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Characterization and Analysis of Farming System in Central Oromia, Ethiopia

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ABSTRACT

Designing agricultural transformation strategies that modernize small-scale farming in Ethiopia require actions built upon solid, holistic baselines, and affordable technical intervention. A study was conducted to identify and prioritize the production systems and major production constraints of farming of the study area. Study was conducted in four zones of Oromia region: West shewa, South west shewa, North shewa and Oromia special zone of surrounding fin fine. The selection of the zones and districts was done purposively based on the agro ecology. Themain methods used to gather the data were survey, key informant interviews, group discussions, observations and reviewing of secondary data from different sources. Sample size was 200 randomly selected far farm households. Descriptive ways of analysis method were applied using SPSS version 20. The study was focused on major characteristics of crop production, livestock production, and natural resources management. The study revealed that mixed crop-livestock production system was found as the dominant farming system with the average landholding is less than 2 ha per family size of five. The dominant crop was cereal and pulse crop followed with vegetable. Mixed crop-livestock production, peri-urban, and urban dairy farming system were the identified livestock production system in the study area. Livestock production is subsistence-oriented and is an important component of the mixed farming system and is well integrated with crop production. The study indicated that major constraints of agricultural production in the area are farm land shrinkage, crop disease, insect-pests, inadequate livestock feed resources, lack of improved seed and input, less farming mechanization, less attention on irrigation production, no legal limitation between upper and lower stream among irrigation product, water pollution from urban for irrigated products, and less attention given to the livestock sector by government. So, concerned body will invited to intervene through lessening the main constraints mentioned.

Keywords: *Farming system characterization, opportunities, constraints, central Oromia*

INTRODUCTION

Farming system is set of agricultural activities organized while preserving land productivity, environmental quality and maintaining desirable level of biological diversity and ecological stability. The emphasis is more on a system rather than on gross output. Farming system consist of several enterprises like cropping system, dairying, poultry, fishery, bee keeping etc. these enterprises are interrelated. Farming characterizing research is considered a powerful tool for natural and human resource management in least developed countries such as Ethiopia. Ethiopia is an ecologically diverse country with an agricultural sector. Yet, the largest share of the GDP of the country still comes from agriculture (Diao *et al.*, 2010). The country's economy is predominantly rural and agricultural, and the declining trend in size of land holding poses a serious challenge to the sustainability and profitability of farming. Under the gradual shrinking of land holding, it is necessary to integrate land-based enterprises within the bio-physical and socio-economic environment of the farmers to make farming more profitable (Behera *et al*., 2004). No single farm enterprise is likely to be able to sustain the small and marginal farmers without resorting to integrated farming systems for the generation of adequate income and gainful employment year-round. The present critical situation in the countries food supplies, especially in food insecure areas demands that all available agricultural resources be utilized to the full to maximize food production through improved agronomy, efficient use of water, effective weed control, effective crop protection, improved crop and livestock husbandry practices. To implement the above-mentioned agricultural technology interventions, farming system study

is very crucial and hence, improves agricultural technology interventions in the area. Past experiences show that most of the time technologies disseminated to the farmers did not bring the required change on the livelihood of the farming community. This is mainly due to lack of detail farming system analysis of the environment in which the technology is disseminated. Moreover, farmers` perspectives have been not adequately considered in the development and dissemination of technology to alleviate their problems. Therefore, conducting farming system study is very important to develop and disseminate appropriate agricultural technologies that fit to the environment, which is also important for further agricultural research and development intervention in the area.

RESEARCH OBJECTIVES WERE

- To assess and identify the agricultural production systems of the study area and;
- To identify and prioritize major constraints agricultural production in the study area

METHODOLOGY

The study was conducted in four zones from which fifteen districts contacted were: South West Shewa zone (wenchi, waliso, Becho, Ameya) districts; O/S/Z/S/Finfine (Walmara, Sululta, Sebetahawas, Berek) districts; North Shewa (Wichale, Abote, Degem, Warajarso) district; West Shewa (Chaliya, Toke kutaye, Direinchinni) districts. Some districts of the study area like Walmara, Sululta & Berek, and Sebetahawas are geographically located under west shewa, North Shewa, and south west shewa zone of the Oromia Regional State respectively; but they have been administratively placed under the Oromia Special Zone Surrounding Finfine since 2008 (https://en.wikipedia.org).

The Study Location

West shewa: The Zone is known for its mixed crop-livestock farming systems. Geographically, West Shewa bordered on the south by the Southwest Shewa Zone and the SNNPR, on the southwest by Jimma, on the west by East Wellega, on the northwest by Horro Gudru Wellega, on the north by the Amhara Region, on the northeast by North Shewa, and on the east by Oromia Special Zone Surrounding Finfine (figure 1). The zone has located between 8°51'16"N to 9°14'53"N 38°15'2"E to 38°28'45"E and about 120 km west of Finfine (ZAO, 2017).

North shewa: It is surrounded by Amhara National Regional State and three Oromia zones, which is North shewa of Amhara National Regional State in the North and East direction, in the Western, West Shewa zone of Oromia regional state, Oromia special zone surrounding Finfine in the south, and in the South East Shewa. Astronomically, the Zone lies between 8^0 55'N and 10^0 23'N latitude and 37^0 56'E and 39^0 32'E longitude (ZAO, 2017).This Zone features crop-livestock farming systems.

Southwest Shewa: The Zone is known for its mixed crop-livestock farming systems. Geographically, is bordered byby Oromia Special Zone Surrounding Finfine on east, north by West Shewa zone, on the northwest and south west by SNNPR. It is located at 8°16-9°56´N latitude and 37°05´-38°46´E longitude.

Special Zone of Surrounding Finfine (S/Z/O/S/F): is located in the central highlands of Ethiopia, in Oromia Regional state surrounding the capital city, Finfine. Geographically, the zone lies between 8^0 34' – 9 ^{0} 32' north latitude and 380 25' – 390 08' east longitude jere is located between 8°51'16"N to 9°14'53"N and 38°15'2"E to 38°28'45"E and about 40 km west of Addis Ababa

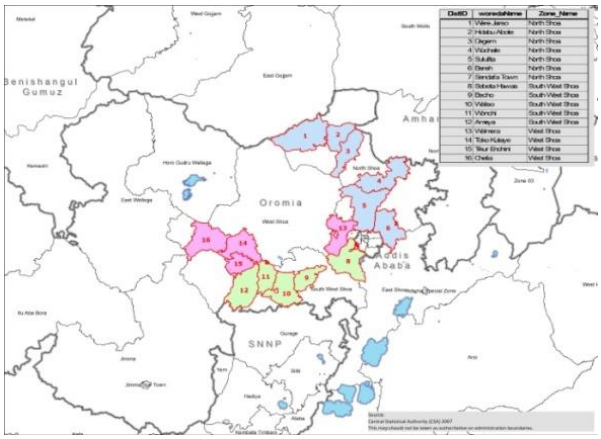

Figure1. *Map of the study area*

Topography and Soil Type

This study area has four major physiographic divisions: Plane, Mountain, Valley, and Hill based on topography; and highland, midland and low land based on agro ecology. From table 1 zones conducted for the study, topography of the area is plane in large proportion except data unavailable for Oromia Special Zone Surrounding Finfine (O/S/Z/S/F). However study from (http://shodhganga.inflibnet) indicates the low plateaus and the associated low lands are constituted about 50 per cent of the total area of the Zone lies within the range of 1500-2500 meters. This indicates that half of this special zone lies in the low plateau (mid land) area.

In the study area plane, mountains, valley and hills are characterized by black, reddish, and reddish brown in color; clay and heavy clay soil in texture. Categorically: Vertisols, Leptosoils and Cambisols soiltypes are prevailed predominantly. Vertisols is developed on the flat highland of the study area and suitable for cultivation of cereals and pulses and is a heavily textured soil dominating the study area. Because of the high content of shrink-swell clay in these soils, cultivation is difficult when they are dry and water logging is a problem when they are wet. *Lepto*-soil is low in agricultural potentials, and *Cambi*-soils which is well drained and has relatively good organic content. These soils are mainly pulverized acid soils. The main problem is high acidity and low soil organic matter. The study visited with poor or no soil conservation practices in the study area however, the fertility status of the soil of the zone is good and conducive for crop production (OWWDSE, 2011). Detail Topography, ecology and scientific soil type of the study areas are observed from table 1.

Rainfall and Temperature

There are two main seasons: *Genna* is a main rainy season which extends from June to early September, and *Arfaasaa* the period that extends from March to May. The *Gannaa* rains are used for planting both long and short cycle crops. Maize, the long cycle crop, is grown from May to December. Teff and wheat, short cycle crops are grown from July to November. Chickpea, another short cycle crop is grown from September to December. The harvesting period for teff and wheat is the month of October and November. Chickpea is harvested in December. Vegetation coverage consists of scattered bushes and scrubs. Detail rain fall amount and temperature of the study area presented in Table1.

Table1. *Topography, ecology and soil type of the study areas*

Variables	N/Shewa	W/Shewa	O/S/ZS//F	S/W/Shewa
1. Topography				
Plane	43.8%	47.7%	nd	33.5%
Mountain	19.8%	16.8%	nd	25%
Valley	7.4%	46%	nd	26.7%
Hill	28.9%	25.7%	nd	14.7%
2. Main soil type	Vertisol, Lepto soil,	Vertisol,Luvisols, Leptosols, Nitisols	Chromic and PellicVertisols	Vertis soil, Luvisols
3. Total farmland (ha)	433020	621132.7	203270	232491
4. Lowland	23%	33%	nd	0%
5. Midland	34.82%	40%	50%	70.9%
6. Highland	42%	27%	nd	29.1%
7. Rain fall (mm)	800 - 1600	812 - 1699	nd	900 - 1900
8. Temperature(0c)	16 – 32	20 - 25	16 - 26	10 -30
9. Elevation (m.a.s.l)	1080 - 3541	1050 - 3500	1500 - 3440	1600 - 3576

***Sources**: ZAO (Zonal Agricultural Office, 2017)*

Note: nd = No Data

Data Collection and Analysis

Blends of tools and techniques were adopted to collect the required information and dataset that address the objectives of the study. The standard data collection techniques and approaches employed in this study included desk reviews, quantitative and qualitative survey techniques, and group discussion. Qualitative survey methods including participatory approaches to collect primary information from the key informant of farming community and staffs of zone and district level Agriculture Offices. Quantitative survey was from randomly selected farm household respondents of 200 in size.Data

analysis was done as per the data collected using SPSS software 22.

Results and Discussion

The results discussed in this paper will focus mainly on farming systems characterized in the low, mid and highland areas of central oromia. Main farming system is mixed (crop - livestock) and main crop production system is sole cropping systems.

Demographic Characteristics

Demographic characteristics may include: Category of farmers (wealthy category), Farmer ethnicity, HH Education status, HH Religion, HH Sex, HH Marital Status and Family size.

During discussions with zone and district offices of agriculture staff and the community, ranges of socio-economic issues were assessed. Accordingly, farmers of the study area are categorized under different farming group based on resources they owned and farm. In the context of highland agro-ecologies, relatively well-to-do (wealthy) households are those who own more than 10 cattle with a pair or more of oxen for farm operations. Result is similar with the study conducted by Agajie *et al.*, (2018) on the same area. The farmers perceive that large livestock ownership ensures high production of grain and livestock products such as milk and butter. The implication is that such households can also afford to purchase inputs including new agricultural technologies and they are often risk takers in trying new technologies. Even though there could be variability from location to location, such households, however, account for a very small proportion in the community; the result point out 34.5% yet which is far above 10% have been reported by Agajie *et al.*, (2018).Similarly, in the context of lowland agro-ecologies, wealthy farmers are those who can produce and cover food demands but not in full months of in year. They adopt various practices to achieve this level of food security, such as the use of short maturing varieties, and others. Medium wealth categories in the context of highland agro-ecologies often own a pair of oxen. Apart from agricultural produce, they also strive to generate supplementary incomes through off-farm activities. Despite not as much as well-to-do households, they make all the efforts to afford purchases of inputs, send their children to school, and produce food for their family. They are not, however, food secured and economically strong as the rich wealth category. They have to strive further and enhance their economic capacity through technology use and other options of income sources. According to survey' estimates, this wealth category accounts for about 83.5 % of the farmers are middle farmers from four zones of central oromia. While the least portion about 17% is resources poor relatively (table 2).Households categorized as poor farmers in the context of lowland agro-ecology can produce and cover food demands only for five months. This means, they have to run food insecure for seven months in a year and find a living through various options, such as looking for government supported, and engagement in daily labor, migration to towns, and others.

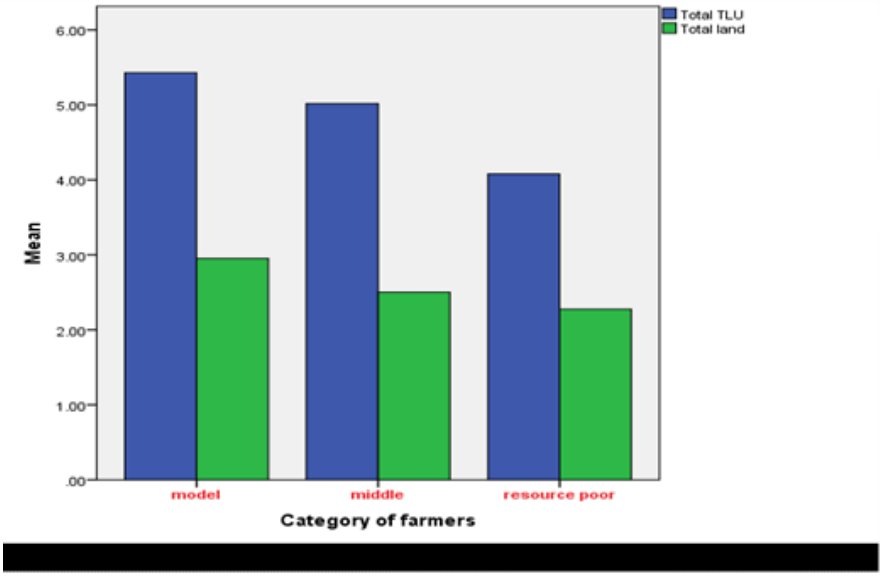

Figure2. *Category of farmers based on farmland and TLU owned*

Generally, the wealthy indicators of farm households of the study area are Livestock and land since all dependency of rural economy is on these factors. Figure 2 indicates land resources in ha for crop production and livestock holding in TLU. The results of the present study revealed that larger proportion of land owned and allocated for crop production is an indicator of wealth status. In addition, Livestock and livestock products serve as routine sources of income to smallholder farmers in the study areas. The data collected also provide supported result obtained from qualitative data generated through key informant group discussion. Accordingly, the model farmers are better-off in terms of farmland and livestock holding (figure 2).

The ethnicity groups from the study area are almost all are Oromo with a few number Gurage ethnic group. The education status of household head is on good status since the nearness of the study areas to the center. About 47.5% have elementary school and 25% have high school. While only 2.5% of them have higher education. This may indicate the educated one has chance to participate on off-farm/no farm activities rather on farming activities like work in different industries located around the area. The household religions of the sampled are Orthodox Christianity in large proportion following with protestant.

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Table2. *Demographic characteristics of farmers*

Variables	parameters	N	%
Category of farmers	Model	69	34.5
	Middle	97	83.5
	Resource poor	34	17.0
	Total	200	100.0
Farmer ethnicity	Oromo	199	99.5
	Gurage	1	0.5
	Total	200	100.0
HH Education status	No educated	34	17.0
	Read and write	16	8.0
	Elementary school	95	47.5
	High school	50	25.0
	Higher education	5	2.5
	Total	200	100.0
HH Religion	Muslim	4	2.0
	Orthodox	124	62.0
	Protestant	72	36.0
	Total	200	100.0
HH Sex	Male	197	98.5
	Female	3	1.5
	Total	200	100.0
HH Marital Status	Single	13	6.5
	Married	184	92.0
	Divorced	1	0.5
	Widowers	2	1.0
	Total	200	100.0
Family size	Min = 1	Max = 12	Mean = 5 (Sd.D = 2.27)

Sources: *Own computational survey, 2017*

Crop Production Systems

The general agricultural feature of the study area is mainly characterized as traditional and subsistence type crop production. The production was nearly all rain fed dependent and produced for consumption and local market, whilst little amount of vegetables produced by irrigation for same purpose.

Grain: Farmers practice a cereal dominated cropping system with teff as the most important crop in low and medium altitudes, followed by maize, Chickpea, lentil, and rough pea/grass pea. In the high altitude, wheat is the most important crop followed by fababean, barely, field pea. At high altitude, the settler from the Gurage area introduced enset and is adapted by many farmers in the area. The average farm size in the central highland cereal- pulse mixed farming system is about 0.25 – 9 ha under rain fall. Under irrigation, *Guaya* from pulse crop and almost all vegetables are produced allocating an area of 0.13 – 3 ha. In the zones, the average landholding is less than 2 ha per family size of five. The system is characterized by low management intensity, a medium level of market linkages and narrow crop commercialization.

Vegetables and fruits: The consumption and marketing of vegetables and fruits is relatively limited, largely because of their low productivity; high perish ability, long time maturity and high production cost. Horticultural crops (vegetables& fruits) such as Potato, tomato, onion, cabbage, beet root, sweet Potato, Carrot, Pepper (green and red), banana, garlic, orange, avocado, mango, apple, enset, lemon, Papaya and Shallot are the major ones that grow in the study site. Even though the zones are suitable to grow any types of horticultural crops, most farmers grow the mentioned one in table 3normally.

Oilseeds: The main oilseeds are neug (also known as noug or Niger seed; *Guizotiaabyssinica*), and linseed (also known as flax; *Linumusitatissimum*) with a little share of land. The cultivation of neug is found mostly in the northern and central highlands at elevations between 1800 and 2500 meters. Linseed is cultivated in the same areas as Niger seed. Generally, production of oil crop is not principal in the area. Linseed and Noug are represented the oil crop, and they share little amount of land size.

Table3. *Dominant crop and livestock*

Zone	Dominant crop	Dominant vegetables	Dominant fruits and roots	Dominant livestock
N/Shewa	Teff Chickpea Wheat Barley H/bean	Potato Onion Garlic Cabbage Carrot	Mango Banana Orange	Dairy Small ruminants Equines
W/Shewa	Teff Chickpea Wheat Pea	Peppers Cabbage Potato Tomato	Mango Koki	Dairy Beekeeping Poultry Ruminants Equines
O/S/Z/S/Fin finnee	Wheat Teff Chickpea Lintel	Potato Tomato Cabbage Carrot Onion	Lettuce Cabbage Carrots	Dairy Equines (horses) Beekeeping
S/W/Shewa	Teff Wheat Chickpea	Potato Tomato Onions Cabbage carrot	Enset Mango Banana Avocado	Power cattle Ruminant dairy

Sources: *Key informant and community group discussion, 2017*

Results from table 4 indicates, that majority of the farmers produce Tef as the first, and land allocation is also going to Teff in large amount. Table 4 clarified that the mean land allocation for Teff is about 1 ha with ranging 0.13 to 5 ha which shares above half of the land owned, and the next largest land area is goes to wheat on average 0.72 ha and ranging from 0.13 – 10 ha.

Land allocated for Barley production per year was about 0.68 ha with maximum 3 ha. From cereal crop, less size of land is allocated for maize and sorghum as data from sampled households. This because of large portion of agro ecology of the study area is highland and mid to highland which is less suitable for maize and sorghum. From pulse crop chickpea, lentil, pea, bean is also share large areas of farm land, and on specific chickpea particularly in all zones shares about 0.60 ha of land ranging from 0.13 – 2 ha. Generally, in the study area *Teff*, chickpea, Wheat, Lentil, Potato are the main production crop and they have been considered as food and cash crop. Maize and wheat are the most productive crop per hectare followed by Teff (table, 4). Potato is the most dominant vegetable crop in terms of production, consumption and marketing.

Table4. *Land allocated for each crop and productivity in the study area @ 2017*

Land allocated (ha)					Productivity (Qt/ha)			
crop	Min	Max	Mean	Std. D	Min	Max	mean	Std. D
Teff	0.13	5.0	0.94	0.817	1	25	6.4	4.77
Wheat	0.13	10.0	0.72	0.962	1	30	7.7	5.35
Chickpea	0.13	2.00	0.60	0.430	1	8	3.8	1.91
Bean	0.13	5.0	0.60	0.887	1	10	3.8	2.41
Maize	0.10	2.0	0.33	0.328	2	30	12.5	10.04
Barley	0.13	3.0	0.68	0.620	0.25	40	9.1	8.99
Guayas	0.13	5.0	0.54	0.988	1.5	10	4.2	2.75
Sorghum	0.13	2.0	0.42	0.644	3	30	12	15.59
Enset	0.10	5.00	0.735	1.505	-	-	-	-
Potato	0.13	1.00	0.268	0.188	1	150	27	35.34
Lin seed	0.10	0.50	0.267	0.129	1	4	1.7	1.211
Noug	0.25	0.25	0.250	.				
Oath	0.13	0.13	0.125	.	1	1	1	.
Pea	0.20	2.00	0.738	0.852	6	6	6	.
lentil	0.50	1.25	0.750	0.433	3	22	9.5	8.58

Sources: *Own computational survey, 2017*

Cropping techniques calendars: In general cereals require finer seedbed preparation than pulses and hence more cultivation is carried out before sowing. As specified earlier, seedbed preparation for planting begins normally with the Arfaasaa/*belg* rain in March/April. Cultivation generally continues up to May depending on the soil moisture and resumes in late June when the main rain commences. But sowing of each crop is occurred in different time. Traditionally, farmers without adequate number of draught animals take advantage of the long ploughing period to share them with others.

Farm clustering-based crop production: Crop is the main stable food, income generating and export commodity in the country. The study area is the core for production of crop those are explained in table 5. Generally, over all the study area is categorized under *Teff* cluster. The *Teff* cluster in Oromia encompasses West Shewa, East Shewa, South West Shewa and Special Zones covering 200,192 hectares over 15 wored as. Approximately 72% of farmers in this area are engaged in *Tef* production. Slightly more than half (52%) of *Teff*grown is marketed, primarily through traders, but also through six major unions to a smaller degree (ATA, 2018).

However, detail classification was occurred to farmers. Accordingly, most of farmers are categorized under *Teff*, chickpea, wheat, *Guaya* are the dominant production in the area however other crops could also participated in small amount. The ordering indicates the dominance of crop produced and majority of farmers participated on in the area. As farmers said the very importance of the clustering system like convenience to produce homogenous product for marketing, quality product, and it is imperative to control pests.

Table5. *Type of farming system cluster ordering based on dominance*

	Crop based farm clustering	**Frequency**	**Percent**
Crop	Teff,chickpea, wheat, *Guaya*	93	46.5
	Teff, wheat, barley,	45	22.5
	Teff, chickpea, lentils,	35	17.5
	Teff, chickpea, haricot bean	27	13.5
	Total	200	100.0

Sources: own survey result, 2017

Livestock Production System

Mixed crop-livestock production, peri-urban, and urban dairy farming system were the identified livestock production system in the study area. Livestock production is subsistence-oriented and is an important component of the mixed farming system and is well integrated with crop production. Livestock species kept by the farmers comprise cattle, sheep, goats, equines and chicken. Cattle are the dominant species, mainly used for draught power, followed by milk and meat production, income and manure for fuel than for maintaining soil fertility. Livestock also have an important socio-cultural role in the study area. The livestock owned had been converted to TLU for each species. Accordingly, the largest total livestock was found in west shewa having top in cattle and least in ruminants (Figure 2). Oromia special zone surrounding Finfinnee (O/S/Z/S/F) stands second in all types of livestock units and first in ruminants. Peri-urban and urban production systems are developed in areas where the population density is high and agricultural land is shrinking due to urbanization around big cities like Addis Ababa and other zonal towns. In this system crossbred animals are kept in small sized farms.

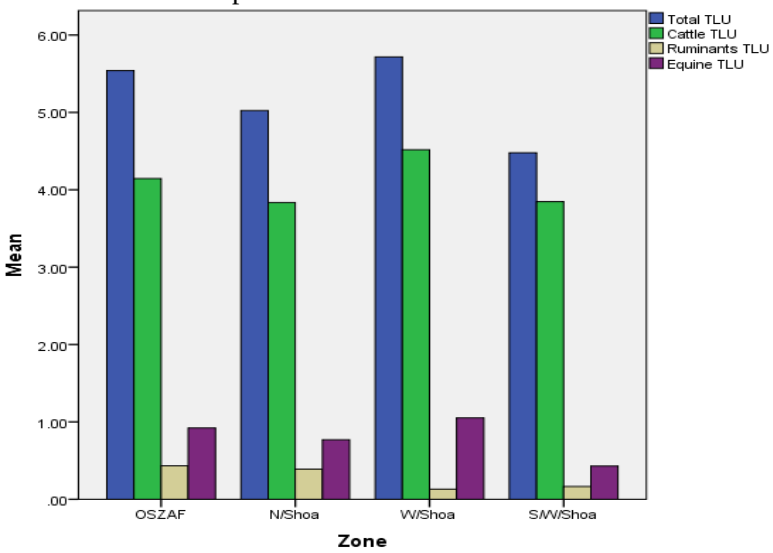

Figure2. *Livestock in TLU found in each zone*

Dairy Production Systems: Two major dairy production systems, namely urban (Urban and peri-urban milk production) and rural or mixed crop/livestock production systems were identified. On average, about 7.25 and 1.3 liters of milk were produced daily per cross breed and respectively (table 6). However, the majority of milking cows are indigenous animals which have low production performance. Due to low milk productivity of cows, animals are milked to provide the family with fresh milk butter and cheese. Surpluses are sold, usually by women, who use the regular cash income to buy household necessities or to save for festival. From cross bred the primary of the production system is to sale milk as a means of additional cash income because of high milk yield relatively. So, provision of better milk yielding animals with management practice to rural farmers may lessen food insecure problem area.

Peri-urban and urban dairy production systems also found in the outskirts of the capital city and zonal cities and mostly concentrated with in below 100 km distance around Addis Ababa which includes dairy farms ranging from smallholder to commercial farmers. The system comprises small sized dairy farms that own crossbreed dairy cows. The primary objective of milk production in this system is generating additional income to the household. Husbandry practices such as feeding, watering, housing, breeding, milking, calf rearing, waste management, and record keeping were different in the two production systems.

Table6. *Milk yield per cows /L/Day*

Type of cows	N	Minimum	Maximum	Mean	Std. Deviation
Local cow	200	0.25	3.00	1.2900	0.70775
Crossbred cow	200	2.00	12.00	7.2500	2.23438

Sources: *own survey result, 2017*

Feeding system: The feed resource base for livestock producers in the mid and highlands includes feeds produced on-farm and those obtained from off-farm sources. While roughage feeds are mainly produced on-farm by the farmers, concentrate feed ingredients are produced as by-products of agro-industries located in different parts of the country and being channeled to the smallholder farmers through various chains. Accordingly type of feed supplied to dairy cattle is explained in table 7 based on locations. Mostly, urban dairy cattle feed with by-products of agro-industries and little amount of cereal by product while the rural one from farm by product. The daily feed supply to animals was not measured by any of the dairy farmers rather feed was provided roughly based on the availability of feed and daily milk yield. Shortage of feed supply and poor nutritional quality of available feed resources are the major constraints affecting livestock productivity in study area. It is thus important to tackle the feed shortage issue to ensure economically viable and environmentally friendly livestock production.

Table7. *Common Livestock feed type*

Rural	Urban
Planted fodder	Linseed cake
Cut grass/hay	Noug cake 7.7 0.01 600 20 - 62.0 Wheat bran Noug cake 7.7 0.01 600 20 - 62.0 Wheat bran Noug cake
Green Stover	wheat bran
Cereal crop residue	Green Stover
Green Stover	Cereal crop residue

Sources: *own survey result, 2017*

Beekeeping production system: Ethiopian farmers have a very long tradition in bee keeping. Many smallholder farmers keep bees for their honey and beeswax, and bee colonies are a good source of income. These products have a high demand and the prices stay high throughout the year. Moreover, they are not perishable. This contributes significantly to the household's food security; especially areas with moisture stress and degraded farming areas. Report from farmers of the study area said recently beekeeping is facing serious problems: one is that the bee colonies are escaping from their hives. This is because the bee forage is drying up faster than before and as well as there is insufficient water supply, the other foraging problem is chemical application that farmers use pesticides for the control of weeds, diseases, and insects and bees are foraging that. Poor knowledge in using of modern technology, and over confidence of using the unwisely constructed material like hives constructed out of recommended design. Sometimes the beehives sold in the market are not made from selected and suitable wood (Flailu *et al.*, 2012). This also causes the absconding of bees and deriving the low productivity of the sector. There are two basic types of beehives in farmers' hands. These are the traditional and modern types.

Traditional beehive: There are different designs of traditional beehives that are cheap and easy to produce or buy. One type looks like a large log, circular in cross-section, is made from wood, even a hollow branch, or sticks tied together and plastered with cow dung and/or mud. Farmers use this design of beehive to put their bee colonies up in the branches of trees when they are flowering and in trees next to their flowering

crops. They also hang them up in trees to catch escaping bee colonies.

Modern beehives: Farmers are interested to have modern beehives as they have different compartments inside and they have higher yields, but it is expensive. However, they do not sit and wait for a solution to be given to them. To improve their incomes, many farmers are creative in improving beekeeping. However some Farmers started their innovations by combining components of the traditional and modern hives, and said that improved endogenous beehive is far cheaper and easy to make, easy to understand, it is better insulated against both heat and cold, and brings higher net return than the modern beehives in some areas. However, this reversely cause for absconding, leads zero production. So, affordable hive price may be the solution to follow the modern one for the farmers. Currently farmers of the study area were found with large number of traditional beehives in all selected zones (table 8).

Table8. *Beehives (colony) owned by beekeepers of the study area (2009 E.C)*

Zone	Traditional hive (#)	Transitional hive (#)	Modern hive (#)
West shewa	159300	36251	6410
O/S/Z/S/F	18780	10857	4968
South west shewa	55618	15017	5002
North shewa	158948	14422	6481

Sources: *Zonal Livestock and fishery development office, 2017*

Potential are of beekeeping: From table 9 districts of having potentiality in beekeeping were displayed from the study area. Accordingly, Dannoo, Noonnoo Chaliya Gindabarat**,** Ada'aberga, Bako tibe, Ejersalafto and Jaldu districts are from West shewa zone where as Wonchi, Amaya and Waliso districts from S/W/Shewa has potential for beekeeping activities because relatively the area is coved with high natural resource and thus in the district's apiculture resource is immense. In addition, North shewa and Oromia Special Zone Surrounding Finfine Zones have also some potential districts like Dera, Warajarso, YyaGulalle, Walmara, and Sebeta as listed in Table 9 categorically. In this area the constraint of beekeeping potentiality is chemical of the flowering project and limited diversified forest since the place is central to the capital city of the country, most land is going for urban development.

In general, even though, the district has huge number of bee colonies, farmers cannot get the benefit they should get from beekeeping sub-sector because of more than 90% beekeepers follow the traditional method of beekeeping.

Table9. *Districts of Potential areas for bee keepingunder each zone in the study area*

West shewa	S/W/Shewa	North shewa	O/S/Z/S/Finfine
Dannoo	Wonchi	Dera	Walmara
Noonnoo	Amaya	Warajarso	Sebeta
Chaliya	Waliso	Yaya Gulalle	
Gindabarat			
Jaldu			
Abboonaa			
Ambo			
Ejersalafto			
Ada'aberga **Bako Tibe**			

Sources: *Zonal Livestock and Fishery development office, 2017*

Farm Resources

Landholding and Land Use Pattern: The average land holding per household varied among land types of the study area. Result from the sampled household indicates major proportion 47 % and 21.7% of the land was allocated for crop production produced both under rain and irrigation respectively. However, since, some portion of crop land under rain feed is used again under irrigation in un rainy season; no valid amount is known separately. Hay and pastureland occupied 9.12 % of the total land of the study area (figure 4). The overall average landholding per household in the study area was 2.6 hectare including productive and unproductive land. The average landholding

reported in this study is comparable with 2.5ha per household for Debre Zeit, central Oromia. Beyene (1984) reported that about 90% of the landholdings in the central highlands of Ethiopia are below 5ha and 65% are less than 1.5ha. The results are consistent with the land holdings of smallholder farmers in Jaldu district of West Shewa, Zone of Oromia Regional State, (Andnet *et al.,* 2014). Such small land holdings are typical of the densely populated areas of the Ethiopian highlands. None of the respondents from either kebeles was landless.

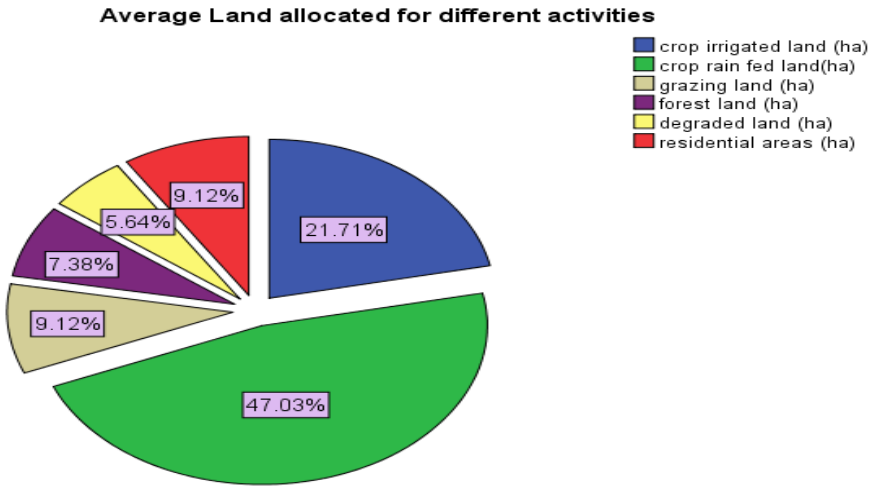

Figure3. *Average land allocated under different activities*

Labor Availability: The second resource in agriculture is labor. Farmers in the area use human and animal labor to support their agriculture. Availability of labor in the area is not a major problem. Farmers need labor throughout the year for various agricultural activities such as planting (especially for farmers using oxen to plough their farmland), weeding, harvesting, threshing and crop residue collection from the farm in rare case. The average family size is 5, with the minimum and maximum being 1 and 12, respectively. Farmers primarily use family labor in their agricultural activities. When family labor is not enough, farmers hire in labor. Thus, the requirement for daily laborers is not a critical problem for the majority of the farmers. However, labor is required during planting and harvesting by and large.

Gender Division of Labor: Men are mostly engaged in productive (agricultural activity) and also in other socio - political responsibilities also. Women on the contrary play triple roles and responsibilities. Women are mainly responsible for productive, reproductive and also social activities. Women play significant role in agricultural production in the study area. Many labor-intensive agricultural activities such as land preparation, weeding, harvesting and transporting require active involvement of women and men. The gender division of labor in different farm tasks has revealed that women across the study sites take part in almost all farming activities. The only exception is ploughing, which is exclusively done by men. Taking care of the cattle is done equally by men and women, while managing dairy products is more often done by women.

Capital and Technology: There is no question that small farmers characterized by high labor /capital ratios, account for the major portion of agricultural production in Ethiopia. However almost all of the farmers are using some common technologies like, in organic fertilizers, crop varieties, herbicides, pesticides, and row planting, however some agronomical problem was observed due to costs and knowledge gap on input usage. In the area none of mechanized agriculture is observed like using tractor for plowing, harvesting, and threshing due to costly and awareness problem on how to use, cost – benefit analysis and confessing the users (farmers) is important in spite land suitability of the area. Table 10 presents technology used in the study area.

Table10. *Type of technology used in the study area*

Type of technology	Name of the variety used	Most preferred and demanded variety
Fertilizer	DAP &UREA	Both
Row planting	Maize, wheat, Tef	Maize, wheat
Improved Tef	Kuncho,D2-01-354, Kaacha, Gaajoo, Magna, Ada'e	Kuncho, Kora, D2-01-354
Improved Wheat	Danda'a, Digalu, Qaqaba, Huluka, Quubsa, Hidase	Digalu, Danda'a, Kakaba
Improved Barley	Cocobe, Beera	
Improved Maize	BH 660, BH 661, Boset, Limu, Shone	Shone, BH660, BH661, Limu
Improved Sorghum	Abshir, Gubiye	
Improved Bean	Rare	
Improved Chick pea	Dubbe	
Improved Potato	Jalanne, Balaxa, Gudane	Jalanne
Improved Lentil	Alamaya	Alamaya

Sources: *Group discussion, 2017*

Natural Resource Context

Ethiopia is a largely agricultural country whose economy is based on renewable resources in rural areas. Given the low level of economic development in the country, the pressure exerted on the environment by growing human and livestock populations has exacerbated the rapid depletion of the natural resource base (Feoli *et al.*, 2002).Endowment of natural resources (favorable land, water resources, vegetation and climate) makes Oromia the leading region in contributing to agricultural growth and economic development of the country. However, the climax vegetation of the study area has been extensively cleared to give way for agricultural activities and establishment of human settlements. Thus, only some patches of natural vegetation and scattered trees are remained, and now the main natural resources existed are forest, water body, communal grazing land, and mountain. Utilization of the resource is on infant stage due to facility service problem, pollution, land escape and less attention by any concerned body in the region and the study area particularly. For instance, Akaki and Sebeta water has a potential for irrigation, fishery and recreation but due to pollution from urban settlementsand industries the impact leads to negative for the users instead of benefiting.Similarly, there are natural tourist attraction sites in the study area. Among others Wenchi creator lake, panoramic view of wenchiWoreda landscape in wenchiwereda and panoramic view of Tulu Maja (Abbo Mountain) in Weliso woreda of south West Showa zone and Huluka water fall, book-tulle and Boku-chitu ritual sites are the main tourist attraction identified in Ambo Wereda of West Showa zone. So, it is deemed that the intervention of important facility and attention will have significant contribution for effective utilization of the specified attraction and to explore the non-identified sites.

Table11. *Natural resources locations and name in the study area*

Zones	Forest name[a]	Water body[b]	Mountain and others[c]	Purpose
West shewa	Chilimo, JibatGedo Wos-washa	Huluka water, Guder river,	Book-tulle Boku-chitu ritual sites Sankale stone	[a](Bee keeping, charcoal & construction) [b](recreation) ***c***(tourist attraction)
South west shewa		Wanchi lake Kulit, Derge Waliga Awash, Wudocha, Wealcha, Bibin	Tulu Maja	[b](tourist& irrigation)

O/S/Z/S/Finfine	Menagesha Entoto forest	Akaki river Sebeta lake		[a](Beekeeping &tourist) [b](Irrigation and fishery)
North shewa	Hagenia forest			

Sources: *Key informant Group discussion, 2017*

Natural resources conservation: Type of Land Management Practice like Soil bund construction, Stone bund construction, Compost & manure and Fencing the farmland are the common practice. In this regard, diversifying as well as increasing the quantity of tree planting and construction of other terracing structures is crucial in order for the land management undertaking to be robust enough.

Problems and Opportunities

Crop related problem: Many interrelated challenges for crop production were identified and prioritized.

- Land shortage: An increasing conversion of land from agricultural to urban use has attracted a large number of investors in different sectors, wage laborers, small scale businessmen and others which increased the dynamicity of population and activities in the area especially O/S/Z/S/F. Even if the zone has huge potential for investment in manufacturing, flower farming and agro-industries, it became the major recipient of some negative externalities on the farmland and environment. There are challenges already emerged and likely to emerge in the nearest future with regard to sustainable use of resources and environmental sustainability as farmers reports. There is an increasing and of course, unregulated competition for land which affects the sustainable use of land resource. In addition, Traditional farming like less farming mechanization, less attention on irrigation production is main problem for all.
- Inefficiency of supply and delivery of inputs: Lack of seed of improved varieties was a major concern with most farmers who are presently using own, exchanged or market purchased grain. This included crops grown primarily food crops (Teff, Barley, Enset, and Maize); dual purpose food and cash crops (Wheat, lentil, chickpea, Faba bean, Potatoes, Teff, Field pea) and those crops primarily grown for cash (vegetables). Most farmers reported not being able to access agro-chemicals when required, especially agrochemicals for weed and pest control. Problems of adulteration, selling after expiration dates and failure to work effectively were often mentioned. Failure to work effectively could be due to poor application. At present cooperatives are providing fertilizers but often at unaffordable prices.
- Crop diseases and Pests: Disease and pest is another problem of crop production in study area. These diseases attack crops mainly at the very beginning of germination, vegetative stage, at flowering stage and grain filling stage of the crops. Diseases and pests and crop(s) affected summarized in the tables bellow.

Table12. *Major diseases and crops damaged Disease Attacked Crop(s)*

Disease	pests	Attacked Crop(s)
	Stack born	Sorghum and maize
	Red Teff warm	Teff
	African boll warms	Chickpea& vetch
Wheat rust		Wheat & barley
Faba bean gall		Faba bean
Unknown diseases on green pepper		Green pepper
Anthracnose disease on orange fruits		Orange fruit
rust disease		Garlic leaves

Sources: Group discussion, 2017

- Pollution: Environmental pollution is another major threat to the sustainability development of crop production. As information from Livestock and fishery development office, Farmers of the area (surrounding Finfinnee) seriously affected due to that the rivers in Finfinnee are simply used as a receptacle of all kinds of wastes

released in the city. There is a high amount of waste disposal in the river and riverbanks from municipal source (municipal solid and liquid wastes), liquid wastes from toilet, open urination and defecation. Other waste sources come from construction buildings, fuel stations, garage operations and congested settlements.

- Shortage of Storage and processing: Most of the farmers use local sacks, that is, polyethylene bag to store their grain while few of them use grainer "Gotera". No farmer uses the modern containers like PICS Bags, Supper Bags, Hermetic Bags, or Metal Silo. These containers are airproofing and believed to control storage insects by limiting oxygen in the bags So, lack of crop storage facilities leading to post harvest pest and disease problems. With regards processing, serious constraints included; lack of knowledge about processing and lack of processing equipment for instance harvesting, drying and grinding mills, which limited opportunity for adding value. At the same time concerns were raised about low market prices. Farmers often sell their crop soon after harvest to avoid pest damage, but when prices are low. Early selling is also necessary to ensure timely loan repayments with late payments attracting high interest rate penalties. Little value addition was reported, with output prices being largely dictated by traders.
- Water logging: In the North and southwest Shewa Zone, there is a problem of water logging, especially along with poor soil fertility while in lowland areas where sorghum is the main stay of the population, the problem of moisture stress is seriously affecting crop production. The farming community has great interest to use different agricultural technologies that are found appropriate in their soil characteristics of farming system.
- Irrigation Conflict: Other problem on crop production of the study area was conflict on irrigation among upper and lower streams of farmer. The impact of conflict on irrigated agriculture and consequently summer crop production within conflict-affected agricultural lands was observed in some parts the study area. Farmers and development agents (experts of irrigation) complaining no rule and regulation in the use of irrigation.
- Marketing: Major constraints related to vegetables marketing are: Fluctuations in volume of supply and demand, seasonal unavailability of vegetables, fluctuation in price, problems with storage, processing and packaging (lack of post-harvest handling), lack of marketplace (shade). Specifically, women also encounter some challenges in vegetable marketing such as shortage of marketplace and thereby women exposed to sun, Lack of awareness for nutritional issues, reluctance to consume indigenous vegetables were major problem raised.

Constraints in Agricultural Production3

Introduction

Livestock production is an important source of livelihood for smallholder farmers in Ethiopia and plays a significant role in the national economy. Although the country has the largest livestock population in Africa, its productivity is much below the potential. The poor performance of the livestock sector in the country is due to different reasons such as insufficient quantity and quality feeds and seasonal availability of feed resources, low production performance of local livestock breeds, animal health problems and inadequate health services, inefficient management of livestock, poor infrastructure, poor marketing and credit facilities, inadequate knowledge of integrated mixed farming systems and insufficient attention given to the livestock sector in the past. Among the aforementioned problems, feed scarcity is often cited as the primary and major constraint to livestock productivity in crop-livestock mixed farming systems (Legesse, et al, 2008).

Live Stock Problem

The constraints to agricultural production are many but the main ones are that were given by respondents in order of priority are:

- Shortage of livestock feed
- Little attention given to income generation of livestock production (beekeeping, poultry, dairy, meat and the other)
- Destruction of bee colony due to chemical application and deforestation
- Costly of farm inputs and unavailability of credit facilities with easy bureaucracy for the farmers
- Less and unwise utilization of natural resources (forest, water, grazing land)

Beekeeping problem

- Spread of deforestation in the area leads shortage of bee forage
- Extensive use of agrochemicals in the study area
- Presence of pests and predators that attack bee colonies in the area
- Increasing the cost of input such as modern bee equipment and accessories

Opportunities for integrated interventions

- Capacity building in livestock and crop production technologies from land preparation to harvesting for both frontline extension staff and farmers
- Gender mainstreaming in community activities to involve women in the farming activities
- Study on the operation of irrigation schemes and possible ways of improvement through the use of irrigation Participatory Rapid Diagnosis and Action model (PRDA) developed
- Formation of marketing groups to improve the price regulation and also to use the economies of scale rule to increase profit margins and cut down transportation costs.
- This could also handle issues of collective purchasing thus reducing production costs.
- The demand for agro forestry tree seedlings is very high and this offers an opportunity for a forestation of some areas.
- Beekeeping could be another source of income. There is an opportunity to train farmers on alternative uses for the minimization of food insecurity

Beekeeping opportunity

- Rise of honey price annually at national and international markets
- Availability of government policy which help beekeeper's association to improve its position in honey value chain
- Acceptance and better perception organic local honey by tourists Presence of huge numbers of traditional beehives in the area
- Proximity of the area to big city such as Addis Ababa and big towns

Conclusions and Recommendations

Farming systems in Oromia are highly dynamic and this needs to be well understood in order to formulate interventions that can bring positive change. Farmers are highly to mixed (crop-livestock) farming systems and slowly commercialized crop production under irrigation. They therefore need the skills and knowledge to manage these production systems in a sustainable way. Low productivity levels of these regions were attributed to low soil quality, water logging, land shortage, storage problem, pollution, crop disease and pests. To optimize the crop performance in these areas, it is important to introduce soil management practices, modern storage practices and appropriate diseases and pest control mechanisms at required time. From livestock sector dairy farming and beekeeping constitutes an important part and potential activities which plays a crucial role for economic development of the country as a source of feed and income. It has many opportunities for dairy and honeybee development; more or less stable market price for the products, good infrastructure, healthy dairy cattle and honeybee colonies, and good accesses to beehives are amongst the others. On the contrary, the major constraints hindering for dairy development in the study area includes shortage of feed, little number of improved cattle in spite of its milk yield is superior while the most constraints for beekeeping includes pests and predators, shortage of bee forage, and high cost of improved inputs for beekeeping. Improved beekeeping technologies have been introduced to Oromia regional state in general and the study sites in particular. However, most of the introduced modern ways of beekeeping are not in use to the desired extent. So, affordable input price and appropriate credit system to be developed to solve financial problem. Since adequate, quality and affordable credit system could contribute a lot towards improving the performance of beekeeping business

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