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Analysis of the Role of *Enset (Ensete ventricosum)* Based Cattle Production in Households' Food Security in Four Selected Districts of Gurage Zone, Southern Ethiopia

Dirsha Demam Wonchesa

Department of Animal Production and Technology, College of Agriculture and Natural Resource, Wolkite University, P.O.Box 07, Wolkite, Ethiopia

Abstract: The study was conducted in four districts of Gurage zone of southern Ethiopia to evaluate the role of enset-based cattle production in households' food security and to identify major determinants of food security in the study area. Households of 360 were selected using proportional sample size determination. Around 88.05% of HHs primarily engaged in cattle production for production of manure to fertilize enset garden and milk to support enset-based food. In this farming system, cattle manure is principal source of organic matter, nutrient input and improves quantity and quality of enset products. Mature enset harvested per household was higher ($P<0.05$) for those HHs having greater number of cattle. Cattle and enset were basic source of livelihoods of farmers in the study areas. Farmers and focus group discussants articulated that cattle and enset are the basis of their life, but, they received low attention by development ventures. To promote food security, particular attention should be given on the integration of cattle and enset production through provision of strong and continuous extension services and area specific research works. Planners and political leaders should focus on production and productivity improvement; understand the life securing, economic and famine buffering capabilities of cattle and enset.

Key words: Cattle and Enset Interaction · Cattle Manure · Food Security · Gurage Zone

INTRODUCTION

Livestock plays vital roles in generating income to farmers, creating job opportunities, ensuring food security, providing services, contributing to asset, social, cultural and environmental values and sustain livelihoods [1]. Cattle play a critical role in *enset* system in maintaining soil fertility, agricultural sustainability and food security [2]. According to World Food Summit [3] food security is achieved when all people at all times have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life. The main issue of food security is for individuals to be able to obtain adequate food needed at all times and to be able to utilize the food to meet the requirements of the body. Food availability, on the other hand, is the physical presence of food in the area of concern through all forms of domestic production, commercial imports and food aid. Food availability refers to adequate availability of food in line with current population and demographic growth. This suggests that food availability is not enough indication of food security. There must be accessibility to and utilization of food by the people [4].

In this regard, *enset*-based cattle production can contribute to food availability through income generation, integration with *enset* and other crop production by providing manure to fertilize crop garden particularly of *enset* which open the opportunity for higher productivity per plot of land and make sustainable the production and productivity of *enset* food items that can be harvested at any time and stage of growth. In addition, Cattle are important source of cash income and play a significant role in ensuring food security and alleviating poverty [5]. Because of the low potential for crop production, including absence of or limited irrigation technologies in

Corresponding Author: Dirsha Demam Wonchesa, Department of Animal Production and Technology, College of Agriculture and Natural Resource, Wolkite University, P.O.Box 07, Wolkite, Ethiopia.

Ethiopia and most countries in COMESA, cattle remains a major source of income and food for the majority of rural people in the traditional farming systems [6].

Cattle ownership varies depending on the type of production system, wealth status and the overall farm production objectives. There may be a decline in total cattle numbers in general and also there is a definite decline for individual households' ownership because of increasing population and limited land. This decline will have an impact on manure production and the availability of draught animals. It could also have an impact on human nutrition. The cycle of increasing impoverishment of cattle component in this mixed crop/livestock system is a serious cause for concern [7]. In low input farming systems like *enset,* production of *enset* is strongly dependent on the number of cattle and the amount of cattle manure produced. The use of inorganic fertilizers is limited for *enset* crop because of its high cost and limited availability. Thus, cattle manure is locally available low cost substitute for the majority of resource poor farmers. Apart from its low cost and local availability, cattle manure is highly valued by farmers because of its multiple roles and long-term benefits [2].

Cattle manure plays a vital role in improving *enset* yields and allowing sustainable productivity and has ability of changing soil microclimate condition and restoration of ecological balance [8]. Limiting the number of cattle per household limits the availability of manure to fertilize *enset* plant, hence causing reduction in the long-term sustainability of *enset* product [9]. *Enset* products (Kocho = food prepared from a mixture of scraped pulp of the *enset* pseudo stem and decorticated corm of *enset*) rich in carbohydrates but low in proteins and fats [10]. Due to poor protein and fat content, *enset* food products are not consumed by their own, except during periods of extreme famine or by poor households (HHs) who do not have the means to vary their diet. Therefore, *enset* food is mostly consumed together with animal products such as milk, meat, cottage cheese, yoghurt and other crops such as cabbage, beans and peas [11].

Enset and cattle productions have been tremendously interdependent through generations and have a strong bond with the livelihoods and food security of the rural farming families of Gurage zone. Households of Gurage Zone have paid every endeavour to improve the production and productivity. However, the Local Governments and the respective Offices of Agriculture and Rural Development of Gurage Zone did not give attention towards improving the productivity of cattle either due to undermining or not understanding their potential of contribution to livelihoods and food security of farm HHs. In the absence of cattle, the production of *enset and enset products* will not be sustainable. Therefore this study was initiated with general objective of identifying the role of cattle in household's food security in *enset* based agriculture with the following specific objectives:

- To evaluate the role of cattle in households' food security in *enset* production system of Gurage zone, southern Ethiopia and
- To identify the major determinants of food security in the study area.

MATERIALS AND METHODS

Description of the Study Area: The study area, Gurage zone, is found in the Southern Ethiopia. It is located between 37°28' and 38° 38' longitude and 7° 28' and 8°27' latitude, covering an area of about 5,932 square kilometers. Based on data from Gurage zone department of finance and economy development (DOFED), the zone has 13 Administrative districts with 412 Peasant Associations (PAs) and 2 town administrations. The zone bounds with Oromiya regional state in the north, northeast and northwest, Silti zone in the south east, Hadiya zone in the south and Yem special woreda in west directions. Wolkite, the capital of the zone, is 155 km away from Addis Ababa in the Addis-Jimma road [12]. The estimated human population of the zone is 1,624,125, (51.4% women and 48.6%, being men) and 88.2 % of the population are farmer entirely dependent on subsistent agriculture [12, 13]. Gurage zone is one of the most densely populated areas in the country, with an average of 273.5 people/km^2 mainly concentrated in the agroecology of highland and midaltitude.

Based on data from the department of agriculture and natural resource development of Gurage zone (DANRD), the zone is found in altitudinal range of between 1600 and 3100 masl. The major crops grown in this area are *Enset (Ensete ventricosum*), Barely (Hordeum vulgare), Field pea (*Pisum sativum*), Fababean (*Phaseolus vulgaris*), *Teff* (*Eragrostis teff*), Maize (Zia mays) and Khat *(Catha edulis)* [14]. The average annual temperature is about 18°C. The current land use pattern of the zone, is 398,887 hectare of land for crop production, 92,421 hectare for grazing, 42,933 hectare for forest, 17,168 hectare degraded land and 41,791 hectare of land for other social services giving institutions. A livestock population of 3,611,159 is found in the zone, of which 1,678,455 cattle, 616,900 sheep, 260,420 goats, 820,269 chickens, 128,532 horses, 9,464 mules and 97,119 donkeys [12, 15].

Sampling and Sample Size Determination: Information on nature of PAs in relation to livestock population and *enset* (*E. ventricosum*) production was obtained from zonal and district offices of agriculture and natural resource development. PAs were identified after having *enset* and livestock population data and a total of 8 PAs **(**2 PAs from each district/one highland and one midaltitude**)** were purposively selected based on cattle number, *enset* production and accessibility. Households sample size were determined using [16, 17] sample size determination formula : $n = Z^2*P(1-P)/e^2$; n adjusted = n/ [1+ ((n-1) /N)]; where: n = sample size in population, Z-score = 1.96 for confidence level 95%, N = total HHs of 4 study *districts*, P = proportion of population score of 1= 0.5, 1-P = 0.5 and e = standard error of proportion = α = 0.05.

A total of 360 HHs from 8 PAs (45 HHs from each PA) were selected for the study. The selected PAs of highland and midaltitude from each district for the study, respectively, were *Shamene* and *Shehremo* from *Ezia* district; *Achene* and *Wukiye* from *Muhir* and *Aklil* district; *Moche* and *Yeferezye* from *Cheha* district as well as *Agata* and *Kochira* from *Enemor* and *Aner* district. The HHs selected from each district and PA were grouped in 3 wealth categories depending on number of cattle that each HH has owned (Wealthy: with cattle size of "≥ 6", medium: with cattle size of 4 and 5 and poor: with cattle size of 1-3) that was determined based on group discussion made by HHs, researcher, livestock experts and DAs.

Design of the Study: Information was gathered from a total of purposively selected 5 HHs from each PA through rapid field survey and consultations with experts from respective offices. It was summarized and used as basis to design structured questionnaires to quantify the most important information to the study. The survey questionnaires were also pre-tested with 2HHs from each PA and necessary adjustment was made. One-day training was organized for enumerators on how to administer the questionnaire. Interview was done by researcher together with enumerators on HHs of the study PAs.

Methods of Data Collection: Questionnaire interview of HHs and focus group discussion with experts from Gurage zone as well as experts from selected districts, elders and DAs of each study PA were used to generate pertinent data. Primary and secondary data sources were collected from all PAs selected for the study. Primary data were generated by field visits, interviews and group discussions. Secondary data sources were collected from zonal and respective district offices of agriculture and natural resource development through review of different published and unpublished documents. Structured questionnaire were used to obtain information on HH demography, landholding and land use pattern, herd size and herd composition, major annual crops produced, *enset* production and its use, interaction of cattle and *enset* production, purpose of cattle production, level of food security within the HH, impact of cattle and *enset* on food security status of HHs, uses of cattle manure.

Group discussions were made at zonal and each district level to clarify issues not well addressed thought survey and to validate some information collected from individual interview. A total of 5 group discussions comprised of 44 individuals, 9 from each district (5 farmers, 2 experts and 2 DAs) and 8 experts from zone office (6 from livestock and 2 from crop agriculture) were participated in the group discussion. Topics for group discussion were focused on major annual crops produced, *enset* production and its use, interaction of cattle and *enset* production, purpose of cattle production, level of food security within the HH, impact of cattle and *enset* on food security status of HHs and uses of cattle manure.

In measuring and analysis of household food security, the three dimensions (Pillars) of food security structures (Food availability, food access and food utilization) were used. Furthermore, a modified form of a simple equation termed as household food balance model (HFBM) was used to quantify the available food for the sample HHs to determine per capita calorie consumption [18] which was computed using the formula as described below. Non-grain food items were not considered by the aforementioned researcher of previously used this model somewhat he consider only food grains gained and lost. In this study, however, the researcher modified and used the model to compute the total available foods including food grains, *kocho*, *bulla* and cattle products produced by sample HHs.

$$Nij = (Gij + Pij + Bij + Rij) - (Hij + Sij + Mij + Oij)$$

where,

Nij = The net food available for i^{th} household in j^{th} year.
Gij = The total grain produced by i^{th} household in j^{th} year
Pij = The total grain Purchased by i^{th} household in j^{th} year.
Bij = The total grain borrowed by i^{th} household in j^{th} year
Rij = Total Grain obtained from relatives by i^{th} household in j^{th} year
Hij = The post-harvest losses to i^{th} household in j^{th} year

Sij = The total grain utilized for seed by i^{th} household in j^{th} year
Mij = Total grain marketed by i^{th} household in j^{th} year
Oij = Grain given to others i^{th} household in j^{th} year

Methods of Data Analysis: The collected data were analyzed in such a way that they meet research objectives and answer research questions. The study involved qualitative and quantitative data analysis techniques. Information generated from sample HHs interview, group discussion and personal observation were discussed and narrated qualitatively. Statistical package for social sciences (SPSS) [19] version 20 was used for the analysis of collected data after checking, correcting and coding. Descriptive statistics such as table, percentage, mean, chi-square, standard error and standard deviation was used to present the results. Households were taken as unit of analysis.

RESULTS AND DISCUSSION

Characteristics of Household: In highland areas of the study, HHs of males were about 92.8% whereas females were 7.2%. In the midaltitude areas, however, 74.4% HHs were male and the remaining 25.6% were female headed (Table 1). The overall percentage of male HH in the study areas of Gurage zone (83.6%) was far exceeded from percentage of female HHs (16.4%). The percentage of male headed HHs obtained in the current study was more comparable with 88.89 % male and 11.1% female headed HHs reported by Samuel [20] in Shebedino and Dale districts of southern Ethiopia. Whereas it was different from 67% male and 33% female headed HHs reported by Azage [21] in Addis Ababa, 52.3% male and 47.7% female headed HHs reported by Haile *et al*. [22] for Hawassa town; 75.9% male and 24.1 % female HHs reported by Belay and Janssens [23] in Jimma town of Oromiya region and 56.7% males and 43.3% female HHs reported by Asrat *et al.* [24] in and around Wolayta Sodo town of southern Ethiopia.

The differences observed in the percentage of male headed HHs among midaltitude and highlands of Gurage zone (Table 1) could probably be attributed to the greater rate of evacuation of males from midaltitude areas to the cities and towns found in different parts of Ethiopia in search of job opportunity leaving the rural HH business to their wives. Differences on average number of male and female HHs in current study, on the other hand, might be associated with cultural issues of forcing females to get married and/or pushing aside the females from being having power of bargaining on economic motives (FG D).

Table 1: Characteristics of households in the study areas of Gurage zone in percent

Agroecologies	Male	Female	Total percentage
Highland (n=180)	92.8	7.2	100
Midaltitude (n=180)	74.4	25.6	100
Average (N = 360)	83.6	16.4	100

N = total sample HHs of the study, n = sample HHs per agroecology.

As indicated in Table 2, the overall average family size reported in both agroecologies of the study areas was 7.71. The family size in the midaltitude area was significantly higher (P<0.05) than the highland areas. The average size of the family in the study area was similar to the average family size of 7.50 persons per HH reported by Berhanu *et al*. [25] and 7.54 persons per HH reported by Kassa *et al.* [26] from Awassa but lower than the average family size of 9.92 reported from Adami Tullu Jiddo Kombolcha district of east Showa zone of Oromiya region by Dawit *et al*. [27].

On the other hand, it is higher than the national average of 5.2 reported by CSA [28] the average family size of 6.2 reported by Ahmed [29] from highland and midaltitude of Basona Worana *district* of north Shoa zone, 7.05 reported by Beriso *et al.* [30] from Aleta Chukko district of Sidama zone in southern Ethiopia, 6.46 and 7.17 reported by Kassa *et al.*[26] respectively, from Ambo and Bako Tibe *district*, 6.02reported by Belay and Geert [23] from Jimma area, 6.51 reported by Asrat *et al*.[24] from in and around Wolayta Sodo town of southern Ethiopia and 6.6 person per HH reported by Selamawit *et al.* [31] from north Achefer *district* in Amhara region.

The observed relatively larger average family size in the study areas of Gurage zone could probably be related to the agricultural activities mainly of *enset* (*E. ventricosum*) production, which are relatively labor intensive. The age of the respondents of the study areas ranged from 30 to 78 years with an average age of 48.94 years. The average number of family members in age category of ≤ 14 and > 65 per HH was higher (P<0.05) for midaltitude (Table 2) than the highland areas.

Cattle Population and Herd Size: Cattle ownership varies on agroecology, wealth status and overall farm production objectives. As indicated in Table 3, the average cattle holding in TLU per HH in highlands and midaltitude areas, respectively, was 3.34 and 3.37 with over all mean of 3.35 which was comparable with the results of 3.31TLU for highland and lesser than the value of 4.59 for midaltitude reported by Dereje [32] in three *enset* (*E. ventricosum*) growing regions of Ethiopia but it was much lesser than 7.57 for highland and 6.54 for

Table 2: Mean (±SE) family size in sex and age group in the study areas of Gurage zone.

Agroecologies	Age of HHs	Family size of HHs in sex			Age group	
		Total	Male	Female	≥15to≤65	≤14 & >65
Highland	49.44±.7	7.34±.25^{b}	3.64±.13^{b}	3.63±.13^{b}	5.66±.18	1.68±.1^{b}
Midaltitude	48.44±.6	8.09±.25^{a}	4.02±.14^{a}	4.07±.14^{a}	6.03±.18	2.04±.11^{a}
Total	48.94±.5	7.71±.18	3.83±.1	3.85±.13	5.85±.13	1.86±.07

$^{a-b}$ means in the same column sharing different letters of superscripts are significantly different (P<0.05), HHs = households

Table 3: (Mean ±SE) herd size and structure per HH in highland and midaltitude in the study area of *Gurage* zone

Species	Herd size and structure (in number)			Herd size and structure (in TLU)		
	Highland	Midaltitude	Overall	Highland	Midaltitude	Overall
Cattle	4.86±0.17	4.88±0.18	4.87±0.12	3.34±0.12	3.37±.14	3.35±0.1
Cows	2.08±0.07	2.21±0.09	2.14±0.06	1.78±0.07	1.87±.09	1.82±0.06
Oxen	0.23±0.03	0.21±0.03	0.22±0.02	0.26±0.04	0.23±0.04	0.24±0.03
Bulls	0.61±0.04	0.57±0.04	0.59±0.03	0.67±0.04	0.62±0.04	0.65±0.03
Heifers	0.73±0.06	0.83±0.07	0.78±0.04	0.38±0.03	0.43±0.03	0.40±0.02
Calves	1.21±0.07	1.07±0.05	1.14±0.04	0.25±0.02	0.22±0.01	0.24±0.01
Sheep	1.94±0.08^{a}	0.56±0.07^{b}	1.25±0.06	0.19±0.01^{a}	0.06±0.01^{b}	0.12±0.01
Goats	0.01±0.01^{b}	1.42±0.10^{a}	0.71±0.06	0.01±0.00^{b}	0.14±0.01^{a}	0.07±0.01
Horses	0.55±0.04^{a}	0.02±0.01^{b}	0.28±0.02	0.44±0.03^{a}	0.01±0.01^{b}	0.23±0.02
Mules	_	0.47±0.04	0.24±0.02	_	0.38±0.03	0.19±0.02
Donkeys	0.09±0.02^{b}	0.35±0.04^{a}	0.22±0.02	0.04±0.01^{b}	0.18±0.02^{a}	0.11±0.01
Overall	_	_	_	4.02±0.03	4.14±0.03	4.07±0.03

$^{a-b}$ means with different letters of superscripts in the same row for highland and midaltitude differ significantly (P<0.05) for livestock number and TLU, TLU = Tropical Livestock Unit.

Table 4: Objective of cattle rearing in the study areas of Gurage zone

Study *districts*	Purpose of cattle rearing (%)				
	Milk	Manure	Traction	Milk and traction	Milk & manure
Ezia (n= 90)	0	0	0	15.6	84.4
Muhir and Aklil (n= 90)	0	0	0	4.4	95.6
Cheha (n= 90)	0	0	0	8.9	91.1
Enemor and Aner (n= 90)	0	0	0	18.9	81.1
Total (N=360)	0	0	0	11.95	88.05

n = sample HH per district, N = total sample HHs of the study.

midaltitude areas reported by Abera *et al.* [33] in selected districts of Sidama Zone, Southern Ethiopia. On the other hand, there was no significant difference (P>0.05) on average cattle holding per HH of highland and midaltitude areas of the study.

Primary Objectives of Cattle Rearing: According to the responses of HHs (Table 4), the primary objective of cattle rearing was necessity for high demand of manure to fertilize *enset* fields and milk production to supplement *enset* product which is low in protein. About 88.05% of cattle owners of HHs found in both agroecologies of Gurage zone kept their cattle mainly to satisfy the need of manure to be utilized in production of *enset* crop (Its product: *kocho, bulla* and the corm are the staple food of the farming families) and to produce milk and milk products to support the *enset* products without which it is impossible to get necessary nutrients enough to lead healthy life. The result of current study is in agreement with the result of Beriso *et al.* [30] reported from Aleta Chukko district of Southern Ethiopia, who reported that cattle were important component of the mixed-farming system and provide, milk, fertilizer, income and saving to the farmers and the primary purpose of cattle rearing was for milk production and manure.

Productivity of Land in *Enset*-Cattle Production System: As indicated in Table 5, the average cultivated land for *enset* production was 0.37 hectare, the average mature *enset* harvested per year per plot of cultivated *enset* land

Table 5: Average land holdings for *enset* production and productivity of *enset* in the study area of Gurage zone

Descriptions	Sum	Mean	Minimum	Maximum
Land allocation for *enset* per HH (ha)	134.37	0.37	0.11	1.20
Mature *enset* harvested per year/ha	25971.00	72.00	15.00	210.00
Kocho produced per mature *enset* (kg)	18645.00	51.80	38.00	80.00
Kocho produced per HH (kg)	1289100	3580.8	690.0	9450.0
Bulla produced per mature *enset* (kg)	675.30	1.88	1.00	3.00
Bulla produced per HH (kg)	46856.9	130.16	15.00	416.00

Source = own survey data (2017/18), ha = hectare

Table 7: Food self-sufficiency of HHs from own production in the study area of Gurage zone

	Households of different wealth groups			
Households' response	Poor (n = 120)	Medium (n = 120)	Wealthy (n = 120)	Total(N= 360)
Yes	60.8%	72.5%	87.5%	73.6%
No	39.2%	27.5%	12.5%	26.4%
Total	100%	100%	100%	100%
Chi-square value = 22.08, level of significance = 0.000***				

Poor = HHs with cattle size of 1-3, Medium = HHs with cattle size of 4-5, Wealthy = HHs with cattle size of ≥ 6, n = number of HHs in each wealth group, N = total HHs of the study.

was 72, the average production of *kocho* and *bulla* harvested from individual mature *enset* plant, respectively, was 51.8 and 1.88 kilogram. The result of *kocho* production per mature *enset* in the current study ranged between 38 kg to 80 kg with the average production of 51.8 kg.

The average kilogram of *kocho* (51.8 kg/mature *enset)* reported in the current study was not in agreement with the nationwide survey report of 19.04 kg/*enset* or 11.9 tons per hectare per year reported by Taye [34] and 30.2 kg per mature *enset* reported by CSA [35]. The kg of kocho produced in the study areas per mature *enset* plant found to be in the ranges of *kocho* produced per mature *enset* reported by Shank and Entiro [36] which was 19.7 to 84.6 kg/*enset* but a higher than the report of Admasu [37] who reported a maximum yield of 42.02 kg/*enset* or 26.26 tons per hectare per year. *Kocho* pre-dominates other *enset* food products such as *bulla* in its quantity. Consequently, quantification of *enset* yield mostly considers the yield of *kocho* production. The average yield of *bulla* produced per mature *enset* reported in current study is 1.88 kg which is much higher than the average *bulla* produced (1kg) per mature *enset* plant reported by the national survey of CSA [35].

Role of Cattle in HHs' Food Security in *Enset* Production System: The contribution of cattle production to HH food security in *enset* production system, categorization of sample HHs in food secured and food insecure, perception of HHs about cattle and *enset* production and factors affecting HH food security status were analyzed and briefly discussed. In this section, the researcher employed the 3 major pillars of food security structures (Food availability, food access and food utilization) to see contribution of *enset* based cattle production to HH food security.

Food self-sufficiency from Own Production: As far as food self-sufficiency from own production was concerned, differences were recorded on level of food self-sufficiency between HHs having different cattle size (Wealthy, medium and poor wealth groups). According to responses given by respondent HHs, 87.5% wealthy, 72.5% medium and 60.8% of poor HHs were self-sufficient from their own production. To understand the existence of association in level of food self-sufficiency of HHs from own production and differences in cattle ownership, Pearson chi-square test of association was carried out. The result of Pearson chi-square test indicated existence of significance association ($P<0.05$) between level of HHs' food self-sufficiency and the number of cattle owned by HHs of different wealth groups. The result of current study realized the existence of well-built interdependence between numbers of cattle owned by HH in *enset* based cattle production system and HH's food self-sufficiency from own production (Table 7).

Food Access: Food accessibility is viewed from perspective of purchasing power of HH and physical accessibility of HHs to the sources of food. Cattle support this pillar by direct income generation of 808.28 Ethiopian currencies (Birr) per year which is 17.15% of annual

Table 8: Income from sale of cattle and cattle products in the study areas of Gurage zone.

	Range and % annual income of HHs in Birr						
Pas of the study	≤500	501-2000	2001-4000	>4000	Total	Mean	% income
Highland							
Shamene (n =45)	34	7	3	1	45	1100.4	23.87
Achene (n =45)	37	5	2	1	45	1021.0	23.10
Moche (n =45)	33	9	3	--	45	822.2	17.8
Agata (n =45)	36	5	3	1	45	894.9	19.95
Midaltitude							
Shehremo (n =45)	29	12	2	2	45	503.6	10.43
Wukiye (n =45)	27	13	3	2	45	671.8	13.19
Yeferezye (n =45)	31	10	2	2	45	846.4	17.03
Kochira (n =45)	21	14	6	4	45	605.3	12.96
Overall (N = 360)	68.89	20.83	6.67	3.61	100	808.28	17.15

Source = own survey data (2017/18), percentage of income = mean annual income from cattle (Table 8) divided by average annual aggregate income (Table 9).

Table 9: Households' annual minimum and maximum as well as mean aggregate income in the study area of Gurage zone

Annual aggregate income in birr	Respondents HHs in highland Pas					Respondents HHs in midaltitude PAs				
	Shamene	*Achene*	*Moche*	*Agata*	*Shehremo*	*Wukiye*	*Yeferezye*	*Kochira*	Total	(%)
1800-2500	3	4	0	4	0	0	0	0	11	3.0
2501-4000	18	18	13	16	16	4	6	7	98	27.2
4001-6000	19	22	24	21	23	34	32	25	200	55.6
6001-8000	5	1	7	4	6	7	7	10	47	13.1
Above 8000	0	0	1	0	0	0	0	3	4	1.1
Minimum	1800	2100	2650	1800	3200	3200	2100	2350	1800	--
Maximum	7000	10000	13500	8000	7300	9000	8500	7600	13500	--
Mean	4610.67	4423.33	4619.11	4485.56	4827.33	5093.11	4970.44	4672.00	4712.69	--
Std. Dev.	1091.69	1455.27	1635.27	1303.6	871.54	1204.02	1378.94	1223.93	1294.90	--

Source = own survey data (2017/18), Birr = Ethiopian currency

aggregate income that improved the purchasing power of HHs (Table 8). On the other hand, cattle also provided about 10.2% of kilocalorie of energy (Table 12) consumed by HHs of the study areas. In addition to these, cattle in the study areas have also played a major role in improving production of *enset* and keeping sustainability of *enset* products *(kocho and bulla)*. The result of current study corresponds with the report of Obamiro *et al.* [38] who revealed that food access refers to individuals having adequate resource entitlements for acquiring appropriate foods for a nutritious diet. It depends on income available to HH, on distribution of income within HH and on price of food. The same authors also indicated that food access depends on market, social and institutional entitlement and rights to which individuals have access. Simply, making food available is not enough, one must also be able to purchase it, especially the low income HHs.

Income Generation from Cattle: Majority (68.89%) of respondent sample HHs were obtained annual income of 0-500 Birr whereas 20.83% were gained annual income of between 501-2000 Birr and the rest of 6.67% and 3.61% HHs gained an annual income of between 2001-4000 and above 4000 Birr, respectively. This income, hence, created an access to food directly or/indirectly by creating purchasing power. As indicated in Table 8, the overall annual income obtained from sale of cattle and cattle products accounted for about 808.28 Birr, which is 17.15% of aggregate annual income of HHs in the study areas. However, the result of this study indicated the existence of differences in income generation from cattle and cattle products between study PAs and agroecologies. PAs found in highland areas accounted for greater percentage of annual income from cattle and cattle products than PAs found in midaltitude areas.

Aggregate Income of Sample HHs: Aggregate income of the respondent HHs in the study areas of Gurage zone was ranged from 1800 to 13,500 (Table 9) and the average aggregate income of sample HHs was 4,712.69 Birr with standard deviation of 1,294.90. About 82.8% of sample HHs have earned annual aggregate income of between 2,501-6,000 Birr, whereas about 14.2% and 3%, respectively, were earned annual aggregate income of

Table 10: Difference in food easting per day among HHs in the study area of Gurage zone

	Responses of HHs (%)			
Number of eating food per day	Poor (n =120)	Medium (n=120)	Wealthy (n=120)	Overall
One time	6.7	5.0	4.2	5.3
Two times	52.5	35.8	18.3	35.5
Three times	40.8	59.2	77.5	59.2
Total (N=360)	100	100	100	100

Chi-square test Value = 34.07, level of significance = 0.000***

Source = own survey data (2017/18), Poor = HHs having 1-3cattle, Medium= HHs having 4-5cattle, Wealthy = HHs having ≥6 cattle, HHs = Households.

Table 11: Perceptions of HHs on eating diversified food in the study areas of Gurage zone

	Perceptions of HHs of different wealth groups (%)			
Response of households	Poor (n =120)	Medium (n = 120)	Wealthy (n = 120)	Overall
Yes	36.7	48.3	60.8	48.6
No	48.3	39.2	29.2	38.9
Not known	15.0	12.5	10.0	12.5
Total (N =360)	100	100	100	100

Chi-square test Value = 14.08, level of significance = 0.007**

Source = own survey data (2017/18), Poor = HHs having 1-3cattle, Medium= HHs having 4-5 cattle, Wealthy = HHs having ≥6 cattle, HHs = Households.

above 6000 and less than 2501 Birr in the year of 2017. Within the study areas, PAs found in midaltitude earned better average aggregate income when compared to PAs found in highland areas mainly due to the possibility of having *Catha edulis and eucalyptus* production potential of HHs which were major cash crops of midaltitude PAs.

Food Utilization: Food utilization is defined as the means by which individuals reach a state of nutritional well-being where all physiological needs are met. This refers to HHs' use of the food to which they have access and individuals' ability to absorb and metabolize nutrients. These ideas highlight the importance of non-food inputs into food security including knowledge of dietary needs and their potential impact on human health. According to Obamiro *et al.* [38] building knowledge of dietary needs and their potential impact on human health means, investing in complementary resources such as nutrition education, health care, provision of safe water and better sanitation, instituting gender equilibrium and removal of child abuse practices. In this study whereas, food utilization was discussed using HHs responses on number of meals consumed per day and dietary diversity of consumed food.

Number of Meals per Day: In the study area, the number of meals consumed per day was one of important indicators of HH wealth status and level of production. Thus, the number of meals per day for each sample HH was assessed and indicated in Table 10. The number of meals under normal situation in current study ranged between 1-3 times per day. Out of a total of 360 sample HHs, 5.6%, 33.9% and 60.5% of them were grouped under one time, two times and three times eating in a day respectively.

However, there are differences on having number of meals per day between HHs possessing different number of cattle (Wealth groups). From 120 sample HHs of each wealth group, about 77.5% wealthy and 59.2% medium HHs had normal number of meal (3 times) per day. In the case of poor HHs, on the other hand, only 40.8% of them had opportunity of three times food eating in a day and about 52.5% of poor HHs had ability of only two times food eating per day. Out of a total of 360 samples HHs, about 59.2% of HHs had normal or three times eat per day (Table 10). At the same time, Pearson chi-square test of association also revealed the existence of significant association (P<0.05) between the number of cattle owned and the number of times that the sample HHs eat food per day. That means, the greater the size of cattle owned by individual HH, the higher could be to have better number of food eating times per day.

Food Diversity: Having highly diversified diet is greatly correlated with productive and healthy life, adequate calorie and protein adequacy, HH's capability of production and wealth status of HHs. To assess HHs' utilization of diversified food, sampled HHs were asked whether their family members consume nutritious and balanced food sufficient to lead healthy life in the previous year. From a total of 360 samples HHs, 48.6% of them replied that their family members consumed diversified diet, however, 38.9% of HHs replied no and the remaining 12.5% of them didn't know whether their family members were eating diversified food or not (Table 11).

From 175 or 48.6% of the HHs who had opportunity of eating diversified food, about 36.7%, 48.3% and 60.8% of them, respectively, were poor, medium and wealthy HHs of cattle owners (Table 11). The statistical Pearson chi-square test also revealed the presence of significant association (P<0.05) between HHs owing different number of cattle and the ability of Hhs getting opportunity of eating diversified food necessary for normal life. This indicated that HHs with higher number of cattle had better opportunity of getting more diversified food to eat

Table 12: Caloric content of the food commonly consumed in the study Area

No	Food items		
A	Enset products	End products	Food energy (Kcal/100 grams)
1	Kocho	= Pan cake	157
2	Bulla	= Genfo/Berabrat	105/413
3	Amicho	= Boiled amicho	131
B	Grains		
1	Teff	= Injera	175.20
		= Porridage	189.40
2	Wheat	= Bread	210.65
		= Porridage	146.65
		= Nifro (boiled)	198.10
		= Kollo (roasted)	392.90
3	Barely	=Porridage/besso	142.5
		=Kollo (roasted)	392.40
4	Maize	=Kollo (roasted)	186
		=Nifuro (boiled)	198
		=Bread/tirwoshe	207
5	Pea	=Kik (watt)	260.97
		=Kollo (roasted)	320
C	Livestock product		
1	Milk	=Raw milk	73.70
		=Cheese	132.40
		=Sourmilk (ergo)	82.60
		=Aguat	23
2	Beef	=Raw meat	114.80
		=Key watt	177.40
		=Tibs / Kitfo	256.80 / 283.0
3	Mutton	=Key watt	152.90
		=Tibs	201.10
4	Goat	=Key watt	200.00
		=Tibs	212.80
5	Egg	= kikile / Tibs	152.90 / 295.10

Source: Ethiopian health and nutrition research institute (EHNRI) food composition table (1968-1997).

by the members of their family to lead better life than those HHs having lesser number of cattle. According to information gathered from interviewed HHs and focus group discussion, cattle products of milk, milk products and meat as well as vegetables are commonly consumed with *enset* products. It is all known that animal products are high in protein, vitamins and mineral contents which create chance to have better feeding status of family members who are dependent on *enset* products.

Classification of Food Secure and Food Insecure HHs: Household food balance model (HFBM) described in methods of data analysis was used to quantify the available food for the sample HHs to determine per capita calorie consumption and through which the sample HHs classified in to food secured and food insecure. Data used for the computation were generated through field survey. The post-harvest losses for the food crops in current study were estimated as 10% of the total yield of HH as per estimates made by Degefa [39]. While losses for cattle products were not considered in this study due to lack of reliable data. The quantity of grains, *enset* and cattle products consumed by HH was calculated and converted in to daily dietary calorie equivalent separately based on food composition table of Ethiopian health and nutrition research institute of 1968-1997 (Table 12).

The calorie equivalent of *kocho*, *bulla,* grains and cattle products varies by type and kind of end products prepared for consumption and average value of major end product was taken for consideration of conversion processes (Table 12). Based on results of current study, about 195 mature enset, 10,101kg of kocho and 366.6kg of bulla can be harvested per hectare of land per year. Average productivity of cereal grains in the study areas as per the results obtained from survey reports of HHs and Offices of Agriculture and Natural Resource Development (2017/18) was 2079.5kg per hectare. To compare the differences in dry weight and caloric productivity of *enset* and cereal grains, the researcher used cereal equivalents (CE) to convert these products. The cereal equivalent (CE) conversion of yield or weight value of a food to proportion of 3500 kilo calories per kilogram equivalents of cereals of *kocho* and *bulla* is 0.54 and 0.57, respectively, Shank and Entiro [36].

Total dry weight yield of *kocho* per hectare was 0.54 x 10,101kg (5454.54kg/ha) and cereal equivalent weight of kocho/ha was equal to 0.54 x 5454.54kg/ha (2,945.45kg/ha). Dry and cereal equivalent weight of bulla, respectively, was 0.57 x 366.6kg/ha (208.96kg/ha) and 0.57 x 208.96kg/ha (119.11kg/ha). The total cereal equivalent weight (CE) of *kocho* and *bulla* produced per hectare was 2945.45kg +119.11kg (3064.56kg) which was 3064.56 x 3500 = 10,725,960 kcal. Conversely, the average cereal equivalent weight of grains per hectare was 2079.5kg and the amount of energy produced in kilocalories was 2079.5kg x 3500kcal/kg = 7,278,250kcal.

Comparing the productivity differences among *enset* products and cereal grain, *enset* product surpassed by 985.06 kg in cereal equivalent weight which was 3,447,710 kcal (32.14%) energy per hectare. Hence, *enset* can feed additional 4.50 persons for 365 days with consumption of medically recommended daily intake of 2100 kcal energy per day [40] adequately per hectare per year when comparing it with grains produced per hectare. The proportion of calorie of individual products of *enset (Kocho and bulla)*, grain and cattle products from total was calculated to look into the contribution of each

Table 13: Food and dietary energy sources in the study area of Gurage zone

Food Sources	Types of food and level of kcal/kg	Food available for consumption (kg)	Dietary energy equivalent (kcal)	Dietary energy contribution (%)
Enset	Kocho = (0.54x3500)	1160190	2192759100	
	Bulla = (0.57x3500)	42171.21	84131563.95	
	Total		2276890663.95	65%
Grains	Barley = (2672)	105030	280640160	
	Wheat = (2370.75)	57182.4	135565174.8	
	Maize = (1927.5)	104911.2	202216338	
	Teff = (1822)	82706.4	150691060.8	
	Pulses = (2904.85)	33868.8	98383783.68	
	Total		867496517.28	24.8%
Cattle	Milk & milk product = (77.925)	328354.32	25587010.39	
	Meat = (2080)	157772.85	328167528	
	Total =		353754538.39	10.2%
Over all	3498141719.62	100%		

Source = own survey data (2017/18), kcal = kilo calorie, kg = kilo gram.

Table 14: Available daily dietary kilocalorie for family members of HH of different wealth groups in the study area of Gurage zone

	Household members of different wealth groups							
	Wealthy		Medium	Poor	Total			
Dietary energy /head/day kcal	Count	%	Count	%	Count	%	Count	%
1000-1499	5	4.17	13	10.83	37	30.83	55	15.28
1500-2099	4	3.33	19	15.83	25	20.83	48	13.33
2100-3099	7	5.83	13	10.83	13	10.83	33	9.16
3100-4000	10	8.33	19	15.83	17	14.17	46	12.78
4001-5000	23	19.17	23	19.17	13	10.83	59	16.39
5001-7000	36	30.00	17	14.17	11	9.17	64	17.78
> 7000	35	29.17	16	13.34	4	3.33	55	15.28
Total	120	100	120	100	120	100	360	100
Mean	6057.32	-	4221.7	-	2812.04	-	4799.19	-
Std. Dev.	2997.82	-	2649.39	-	1758.37	-	3133.07	-

Chi-square test value = 28.62,level of significance = 000***

Source = own survey data (2017/18), Poor = HHs having 1-3cattle, Medium= HHs having 4-5 cattle, Wealthy = HHs having ≥6 cattle, HHs = Households.

product to the dietary calorie supply of HHs in the study area as indicated in (Table 13). Out of total dietary energy supply of the available food, 65% dietary energy obtained from products of *enset* (*Kocho* and *bulla*), 24.8% was obtained from grains and 10.2% obtained from cattle products (only cattle products were considered).

Based on the perception of interviewed sample HHs and results obtained from focus group discussion (FGD), the production and productivity of *enset* as well as the amount of dietary energy produced from *enset* products basically dependent on cattle production and on the number of cattle (Large or small) owned by HH. Household respondents and group discussants concluded that the owning of either larger or smaller number of cattle had determining effect on the amount of manure produced which affects the growth performance of *enset*, the quantity and quality of *enset* products, the total amount of dietary energy supply from *enset* and therefore, the HHs' capability of being food secure or not. The result of current study on dietary energy supply from *enset* products (*Kocho* and *bulla)* corresponds with the report made by Kefale and Sandford [41] who stated that *enset* gives higher yield (1.3 to 3.5 times food energy) per unit area than other crops and thus supporting the densely populated areas in Ethiopia which is similar to the result of current study (Table 13).

Kilocalories of Available Daily Dietary Energy: Based on the average dietary energy reported from current study, 71.39% of HHs were food secure and those of 28.61% (N = 360) were food insecure (Table 14). To distinguish the variation between wealth groups and to see the contribution of cattle in food security, the distribution of available daily dietary energy by HHs on the level of cattle ownership were measured and about 92.5% wealthy, 73.33% medium and 48.33% poor HHs got daily dietary

Table 15: Households' response on the amount of *kocho* produced and months in which the family members consume *kocho* in the study areas of Gurage zone

Agroecologies	Do HHs produce enough *kocho* for annual consumption: Yes	No	Months of the year in which *kocho* is consumed by family members
Highland (n = 180)	72.78%	27.22%	Year round
Midaltitude (n = 180	82.22%	17.78%	Year round
Overall (N = 360)	77.5%	22.5%	Year round

Source: own field survey data (2017/18), n = sample HHs per agroecology, N = total sample HHs of the study.

energy greater than 2099 kcal (Table 14). Accordingly, those HHs who had daily dietary below medically recommended (<2100kcal) energy [40] sorted as food insecure group.

Whereas those HHs consuming above medically recommended daily dietary energy (≥2100 kcal) are grouped as food secure. Households having large number of cattle (Wealthy HHs) were in a position to produce greater amount of average daily energy of 6057.32 kcal per person which is much beyond the daily recommended energy intake of 2100 kcal/person/day [40]) and it is greater than twofold of the average dietary energy of 2812.04 kcal produced by those HHs owning small number of cattle (Table 14).

Tefera [42] reported that HHs who owned greater number of cattle have better food security status than those HHs with less number of cattle ownership and agreed with the result of current study. In the study areas of Gurage zone cattle not only influence the food security of HHs through improving production and productivity of *enset* products but cattle also put their direct effect (10.2%) on energy supply and food security status of HHs (Table 13). Statistical Chi-square test of association also revealed the existence of significant association ($P< 0.05$) between HHs owing different of cattle number and on gaining required amount of dietary kilocalories of energy per day per person (Table 14). This indicated that differences in ownership of number cattle could affect the capacity of HH in realizing food security.

Months of the Year in Which the HHs Consume *Kocho*: According to the perceptions of HHs participated in current study, almost all of the HHs in both highland and midaltitude agroecologies confirmed that they have primarily depended on *kocho* consumption as main or staple food throughout the year. From total sample HHs in highland agroecology (n =180), about 72.78% were confirmed that the amount of *kocho* produced was enough to feed their family members and the rest 27.22% were not in a position to produce enough *kocho* to fulfill the year round consumption need of their family (Table 15). On the same way, around 82.22% of HHs in midaltitude areas (n = 180) were reported that the quantity of *kocho* collected from *enset* garden was enough to feed their family members but 17.78% of HHs did not produce enough *kocho* to nourish their family members. In general the number of HHs who had potential of producing *kocho* enough to realize the annual food requirements of the family members in both highland and midaltitude agroecologies of Gurage zone (N =360) were accounted for about 77.5%.

Factors Affecting Household's Food Security: The study applied the binary logistic regression model to examine the relative importance of supply-side and demand-side factors of HH food security to data collected from 360 sample HHs in Gurage zone of Southern Ethiopia. Among factors included in the model, 4 factors were identified as significant determinants of HH food security. These factors include: number and family members, landholding, cattle holding and number of mature *enset* harvested per HH (Table 16). Among these, size of farm landholding, number of cattle holding and number of mature *enset* harvested were supply-side factors whereas the number of family members was demand-side factor [43]. The reported result of current study was in line with the report made by Degefa [39], Tefera [42] and Kidane [44] who reported that farmland size, livestock ownership, family size and level of technology application by HHs were some from various determinants of HHs' food security.

Households' family size: Family size affects HH food consumption with regard to the number of consumers. This is because, larger family size put more pressure on HH food consumption and causes the available HHs' food to be divided per individual family member. Based on the results obtained from analysis using the binary logistic regression (Table 16), there was a significant difference ($P< 0.05$) on the level of being food insecure between HHs having differences in size of family members. Households with larger family size are more prone to food insecurity than those HHs having smaller family size. The result of current study agreed with the report of Omotesho *et al*. [4] who reported that a HH with

Table 16: Food security status determinant factors/variables

Food security status		HH Number	Mean	SD	B	Sig.	Exp (B)
Number of family per HH	Food secured	254	5.95	2.0	+1.171	0.000	3.225
	Food insecure	106	11.93	1.60			
	Total	360	7.71	3.32			
Landholding per HH	Food secured	254	1.99	0.99	-1.706	0.004	0.182
	Food insecure	106	1.17	0.48			
	Total	360	1.75	0.95			
Number of cattle per HH	Food secured	254	5.40	2.35	-0.583	0.004	0.558
	Food insecure	106	3.59	1.54			
	Total	360	4.87	2.30			
Mature enset harvested per year per HH	Food secured	254	80.0	40.8	-0.001	0.012	0.999
	Food insecure	106	52.0	20.8			
	Total	360	72.0	38.3			

Source: own field survey data (2017/18), B = Coefficient of regression, Sig. = level of significance, Exp (B) = Odds Ratio, SD = Standard Deviation.

greater number of family members tend to be poor or food insecure. When the size of family member within the HH increased by one unit (By one person), the odds of being food insecure was 3.225times more likely than being food secure, taking the number of cattle holdings, number of mature *enset* harvested and hectarage of land holding per HH remain constant (Table16).

In the current study, the average family size of food secure and food insecure HH were 5.95 and 11.93 (Table16) with standard deviation of 2.0 and 1.60, respectively. This indicated the existence of strong association between the number of members of family within the HH and the food security status of the HH. The result of current study also was in agreement with the result of Shiferaw *et al*. [43] who stated that farm HHs in Ethiopia are small-scale semi-subsistence producers with limited participation in non-agricultural sector. Because resources are very limited, the increasing family size may put much more pressure on consumption than it contributes to production. Similarly, Tefera [42] indicated that family size is negatively related with food security status of HHs, because as the family size increases the probability of HH to be food secured decreases.

Landholding: The hectarage of land owned per individual HH in the study areas of both agroecologies affected food security status of farming HHs either positively or negatively which are under subsistence agriculture. Provision of adequate land for crop agriculture and livestock production, with no question can improve the food security status of the farmers and the results of current study realized this fact. It is well known that, the livelihoods of HHs found in the study areas of Gurage zone in general and those of sample HHs in particular mainly dependent on the amount of land that they have possessed. The result obtained from analysis of the binary logistic regression (Table 16), indicated the existence of significant difference ($P< 0.05$) on the level of being food insecure between the HHs having differences in size of land holding. This signified the presence of strong interdependence between landholding and food security status of the HHs. As observed in current study, when the size of landholding per HH increased by one unit (by one hectare), the odds of being food insecure become 0.182times less likely than being food secure, taking the number of family member, number of cattle holdings and number of mature *enset* harvested per HH per year remain constant (Table16).

The mean hectarage of land holding in food secured and food insecure HHs of current study was 1.99 and 1.17 (Table16) with standard deviation of 0.99and 0.48, respectively. The result of current study was similar with the result of Shiferaw *et al*. [43] who reported the larger the farmland that the HH owned, the higher the production level of HHs. Hence, it is expected that HHs with larger farmland ownership are more likely to be food secure as opposed to those having small farmland. Kebreab *et al*. [45] on the other hand, reported that increasing human population coupled with diminishing land resources are creating a growing number of landless people who cannot produce their own subsistence leading in to food insecurity in the HHs. Tefera [42] also indicated landholding has either direct positive or negative impact with food security status of HHs. As the size of individual landholding decreases, food security status of HH also be decreased. When the size of landholding per HH increases, food security status of HH also increased and corresponds with current result.

Number of Cattle Holding: Cattle plaid a major and fundamental role in *enset* based production system of the study area of Gurage zone and there was a close interaction between *enset* and cattle production. Cattle have different functions ranging from supply of manure to fertilize *enset* and other garden crop production, involvement in direct food supply (Milk, meat, butter and cottage cheese), cash generation and have interaction with other livelihoods of population in the study area which agreed with the report of Ehui *et al*. [5] who indicated that cattle are an important component of nearly all farming systems in Ethiopia and provide draught power, milk, meat, manure, hides and serve as a capital asset against risk. The same authors also reported that, cattle are important source of cash income and play an important role in ensuring food security and alleviating poverty.

The result of current study (Table 16), revealed the presence of significant difference ($P< 0.05$) on the level of being food insecure between HHs having differences in size of cattle holdings. Gryseels [46] on his study indicated that income accumulated from sale of cattle and their products and by-products was wisely used to finance the purchase of HH commodities that support food security status of family such as grains, salt, coffee, tea, cooking oil, sugar and meeting health expenses. Brandt *et al.* [7] also reported that because of increasing population and limited land, there may be decline in total cattle numbers in general and also there is a definite decline for individual HHs' ownership. This decline in cattle numbers has an impact on manure production and it could also have an impact on human nutrition. Brandt *et al.* [7] also comprehended that multiple purposes of cattle cannot be replaced by fertilizers and sustainability of *enset* cultivation system is a result of tight articulation of *enset* crop and cattle production systems. With an increasing population in an already densely populated area, it is likely that negative trend in cattle population will continue with potentially severe impacts on *enset* production that can affect human food security. When the size of cattle holdings of individual farmer increased by one unit (One cattle), the odds of being food insecure was 0.558times less likely than being food secure, taking the size of family members, the size of landholding and the number of mature *enset* harvested per HH remain constant (Table16).

In the current study the mean number of cattle holding in food secure and food insecure HHs were 5.40 and 3.59 with standard deviation of 2.35 and 1.54 (Table 16), respectively. This showed that HHs who owned higher number of cattle was found to be food secured than those farmers having lesser number of cattle. The result of current study also corresponded with the report of Shiferaw *et al*.[43] who stated that wealth status of HH is measured by the number of cattle owned since cattle is the most important indicator of wealth in rural Ethiopia. Household's level of farm resources (e.g., cattle) can affect his ability to withstand abrupt changes in production, prices, income or unforeseen events that create the need for additional expenditures. Shiferaw *et al*. [43] also indicated that particularly in Ethiopia where the incidence of crop failure frequently occurs due to shortage and erratic nature of rainfall, the level of one's resources (Cattle) is very important to combat those incidences. They also added that wealth as proxied by cattle size, is significantly larger for the food secure than for the food insecure HHs, implying that it matters in predicting who would be food secure.

Risse *et al*. [2] and Maryo *et al*. [9] on their study indicated that decreases in cattle number causes reduction in manure production thereby reducing long-term sustainability of *enset* systems. In the absence of cattle in this system, the sustainability of *enset* production definitely becomes disadvantaged. Limiting number of cattle per HH also limits the availability of manure to fertilize *enset* garden, which in turn affects *enset* farming system and production. Furthermore, study made by Staal *et al*. [47] showed that food-secured HHs were associated with high livestock numbers, especially cattle asset ownership, indicating that increased cash incomes primarily came from these animals, through sale of live cattle, milk, meat, hides and skins. Tefera [42] also stated that HHs who owned greater number of cattle have better food security status than those HHs with less number of cattle ownership. Group discussants in the study areas also concluded that *enset* has played different functions including as source of human food, livestock feed, used in cash generations, used as traditional medicine, used in construction, used in hand crafts and contributed a significant role in livelihoods of people in the study area. However, all these significantly important functions played by *enset* can only be practical when there is interaction of *enset* with cattle production. Hence measurers to be undertaken to realize food security must be planned and brought in to practice in integrative manner of *enset* and cattle production.

Number of Mature *enset* Harvested: *Enset* can be harvested at any time and any stage of growth, allowing HHs to balance period of food shortage. *Enset* foods can be stored for long-term uses and storage ability of processed *enset* products for long periods with little storage loss provides HHs with a mechanism to smooth consumption during food shortage and reduces food insecurity. This report is in agreement with the report made by FAO [48] stated that Ethiopia being a food insecure country and in protracted crisis the country would be benefited from increased and improved use of *enset*. Kefale and Sandford [41] reported the primary strategic importance of *enset* in food security is that *enset* helps to prevent famine by surviving drought when other food crops fail. Once *enset* plants are established in areas of sufficient rainfall, they are able to tolerate occasional years of very low rainfall or a short rainy season. The same authors reported that *enset* gives higher yield (1.3 to 3.5 times much more food energy) per unit area than other crops and hence supporting the densely populated areas in the country. Therefore, for HHs facing a shortage of land, the higher energy productivity of *enset* relative to cereals makes *enset* an important food security crop.

Households in the study areas of Gurage zone considered *enset* production as back bone of HHs' food security. The result obtained in current study (Table 16) indicated the existence of a significant difference ($P< 0.05$) on the level of being food insecure between the HHs having differences in number of mature *enset* harvested for the production of *kocho* and *bulla* per year. The result of this study also coincided with the report of Negash and Niehof [49] who reported that *enset* cultivation is a straight-forward method to facilitate for people to achieve independent livelihoods security. *Enset* can improve food security in drought-prone areas where climate is warm, thus in much larger areas than where currently used. Similarly, Mulugeta [50] reported that once *enset* plant is established in the field, it can be utilized as a source of food all year round so long as it exists with reasonable size, thus by which nature it saved many lives in the past in Ethiopia.

As reported by Shiferaw *et al*. [43] it is expected that HHs in cereals-*enset*-based systems are more likely to be food secure than those in the cereal-based system because of better productivity, longer storage and flexible harvesting capability, drought tolerance and other desirable traits of *enset* plant. Brandt *et al*. [7] on the other hand, reported that *enset* acts as a food store which can be used at any time of the year, it is a relatively drought-resistant plant, the leaves along its midribs provide fodder for livestock. By its nature *enset* is considered as a 'Drought security' and 'Strategic' crop. In densely populated areas of southern Ethiopia, *enset* is regarded as a food security crop.

When the number of mature *enset* harvested per year increased by one unit (By one mature *enset*), the odds of being food insecure become 0.999 times less likely than being food secure, taking the number of family members, the number of cattle holdings and the hectarage of land holding per HH remain constant (Table16). Households harvesting greater number of mature *enset* were found to be food secured than those HHs producing lesser number of mature *enset* to produce *kocho* and *bulla* to feed members of their family.

CONCLUSION

Due to necessity for high demand of cattle manure to fertilize *enset* fields and production of milk and milk products to supplement *enset* product which is low in protein, HHs in the study areas urged to keep a number cattle. Farmers and focus group discussants articulated that cattle and *enset* are the basis of their life, but they received low attention by development ventures. To promote food security, particular attention should be given on the integration of cattle and *enset* production through provision of strong and continuous extension services and area specific research works. Planners and political leaders should focus on production and productivity improvement; understand the life securing, economic and famine buffering capabilities of cattle and *enset*.

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