis Ababa and about 17 km South of Chiro, which is capital town of the Zone. The district is bordered with Chiro district in West and North, Oda bultum district in South, and Mesela district in East. Kuni town is the administrative seat of the district. Gemmechis district has a total population of 220,006 out of which 111,658 are male and 108,348 are female. The district is found at altitude ranges from 1300 to 2400msal. Agro-ecologically, the district has three sub-climatic zone highland (15%), midland (45%) and lowland (40%). The district is mainly characterized as steep slopes and mountains with rugged topography. It receives annual rainfall of 850mm and average temperature of 20^{o}C. The district has 29,812ha of farming land, 13,851.2 protected land and 6,185 Grazing land. The district have two rainy season: Spring season (March to end of April) and Summary season (June to end of August).

The soil type of the district is 75% black and 25% red soil. The district's economic activities are based on agriculture. Major crops produced in the district are cereal crops, (maize, sorghum, wheat, teff and finger millet), cash crops (coffee & chat) and vegetable crops (fruit and onion).

Sources of Data and Methods of Data Collection

For this research, both primary and secondary data sources were used. Secondary data were collected from formal and informal documents of District Office of Agriculture and Natural Resources to support the primary data. Both qualitative and quantitative primary data were collected from the selected sample representative households through focused group discussions (FGDs), key informants interview (KII) and direct interviewing by using semi-structured questionnaires in order to meet the objectives of the study. A total of five (5) researchers/enumerators/ from the two research processes (Socio-economic and Agricultural Extension Research Process and Crop Research Process) were included during data collection to conduct the survey. Prior to the administration of the questionnaires, enumerators were thoroughly oriented on the contents of the questionnaire and trained about the intention of the study.

Sampling Techniques and Sample Size

The study was conducted in Tullo, Gemmechis and Habro districts of west hararghe zone which are purposively selected due to their large extent of using improved seed varieties. Out of improved crop varieties using *kebeles* found in these districts, two (2) *kebeles* were selected randomly from each district which sum up to a total of six (6) *kebeles*. Finally, a total of 144 improved seed using respondent farmers were selected randomly by considering probability proportional to population size to collect primary data. In each kebele One FGD with 16 participants (consisting of model farmers, agriculture experts, DAs and elders with adequate knowledge of the farming system of the area) was also used.

Table 1: Frequency and percentage of sample households

Districts	Kebeles	Frequency	Percentage
Gemmechis	Welargi	29	20.1
	Kuni-segeriya	16	11.2
Habro	Bereda	28	19.4
	Ifajiru	19	13.2
Tullo	Reketafura	21	14.6
	Kirakufis	31	21.5
Total		144	100

Source: Own computation

Method of Data Analysis

SPSS software version 20 was used for data management and analysis. Descriptive statistics such as measures of central tendency (mean and standard deviation), frequency and percentages were employed to meet the specific objectives of the study. An index ranking method was also employed to rank constraints of improved major crop varieties seed dissemination in the study area.

Results and Discussion

Demographic and Socio-economic characteristics of sample households

Age, experience in improved crops variety production, land holding and family size

The average age of households in the study area was 39.30 years ranging from 18 to 70 years, while the average family size was 5.72. Averagely, experience of the sample households in improved crop production was 6.17 years. Average land holding size of households in the study area was 4.54 **'***qindi'* with a minimum and maximum of 0.5 and 16 '*qindi'* in the area. This indicated that there is land shortage in the study area.

Table 2: Age, experience in improved crops production, land holding and family size

Variable	Min	Max	Mean	St.dev
Age	18	70	39.30	12.074
Experience in improved varieties production	1	30	6.17	5.194
Land holding size	0.5	16	4.54	2.420
Family size	1	14	5.72	2.097

Source: Survey result

Education status and sex of the household head

The result of the study indicated that out of the total sample households, 116 (80.6%) of them were male household heads, while the rest 28 (19.4%) of them were female household heads. Education is assumed to be important to increase farmers' ability to obtain, process, and use information and improved agricultural technologies relevant to improve agricultural production. The result of the study indicated that about 27.8% of sample households were illiterate, about 13.2% can read and write and 59% of them have taken formal education.

Table 3. Education status and sex of the household head

Variable	Category	N	Percentage
Educational status	Illiterate	40	27.8
	Read and write	19	13.2
	Formal education	85	59.0
Total		144	100
Sex	Female	28	19.4
	Male	116	80.6
Total		144	100

Source: Survey result

Seed Dissemination Pathway of Major Improved Crop Varieties in the study area

Formal seed dissemination

Formal seed systems usually consist of public and private sector research (plant breeding) institutions, public and private sector agencies bulking up seed, mostly private sector companies distributing and marketing seed, and mostly public sector organizations responsible for seed certification and quality control. In the formal seed systems, all parts of the seed production, processing and marketing chain are subjected to regulation, inspection and certification. Within formal seed systems, the seed produced by plant breeders is referred to as breeder seed (or pre-basic seed), which usually exists only in small amounts. When the breeder seed is first bulked up the result is known as foundation seed (or basic seed). When foundation seed is bulked up further, to provide seed that can be sold to farmers, the resulting seed is known as certified seed, standard seed or quality declared seed (QDS).

A lot of efforts have been made by different organizations in developing, adapting and disseminating different types of improved varieties with appropriate agronomic practices to improve production and productivity of different major crops. Among the released major improved crops maize, teff, finger millet, sorghum from cereal crops; chickpea, haricot bean and faba bean from pulse crops and Irish potato from horticultural crops were generated, introduced and disseminated to smallholder farmers through different stakeholders such as Mechara Agricultural Research Center, District Office of Agriculture and Natural Resources, Melkassa Agricultural Research Center, Haramaya University, Odabultum University, Chercher Oda-bultum Union, and different NGOs such as World Vision Ethiopia, Plan International and Pioneer Plc in the study area.

Table 4. Improved varieties of major cereal crops mostly used in the study area

Crop type	Variety(ies)	Seed sources
Maize	Shone, BH-661, BH-660, Javi, BH-140, Pioneer, BH-540, BH-160, Jibat, Dangote, Limu, Sarto, Melkassa 1 &2	Union, cooperatives, DOANR, McARC, Plan international, Pioneer PLC.
Teff	Kuncho, DZ-01-1821, DZ-cr-77	McARC, MARC, DOANR, OBU, World vision Ethiopia
Finger millet	Tadesse	McARC, MARC
Sorghum	Abshir, Gubiye, Chiro, Girana-1	DOANR, McARC, MARC

Source: Survey result

Table 5. Improved varieties of major pulse and horticultural crops mostly used in the study area

Crop type	Variety(ies)	Seed sources
Chickpea	Minjar, Natoli, Arerti, 'dubbee'	McARC, MARC, DOANR, World vision Ethiopia
Haricot bean	Nasir, Awash melka, Awash-1	DOANR, McARC, MARC, World vision Ethiopia
Faba bean	Tumsa	McARC
Irish potato	Muger, Samune	McARC, World vision Ethiopia, DOANR

Source: Survey result

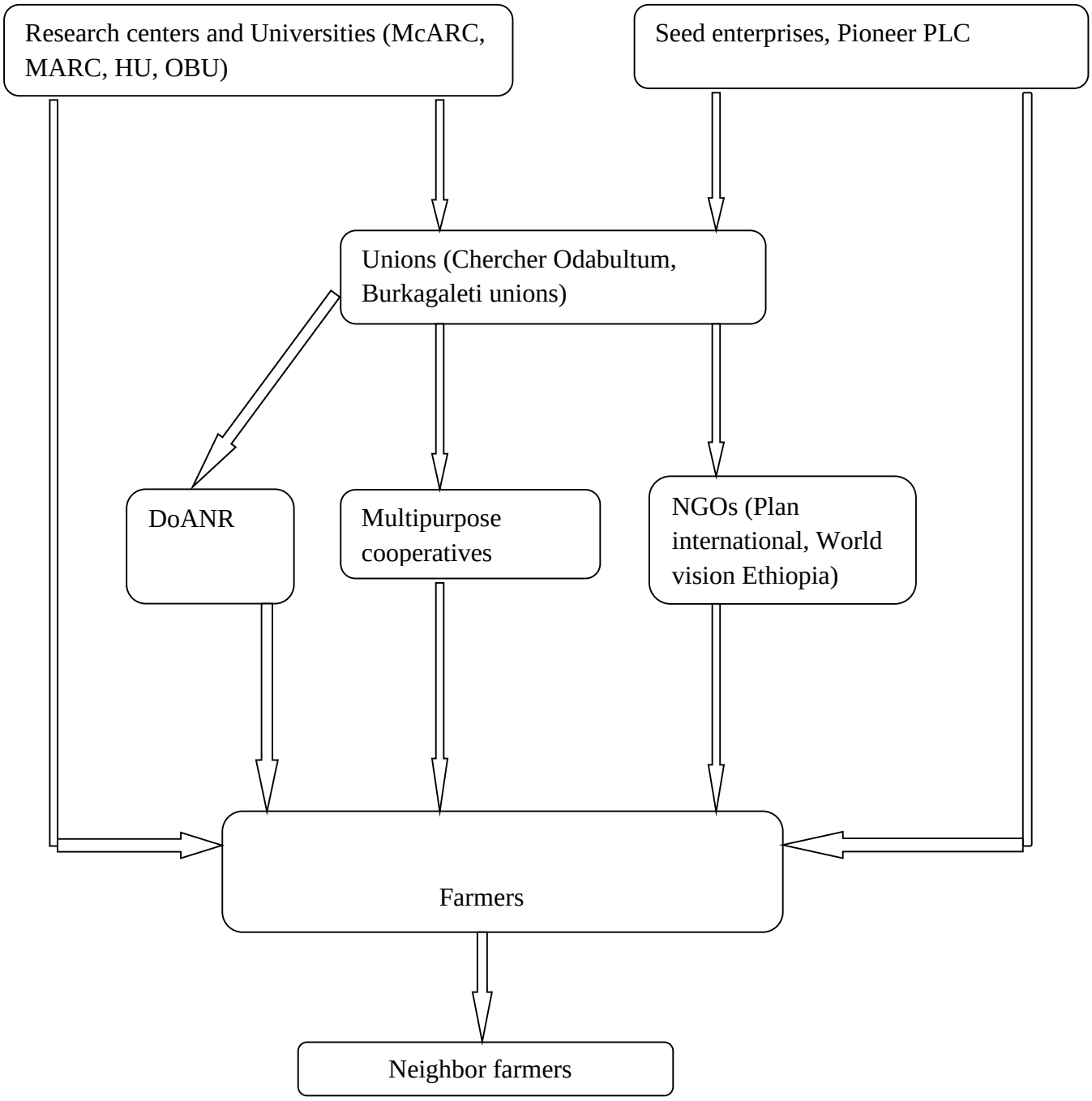


Figure 1: Seed dissemination pathway map of improved major crop varieties in the study area

Table 5. Frequency and percentage of sample households in the formal and informal pathway

Pathway type	Actors	Frequency	Percentage
Formal	Government body to farmer	96	66.67
	NGOs to farmer	18	12.5
Informal	Farmer to farmer	30	20.83
Total		144	100

Source: Survey result

Informal seed dissemination

Informal seed systems comprise large numbers of farmers who produce both traditional (landrace) and modern (improved) varieties with no regulatory oversight. They save, process and store seed for their own use as well as sharing it with their relations, neighbors and other local community members through exchange, barter, gifts and sales. Tied up with these practices may be complex socio-cultural practices and obligations which, even in today's rapidly changing world, many farmers still observe and respect. As a consequence, for some farmers paying for seed is an alien concept, which makes shifting from informal, traditional seed systems to more formal, commercial systems even more challenging. The advantages of traditional seed systems are that they support the management and conservation of local agro biodiversity and make seeds of locally valued landraces and varieties available close by and when needed. Disadvantages are that seed will not be available after droughts and other causes of crop failure; storage facilities can be lacking; and seed quality can be very variable, often poor. Informal systems are best suited to remote areas where seed distributors find access difficult and farmers cannot easily reach seed and output markets; narrow agro-ecological zones where the seed market is limited and widely marketed varieties may not be suitable; and areas where there are high transport costs.

Table 6. Current status of informal seed dissemination existing in the area

Variable	Category	Frequency	Percentage
Informal seed dissemination	Strong	47	32.6
	Weak	97	67.4
Total		144	100

Source: Survey result

The result of the study showed that among the interviewed sample representative households, 97 (67.4%) said farmer to farmer seed dissemination in the area is weak due to the lack of quality the seed obtained from neighbor farmer, decreasing yield of the crops, increasing demand to produce new improved varieties, while only 47 (32.6%) of them said that the current farmer to farmer seed dissemination is strong in the area.

Institutional services

Agricultural extension is of paramount importance to introduce better agricultural practices and improved technologies to smallholder farmers in a country like Ethiopia where the traditional practices are dominating.

Extension visits will help to reinforce the message and enhance the accuracy of implementation of the technology packages (Gezahegn, 2008). More frequent DA visits, using different extension teaching methods like attending demonstrations and field day can help the farmers to adopt a new technology. If the farmers get better extension services, they are expected to adopt seed production technologies than others. Mechara Agricultural Research center along with other stakeholders has been carrying out different researches that increase the production and productivity of farmers in the study area.

Table 7: Frequency distribution and percentage of institutional services in the study area

Category	Type of institutional services			
	Training		Credit service	
	N	%age	N	%age
Yes	92	63.9	41	28.5
No	52	36.1	103	71.5

Source: Survey result

The study revealed that 92 (63.9%) of sample farmers were trained regarding improved major crop varieties, while 51 (36.1%) of them were not given any training during the cropping year. The result of the study also shows that only 28.5% of the sample households have access to credit. Farmers who have access to formal credit are more probable to adopt improved technology than those who have no access to formal credit (Yishak, 2005). If farmers get credit they can buy improved major crop varieties seed. Hence, to sufficiently extend credit access to resource poor farmers contributes very much in the study area.

Constraints related to seed dissemination of major improved crop varieties

Despite the crucial importance of improved seed in bettering the livelihoods of small-scale farmers, in the study area seed dissemination of major improved crop varieties is still constrained by many factors. The constraints related to improved major crops dissemination were identified and prioritized by farmers in order of their importance in the table below (Table 8). Accordingly, insufficient quantity supply of improved seed, unavailability of agricultural inputs on time and land shortage is top three major constraints in the study area.

The survey result showed that insufficient quantity supply of seed is the major constraint in the pathway. This is due to insufficient production of seed of improved varieties needed both by private and public seed sectors. Study made by Abera *et al.,* (2001) signifies that the supply of seed is constrained by the inefficiency of public seed enterprises, poor seed promotion, poor transportation, and inappropriate agricultural and pricing policies. This requires considerable organization, time, and space, and incurs risks due to costs and production. To start with, significant area and effort is involved in seed production, though this varies by crop according to its multiplication rate (i.e. how much usable seed is produced per seed sown (McGuire, 2005).

In 2004, 26 firms were licensed to produce seed but only eight firms were active in seed production (Byerlee *et al.*, 2007). In 2011, 16 private seed enterprises were listed in the business directory but it is not clear whether they were all operating at that time. Two international seed enterprises are producing some of the selected major crops (as at July 2013), Hi-Bred Pioneer and Seed Co. Both focus on the production of hybrid maize, while one of them also produces smaller quantities of wheat, teff and beans (Acemoglu,2012). Some companies also produce varieties of wheat, teff, beans, rice, soybean, sesame and sorghum. But all crops except hybrid maize are only produced in very small quantities. Thus, also for these crops, there are large untapped markets where demand is substantially higher than supply (MOA, 2013).

Untimely availability of agricultural inputs such as fertilizer and seed is also one of the major constraints related to seed dissemination of the major improved crop varieties in the study area. Since improved crop varieties are sensitive to sow/planting date, if the seed of these crops is not available on time the farmers are forced to use their local varieties. Moreover,

because high-yielding varieties perform well with fertilizers, the limited availability of fertilizers constrains demand for improved seed (Walelign, 2008). As a result, in the peasant sector most seed is still produced by farmers themselves.

The survey result also showed land shortage is the major constraint in seed dissemination of improved major crop varieties which is common both for smallholder farmers and actors (research centers) in the study area. Farmers with more land had a higher probability of adoption, probably because they are wealthier and have more land to experiment with improved major crop varieties. This means that farmers who have relatively large farm size will be more initiated to involve in seed production, and the reverse is true for small size farm land. Large farmers are assumed to be less risk averse and therefore able to use new technologies, or they could be under less pressure for alternative ways to improve their income via new technologies, while small farmers adopt labour intensive technologies as they use relatively more family labour which has low opportunity cost (Genius *et al.,* 2006).

Additionally, a study made by Bahadur (2004) also agree that subsistence oriented small farmers are highly risk averse to apply innovation due to limited holding and uncertain outcome of technology. Mechara Agricultural Research Center has a serious shortage of land for multiplication and dissemination of different improved major crop varieties for smallholder farmers and different stakeholder in the study area. Accordingly, the research center need to get more land assigned by the government to improve the multiplication of improved crop varieties seed.

Table 8: Constraints related to seed dissemination of major improved crop varieties in the area

Constraints	Index score	Rank
Insufficient quantity supply of seed	0.129	1st
Unavailability of inputs on time	0.118	2nd
Land shortage	0.114	3rd
Hybrid nature of the crop	0.110	4th
Subsequent drought	0.098	5th
Lack of transportation	0.086	6th
Lack of storage space	0.069	7th
Seed quality problem	0.064	8th
High seed price	0.048	9th
Lack of budget	0.047	10th

Source: Survey result

Conclusion and Recommendation

This study was conducted in order to identify and map seed dissemination pathway of major improved crop varieties in the study area. The study also tried to investigate the related constraints to the dissemination pathway and perception of farmers on the availability and quality of major improved crop varieties mostly used in the zone.

In recent years, a number of research and development institutions, universities, cooperative unions, NGOs, district and zonal agriculture and natural resources offices are working together to improve and establish successful and sustainable seed dissemination of improved varieties in western Hararghe zone.

A number of research and development institutions, universities, cooperative unions, NGOs, district and zonal agriculture and natural resources offices are working together to improve and establish successful and sustainable seed dissemination of improved varieties in west Hararghe zone. Despite the effort made so far supply and availability of improved crop seed with fair price is still not sufficient.

In the study area, there are different major improved crop varieties introduced and disseminated to the small holder farmers. Among the released major improved crops maize, teff, finger millet, sorghum, wheat and barley from cereal crops; chickpea, haricot bean and faba bean from pulse crops and Irish potato from horticultural crops were generated, introduced and disseminated to smallholder farmers.

There is high demand for improved crops seed in western Hararghe zone. Although there is high demand of farmers for improved varieties, Unavailability of inputs on time,lack of storage space, subsequent drought, insufficient quantity of seed, lack of budget, hybrid nature of the crop, seed quality problem, high seed price, lack of transportation the major challenges which hinder the rapid dissemination of the technologies in the area.

On the basis of the the result of the study, the following recommendations were made:

- Responsible government organizations need to increase land area of research centers, government as well as private seed enterprises to enable them increase the volume seed production.

- Supporting informal seed dissemination system, and the on-going up scaling of technologies for enhancing the availability of improved crop varieties seeds and farmers' access to them in the study area.
- Two to three times seed production per year is needed to fill the huge gap between seed demand and supply.

References

Abera Deressa, Ademassu.H, Nigussie and M Seboka.B, 2001. Participatory decentralized secondary improved maize seed multiplication in the Central Rift Valley of Ethiopia. Paper presented on the seventh eastern and southernAfrica regional maize conference, february, 2001, Nazreth Ethiopia.

Acemoglu, D. And J. Robinson, (2012). Why Nations Fail: The Origins of Power, Prosperity, and Poverty. 1sted. Crown Publisher.s, New York.

Bahadur, K.L, 2004. Technology adoption and household food security. Analyzing factors determining technology adoption and impact of project intervention: A case of smallholder peasants in Nepal, Paper prepared to present in the Deutscher Tropentag to be held on 5 – 7 October, 2004, Humboldt-University, Berlin.

Byerlee D, S.David, Dawit Alemu, and G.Madhur, 2007. Policies to Promote Cereal Intensification in Ethiopia: A Review of Evidence and Experience. IFPRI Discussion Paper 00707. Development Strategy and Governance Division. International Food Policy Research Institute. 44p.

Daniel, O., A. Gideon, M. John, and N. Wilson, 2010. Technical efficiency in resources uses: Evidence from smallholder Irish potato farmers in Nyandarua North District Kenya. African Journal of Agricultural Research, 5: 1179-1186.

Dawit A, Deressa A, Dessalegne L, Anchala C (2004). Domestic vegetable seed production and marketing. Research Report No. 57. Ethiopian Agricultural Research Organization.

Genius, M., C.J. Pantzios And V. Tzouvelekas, 2006. Information Acquisition And Adoption Of Organic Farming Practices. In: Journal Of Agricultural And Resource Economics 31 (1): 93-113.

Gezahagn Walelign, 2008. Determinants And Role Of Farmers' Seed And SeedlingMultiplication In The Snnp Region Seed System. M.Sc. Thesis Submitted to the Department of Agricultural Economics, School of Graduate Studies Haramaya University.

HDOANR (Habro District Office of Agriculture and Natural Resources), (2016). Annual Report of 2016 of Habro District Office of Agriculture and Natural Resources. Habro district, West Hararghe Zone, Oromia National Regional State, Ethiopia.

Ike, P.C. and O. Inoni, 2006. Determinants of Yam Production among Smallholder Farmers in South Eastern Nigeria. Journal of Central European Agriculture, 7(2): 337-342.

Kinde Teshome, 2005. Technical Efficiency of Maize Production: A Case of Small-holder Farmers in Assosa District. Thesis Presented to School of Graduate Studies of Haramaya University.

Mbanasor, J. and K.C. Kalu, 2008. Economic Efficiency of Commercial Vegetable Production System in Akwa Ibom state, Nigeria. Journal of Tropical and Subtropical Agro ecosystems, 8(3):313-318.

McGuire, S., 2005. Re thinking seed system analysis and reform for sorghum in Ethiopia, Thesis, Wagenigen University, the Netherlands.293p

MOA (Ministry of Agriculture) (2013): Data on demand and supply of improved seed of different crops. Ministry of Agriculture, Addis Ababa.

Murage A.W., G. Obare, J. Chianu , D. M. Amudavi, C.A.O. Midega, J. A. Pickett and Z.R.Khan, 2012. The Effectiveness of Dissemination Pathways on Adoption of "Push-Pull" Technology in Western Kenya. Quarterly Journal of International Agriculture 51 (2012), No. 1: 51-71.

Tewodros Aragie, 2001. Farm Household Technical Efficiency: A Stochastic Frontier Analysis. A Study of Rice Producers in Mardi Watershed in the Western Development Region of Nepal. M.Sc. Thesis Presented to the Department of Economics and Social Science, Agricultural University of Norway.

Yishak Gecho, 2005. Determinants of adoption of improved maize technology in Damot Gale Woreda,Wolaita, Ethiopia. An MSc thesis Presented to the School of Graduate studies of Alemaya University.