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

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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 is to characterize and analyze the existing farming system, identify the production constraints and further opportunities in the farming system interventions for 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. About 86.18% of the sample respondents were male headed with while 13.82 were female headed households. The zone was characterized by mixed farming systems i.e. livestock and crop production take place within the same locality. The farmers face production and market constraints to improve production and productivity. The production constraints of livestock production were disease, shortage of grazing land, feed shortage, shortage of veterinary medicine, lack of improved breed and shortage of water while marketing constraints were 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 low price of output, lack of market information, lack of market linkage and high transaction cost. Even though the farmers were practice SWC through 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 improved breed, forage, control disease and control illegal livestock trade are need attention. Additionally, improving crop productivity through IPM, improved varieties, minimizes transaction cost, focus on high value of crop, expand soil and water conservation, strength market information and linkage where need urgent concentration.
Keywords: Oromia**,** Horo Guduru Wollega, Characterization, farming system
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Background

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 Region in Ethiopia. It is named after the former province of Wollega whose eastern part lay in the area Horoguduru Wollega now occupies. Horoguduru Wollega was formed of woredas which included to East Wollega Zone.

The seat of the zonal administration cabinet is in shambu town. Shambu is a seat for Horro Woreda and Shambu town woreda in addition to the zonal service.

Based on the 2007 Census conducted by the Central Statistical Agency of Ethiopia (CSA), this zone has a total population of 570,040, of whom 285,515 are men and 284,525 women. 64,739 or 11.36% of the population are urban inhabitants. 121,136 households were counted in this zone, which results in an average of 4.71 persons to household 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 such as focus group discussion and key informants interview were conducted using checklist schedule. Secondary data were collected from published and unpublished materials from respective Horo Guduru Wollega zone and districts for comprehensive the report and rational conclusion.

Sampling Design

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

Methods of Data Analysis

Descriptive statistics such as mean, standard deviation, frequency and percentage were used to analysis quantitative data gathered from respondents. The qualitative data were analyzed through systematically organizing the information and using perceptions and preferences of group and key informants interviews.

Results and Discussion

Demographic characteristics households

About 86.18% of the sample respondents were male headed with while 13.82 were female-headed households. About 83.33% of the sample respondents from Highland were male headed while 16.67 were female headed households. About 90.19% of the sample respondents from midland 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. According to key informants interview model farmers were adopted new technologies early than followers. About 6.94%, 72.22% and 20.84% of sample respondent were rich, middle and poor in wealth status respectively in highland while 11.77%, 84.31% and 3.92% of sample respondent were rich, middle and poor in wealth status respectively in midland. Majority of the respondents (62.6%) follow protestant. The mean household size of the respondent was 7.74 with standard deviation of 2.35 whereas the mean household size of highland was 7.75 with standard deviation of 2.72 while mean household size of midland 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
	Follower	50	69.44	26	50.98	76	61.79
Farmers resource ownership category	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 respondent were 2.57 hectares while it is about 2.31 hectares of cultivated land. The mean of grazing land, forest land, degraded land and residential area land were 0.54, 0.33, 0 .14 and 0.22 hectares respectively as summarized in table 2 below.

Table 2: Land holding

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 technology information to famers. About 98.40%, 86.18% and 87.81% of farmers own ox-plough, sickle and hoe respectively. About 77.24% and 69.92% of households own radio and mobile phone respectively. This implies that the farmers got information through radios and mobile phones would reach most of the farmers in the study areas. 56.09% and 46.34% of respondents own 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. 35%)	9(17.65 %)		69(56.0 9%)	54(43.91 %)	
Electricity/Solar	30(41.67 %	42(58.3 3%)		27(52. 94%)	24(47.0 6%)		57(46.3 4%)	66(53.66 %)	

Source: Survey results, 2017

Households Livelihood activities

Horo Guduru Wollega zone were 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. About 96.75%, 74.79% and 26.02 of respondents livelihood were depend on crop production, livestock rearing and off/non-farm which contribute 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)	
	Percent	Contribution %	Percent	Contribution %	Percent	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 mean 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 importance as income source by the farming population. On average the 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. Although poultry were kept by a huge percentage of households with mean holding of about 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 respectively. About 95% of respondents were reported milk productivity decreased from time to time over last five years due to feed shortage and disease. Result presented in table 6 shows that the lactation period were 6.96 and 7.29 months for Highland and Midland districts, respectively.

Table 6. 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

Production and market constraints of livestock

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 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 disease are production constraint for shoats and equines respectively while about 35.78% and 18.96% were shortage of grazing land. 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 as shown in table below.

Table 7. Major livestock production and market constraints of respondents

Production constraints (n=123)	**% of households cattle**	**% of household shoats**	**% of household equines**	**% of household poultry**
Shortage of grazing land	64.07	35.78	18.96	
Disease	84.6	57.89	60.34	75.53
Shortage of veterinary medicine	21.03	14.76	13.4	18.45
Lack of improved breed	13.7	5.86		
Feed shortage	31.29	10.71		6.02
Water shortage	12.1	6.67	7.3	
Marketing constraints				
Market price/demand fluctuation	45.60	60.23	35.25	59.64
Lack of information	22.28	32.33	21.14	10.75
Lack of market linkage	42.12	22.15	31.75	12.25
High transaction cost	33.45	19.67	12.35	17.36

Source: Survey results, 2017

Common livestock diseases

The common livestock diseases and parasite are summarized in table 8 below. Across the sample, the major common 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. Across the survey about 93.42% of respondents took vaccination and drug against these diseases and parasites.

Table 8. Common livestock diseases and solution of respondents

Common Disease	Native Name	% of households	Solution
Trypanosomiasis	Gandi	33.5	
Black leg	Abba gorbaa	22.45	
Anthrax	Abba sangaa	28.68	
Ticks	Silmi	4.70	93.42% of the farmers used vaccination and drug
Bloat	Bokoksaa	7.76	
Lump skin	Shifshaafi	10.22	
Lichen	Dhulaandhula	10.29	
Pastevrellosis	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 9. 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 used	Preferred by livestock	30	41.67	23	45.09	53	43.09
	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 10. 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 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 11. Major crop pattern and productivity of respondents

#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 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 12. 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 weed 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 13. 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. Maize new varieties used by farmers are 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.

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 16. 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 17. 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 18. 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 19. 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
Purpose to receive credit	Input purchase	50	81.97	38	86.36	88	83.81
	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
Major credit constraints	High interest rate	42	68.85	30	68.18	72	68.57
	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 20. 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

This study was focused on two selectedGuduru (Midland) and Horo (Highland), districts of Horo Guduru Wollega zone. 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 findings of the survey results, the following recommendations specified were need attention:

Livestock production

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

Crop production

1. Capacitates farmers on integrated pest managements (IPM) to control pests (disease and insect) for major crops
2. The concerning body should support the farmers through timely supply of input with quality
3. Agricultural research should develop crops that tolerate weed and pests(disease and insect)
4. 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

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

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