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Full Length Research Paper

Laboratory evaluation, purpose of production and utilization of cattle manure in *enset* (*Ensete ventricosum*) based mixed production systems of Gurage Zone, Southern Ethiopia

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The study was conducted in four districts of Gurage zone in Sothern Ethiopia to determine the N, P, K, organic carbon and nitrogen of cattle manure. Seventy two households, 36 from highland and 36 from midaltitude were randomly selected from a total of 360 sample households selected for the study. Around 88.05% of farmers in the study areas were keeping cattle for high demand of manure to fertilize enset fields and for milk production. There were no practices of using cattle dung as fuel or dung cake for sale. The sampled manure had nitrogen content of 2.68% and C/N ratio of 11:1 in highland and 2.24% with C/N ratio of 12:1 in mid-altitude. The organic matter obtained from manure in highland and midaltitude, respectively, were 51.89 and 44.82%. The gram of N, P, K, kg^{-1} DM of manure, respectively, were 26.8, 16.5 and 1.6 for highland and 22.4, 12.6 and1.2 for midaltitude. To realize production sustainability of *enset* system, cattle manure was found to be of paramount importance. Therefore, appropriate interventions in cattle production and forage development are the prime necessity to realize sustainability in enset production and households' food security.

Key words: Cattle manure, Gurage Zone NPK, organic carbon, organic matter.

INTRODUCTION

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 (Ehui et al., 2002). Manure production is also considered important by most crop/livestock and agro-pastoralist farmers, but as secondary rather than a primary purpose (Alemayehu, 2004; Mekonnen and Köhlin, 2008). Manure is a complex material that contains valuable nutrients and used as a fertilizer for centuries and contains several essential plant nutrients which contributes to increased crop yields when properly applied to soils. Thus, dairy and other livestock producers can use manure as a valuable source of fertilizer nutrients for crops (Jodie et al., 1914).

Southern Ethiopia in general and Gurage zone in particular is characterized by production of enset (Ensete

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ventricosum) which needs cattle manure for its sustainable production and productivity. As a perennial and maturing at around 5 to 10 years, *enset* acts as a food store (security food crop) which can be used at any time of the year. It is relatively resistant to drought, heavy rain, and seasonal flooding which ordinarily devastate other food crops, especially cereals (Brandt et al, 1997; Million et al., 2003; Tesfaye, 2005).

In Gurage zone, a prudent interaction is there between *enset* and cattle production particularly in the altitudes where *enset* serves as a source of fodder for cattle and cattle provide manure to fertilize *enset* fields. In the absence of cattle manure in this system, the sustainability of *enset* production will definitely and negatively be affected. Hence, identifying the existing situations in relation to the purpose of cattle manure production, utilization and its major chemical composition in the area is crucial for further interventions.

Therefore, this study was conducted in the highland and midaltitude agroecologies of Gurage zone with the following specific objectives:

(1) To evaluate the major chemical composition of cattle manure in the laboratory.
(2) To assess the purpose of cattle manure production and utilization.

MATERIALS AND METHODS

Description of the study area

Based on data from Gurage zone Department of Finance and Economy Development (DoFED, 2015), 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 km^2 (DoFED, 2015). Gurage zone has 13 Administrative districts with 412 Peasant Associations (PAs) and 2 town administrations (DoFED, 2015). The zone is bounded with Oromiya regional state in the north, northeast and northwest, Silti zone in the south east, Hadiya zone in the south and Yem special district in west directions. Wolkite, the capital of the zone, is 155 km away from Addis Ababa in the Addis-Jimma road (DoFED, 2015).

The estimated human population of the zone is 1,624,125 (51.4% women and 48.6% men) and 88.2% of the population are farmers entirely dependent on subsistent agriculture (DoFED, 2015; CSA, 2016b). 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, 2016), the zone is found in altitudinal range of between 1600 and 3100 m above sea level (masl). The major crops grown in this area are *enset (E. ventricosum*), Barely (Hordeum vulgare), Field pea (*Pisum sativum*), Fava bean (*Phaseolus vulgaris*), *Teff* (*Eragrostis teff*), Maize (Zia mays) and Khat (*Catha edulis*) (DANRD, 2016).

The average annual temperature of Gurage zone is about 18°C. The current land use pattern of the zone, is 398,887 ha of land for crop production, 92,421 ha for grazing, 42,933 ha for forest, 17,168 ha degraded land and 41,791 ha of land for other social services giving institutions. Livestock population of 3,611,159 are found in the zone, constituting 1,678,455 cattle, 616,900 sheep, 260,420 goats, 820,269 chickens, 128,532 horses, 9,464 mules and 97,119 donkeys (DoFED, 2015; CSA, 2016a).

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 departments of Agriculture and Natural Resource Development. Peasant associations 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 was determined using (Cochran, 1909; Thrustfield, 2013) sample size determination formula:

$n = Z^2 \times P(1-p)/e^2$; 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 from highland and midaltitude in each district, respectively, were Shamene and Shehremo from Ezia district; Achene and Wukiye from Muhir and Aklil districts; Moche and Yeferezye from Cheha district as well as Agata and Kochira from Enemor and Aner districts.

Design of the study

To assess the purpose of cattle manure production and utilization, pre-tested survey questionnaires were used to collect data from 360 sample households of the study. Before commencement of the survey, one-day training was organized for enumerators on how to administer the questionnaire. Interview was done by researcher together with the enumerators and Development Agents (DAs).

Methods of data collection

The amount of cattle manure produced and the percentage of manure utilized by the HHs for different purposes in the study area was assessed in each study PA during the survey at household's home using survey questionnaire along with personal observation. The data on the use of manure in relation to different crops were also collected through interviewing the household. To obtain additional information, group discussions were made at zonal and each district level to clarify issues not well addressed through survey and to validate some information collected from individual interview. A total of 5 group discussions comprising 44 individuals, 9 from each district (5 farmers, 2 experts and 2 DAs) and 8 experts from zonal office (6 from livestock and 2 from crop agriculture) participated in the group discussion.

Sampling and drying process of cattle manure

Cattle manure used for the laboratory evaluation was obtained from 72 randomly selected HHs (36 from highland PAs of above 2200 masl) and 36 from midaltitude PAs of between 1800 and 2200 masl from a total of 360 sample households selected for the study. Fresh manure samples of 2 kg from overnight dropping were collected from each selected HH using plastic bag. The drying process was carried out by thinly spreading of cattle manure on polyethylene plastic sheet separately based on respective agroecology under shade. Cattle manure was turned and mixed up several times a day

Table 1. Objective of cattle rearing in the study areas of Gurage zone (%).

Study districts	Milk only	Manure only	Traction only	Milk and traction	Milk and 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 & Aner (n= 90)	0	0	0	18.9	81.1
Total (N=360)	0	0	0	11.95	88.05

N = Total sample households of the study, n = sample households per district.

to break large particles formed and to ensure uniform drying. At the end of the drying process, representative samples of air dried manure from each agroecology were taken. The air-dried cattle manure was ground in a laboratory to pass 2 mm mesh (Abbasi et al., 2007) at Wolkite regional soil analysis laboratory and packed in an airtight clean plastic bag and stored until required for analysis. The manure samples were analyzed for N, P, K and Organic carbon (Nelson and Summers, 1982)

Chemical analysis of cattle manure samples

Some selected properties of manure such as organic carbon, total nitrogen, phosphorus and potassium were determined following standard procedures (Nelson and Summers, 1982). The percent organic matter in cattle manure was calculated by multiplying the percent organic carbon by an empirical factor of 1.724 or 100/58, following the standard practice that organic matter conventionally assumed to contain 100/58 of % organic carbon (Nelson and Summers, 1982).

% Organic matter = 1.724 × % Organic carbon

The ratio of carbon to nitrogen content (C: N) of manure was calculated as percentage of carbon in the manure divided by the percentage of nitrogen obtained in cattle manure (Nelson and Summers, 1982).

Carbon to Nitrogen Ratio (C: N) = % Carbon / % Nitrogen

Organic carbon on the other hand was determined using the Walkley-Black rapid titration method (Nelson and Summers, 1982).

%Organic carbon = N × (V1-V2/S) × 0.39 × mcf

where N = normality of ferrous sulfate solution (from blank titration), V1= ml of ferrous sulfate solution used for blank, V2 = ml of ferrous sulfate solution used for sample, S = weight of air-dried manure sample in gram, 0.39 = $3\times10^{-3}\times100\times1.3$ (3 = equivalent weight of carbon), mcf = moisture correction factor.

Total nitrogen was analyzed by Kjeldahl method (Yerima, 1992). Accordingly, the phosphorous (P) and potash (K) contents of manure were determined by atomic absorption spectrophotometer (Perkin, 1982).

Methods of data analysis

The collected data were analyzed in such a way that they met research objectives and answer research questions. The study involved both qualitative and quantitative data analysis techniques. Information generated from sample households interview, group discussion and personal observation were discussed and narrated qualitatively. Statistical package for social sciences, version 20 (SPSS, 2012) was used for analysis of collected data after checking, correcting and coding. Descriptive statistics such as table, percentage, mean and standard error was used to present the results.

RESULTS AND DISCUSSION

Objectives of cattle rearing

According to the responses of households (Table 1), the primary objective of rearing cattle by the households was necessity for high demand of manure to fertilize crop land particularly of *enset* fields and milk production to supplement *enset* product (*kocho*) which is low in protein. About 84.4, 95.6, 91.1 and 81.1% of the households in the study districts of Ezia, Muhir and Aklil, Cheha and Enemor and Aner, respectively, were keeping cattle primarily for the production of milk and manure. Some respondents of around 18.9, 15.6, 8.9 and 4.4%, respectively, from Enemor and Aner, Ezia, Cheha and Muhir and Aklil districts held cattle primarily for milk production and traction.

In general, around 88.05% of the livestock owners in these areas engaged in the production of cattle aiming majorly on production of milk to support *enset* based food to lead healthy life and manure to fertilize crop garden which is in agreement with the result of Beriso et al. (2015) from Aleta Chukko district of Southern Ethiopia, who reported cattle keeping was important component of the mixed-farming system that cattle provide, milk and fertilizer (manure). Similar result was also reported by Snijders et al. (2009) who indicated that smallholder farmers in Central Kenya, for example, highly value dairy cows for the production of manure, in addition to their production of milk.

Purpose of cattle manure production

Cattle manure in *enset* production system of Gurage area plays a critical role in maintaining soil fertility and agricultural sustainability. In this low input farming systems the primary purpose of cattle production was to produce manure to fertilize *enset* (Table 2). At the same

Table 2. Purpose of cattle manure production in the study areas of Gurage zone.

Study district	Uses of cattle manure (%)		Manure used for different crops (%)		
	Used as fertilizer	Used as fuel	*Enset* crop	Vegetables & root crops	Khat, coffee &fruits
Ezia (n = 90)	100	0.0	92.0	3.0	5.0
Muhir & Aklil (n = 90)	100	0.0	90.0	4.0	6.0
Cheha (n = 90)	100	0.0	93.0	2.0	5.0
Enemor & Aner (n = 90)	100	0.0	90.0	3.0	7.0
Over all (N = 360)	100	0.0	91.3	3.0	5.7

N = Total sample households of the study, n = sample households per district.

time, 100% of households (Table 2) and focus group discussants (FGD) who participated on the study replied that 100% of cattle manure produced were used for fertilizing the crop lands. From the total manure produced in the study areas, 91.3% was used for enset farms fertilization while 3.0 and 5.7%, respectively, was used for the fertilization of vegetable crops and for khat, coffee and fruits. The participants of the study also confirmed that with no doubt, in the absence of cattle manure in this system, *enset* production could be deprived of sustainability because cattle manure is the principal source of organic matter and nutrient input of *enset* plant. Household participants also realized the absence of any tendency of utilizing farm yard manure for household energy requirement either for cooking or heating.

As indicated in Table 2, households involved in the study also revealed that the only purpose of cattle manure production was to be used as fertilizer and in the study areas of Gurage zone there were no practices of using cattle dung as fuel or making of dung cake for sale which is in line with the report of Muhereza et al. (2014), who reported that 100% of farmers in central Uganda utilized cattle manure on their crop garden and there was no practices of making dung cake for sale or using dung as fuel. In the same way, Snijders et al. (2009) in their report revealed that manure is an important source of nutrients for many smallholder farmers in East Africa, with cattle manure being the dominant type. The result of the current study in relation to the purpose of cattle manure production, however, does not agreed with report of Alemayehu (2004) who stated that manure production is considered important by most crop/livestock and agro-pastoralist farmers in Ethiopia, but as secondary rather than a primary purpose

The result of this work, on the other hand, was not in agreement with report made by Mekonnen and Köhlin (2008), who indicated that from the highlands of Ethiopia where sedentary agriculture is practiced, most of the manure produced is used as fuel, especially in the central and northern part of Ethiopia and only a very small fraction is used for manuring the soil and its use as manure is generally limited to small area of land around the homestead or nearby farms. The same authors revealed also that each farm household in the central and northern part of the country was using dung for his household energy requirement essential for cooking and heating.

Lupwayi et al. (1999) also reported that manure collected from farms of Ethiopian highlands in Deneba area had significantly greater contents of N, P, K, but due to scarcity of fuel wood, farmers in Deneba were using manure for fuel for domestic cooking and heating instead of applying it to the soil which is not in agreement with the report of the current study. The result of the current study also disagreed with the result reported by Yilma (2001), from Sidama zone of Southern Ethiopia indicated, around 20% of livestock dung was used as a source of fuel and the rest (80%) was used for farm yard manure.

Households' potential of producing cattle manure

From a total of 360 household participants of both agroecologies, about 77.25% reported their inability of having potential to produce enough amount of cattle manure to fertilize their crop garden (Table 3) due to an increase in human population that enhanced fragmentation of land distributed to individual farmer. The respondent households also revealed that the fragmented land size allotted to individual household, worsened the ability of household to produce forage enough to feed his cattle. Reduction in household's forage producing capacity correspondingly associated with reduction with the number of cattle and minimizing total amount of manure produced.

The production of low amount of livestock feed also accounted for the reduction of manure produced per animal. The result of the current study agreed with the result reported from central Uganda by Muhereza et al. (2014) who reported that farmers fertilized portions of the farm on a rotational basis according to perceived soil nutrient deficiency. The same authors also indicated that cattle manure was not adequate to fertilize the whole farm in a single cropping season as the result of inadequacy of manure due to small herd size, lack of supplementary feeding and inadequate fodder production due to limited land available. The result of the current study also corresponds with the report of Maryo et al.

Table 3. Households' potential on producing cattle manure in the study areas of Gurage zone.

Manure production adequacy (%)	Study districts (n = 90)				Agroecologies (n = 180)		Over all
	Ezia	Muhir & Aklil	Cheha	Enemor & Aner	Highland	Midaltitude	(N= 360)
Yes	26.7	21.1	24.4	18.9	22.2	23.3	22.8
No	73.3	78.9	75.6	81.1	77.8	76.7	77.2

N = Total sample households of the study, n = sample households per district and agroecology.

Table 4. Perception of HHs on significance of cattle manure in the study areas of Gurage zone.

Significance of cattle manure (%)	Study districts (n = 90)				Overall
	Ezia	Muhir & Aklil	Cheha	Enemor & Aner	(N=360)
Sustainable production and productivity	100	100	100	100	100
Low costly than inorganic fertilizer	96.7	87.8	94.4	98.9	94.4
Sustain soil fertility and reduce erosion	95.6	92.2	98.9	100	96.7
Easily available than inorganic fertilizer	94.4	94.4	87.8	93.3	92..5

N = Total sample households of the study, n = sample households per district.

(2014) who stated the existence of strong interaction between *enset* and cattle. *Enset* provides feed to the cattle and cattle provide manure to fertilize *enset* fields which enhances the production and productivity. In the absence of cattle manure, the sustainability of *enset* production can certainly and negatively be affected.

Perception of households on significance of cattle manure

Households and group discussants (100%) who participated in the interview perceived that without the application of cattle manure, the sustainability of crops particularly *enset* production could be affected negatively. The result of current study agreed with the report of Brandt et al. (1997) and Maryo et al. (2014) who indicated that different factors contribute to the progressive downward spiral in cattle production sector of the rural economy. This decline in cattle size affects the level of manure production and decreases in cattle manure causes reductions in the long-term sustainability of *enset* production that could also have an impact on human nutrition.

In *enset* farming system of the study area, cattle manure is the major source of organic matter, nutrient input and is critically important for productivity of the system. This is in agreement with the report of Snijders et al. (2009) who stated that manure is an important source of nutrients for many smallholder farmers in East Africa, with cattle manure being the dominant type. Based on the result of the current study as indicated in Table 4, 100% of the households reported that sustainability of production and productivity of *enset* cannot be achieved without the application of cattle manure. On the other hand, 96.7% of respondent households in both agroecologies, indicated the significant role of cattle manure in keeping sustainability of soil fertility and reducing soil erosion by improving the organic matter content thereby promoting the percolation and infiltration of run off.

Similarly, the members of group discussion of the study also emphasized that cattle manure is the principal source of organic matter and nutrients for crop production, particularly important for productivity of *enset* garden. This is in agreement with the report of Tadesse (2013), who reported that manure plays a vital role in improving crop yields and allowing sustainable productivity and has ability of changing soil microclimate condition and restoration of ecological balance. As indicated in Table 4, due to manure's ease of availability and low cost when compared with inorganic fertilizer, cattle manure was chosen, respectively by 92.5 and 94.4% households of both agroecologies. This corresponded with the report of Muhereza et al. (2014) who reported that the major benefits obtained from the use of cattle manure included increased crop yields, disease reduction, easily availability of cattle manure and low cost of purchasing the manure.

Correspondingly, the household participants and members of group discussion of the study also reported that the use of inorganic fertilizers was impossible to be used for *enset* crop production due to its high cost and limited availability. The result of the current study also corresponded with the report of Risse et al. (2006) who indicated that the use of inorganic fertilizers is limited for *enset* crop because of its high cost and limited availability. Thus, cattle manure is a locally available low

Table 5. Cattle manure chemical composition in the study area of Gurage zone.

Agroecology	Chemical composition of cattle manure							
	Nitrogen		Phosphorus		Potassium		OC	OM
	%	(g/kg DM)	%	(g/kg DM)	%	(g/kg DM)	%	%
Highland	2.68	26.8	1.65	16.5	0.16	1.6	30.1	51.89
Midaltitude	2.24	22.4	1.26	12.6	0.12	1.2	26	44.82
Overall mean	2.46	24.6	1.45	14.55	0.14	1.4	28.05	48.35

OC = Organic carbon, OM = organic matter, DM = dry matter, Moisture content of cattle manure = 25.3% for midaltitude and 29.4% for highland. Source: Own sample collected (2017/2018).

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. Similar conclusion was made by Maryo et al. (2014) that decline in cattle number will call for decline in cattle manure production which cause reductions in the long-term sustainability of *enset* production and productivity. The cycle of increasing impoverishment on the cattle component in this mixed crop/livestock system is a serious cause for concern.

Chemical composition of cattle manure

The result of chemical composition of manure collected from sample households in the study areas of Gurage zone is shown in Table 5. The manure samples used in the study had a total nitrogen content of 2.68% in highland and 2.24% in midaltitude agroecologies with overall average of 2.46% on dry weight basis. This result is in agreement with the report of Snijders et al. (2009) who indicated that the total nitrogen content of manure on a dry matter basis ranges from below 0.5 to over 4%.

At the same time, the carbon to nitrogen ratio of manure for both agroecologies was assessed and the C: N ratio of 11:1 for highland and 12:1 for midaltitude with an overall average C: N ratio of 11.5:1 which was calculated as percentage of carbon in the manure is divided by the percentage of nitrogen obtained in cattle manure (Nelson and Summers, 1982). The results obtained in the current study on the percentage of total nitrogen and carbon to nitrogen ratio of cattle manure is different from the result reported from southern Ethiopia by Ferew (2012) who found that the manure used in his study had total nitrogen of 1.89% on dry weight basis and a C: N ratio of 18:1. On the other hand, the moisture content of cattle manure in the current study at different agroecology was different and it was about 25.3% for midaltitude and 29.4% for highland agroecology.

The difference in total nitrogen, organic carbon, carbon to nitrogen ratio and moisture content among the study areas in particular and in the country in general could mainly be attributed to differences in environmental conditions of climate, soil, chemical content of the feeds consumed by cattle such as crop residues of different types, variation in legumes to grass composition, leaf and leaf midribs of *enset* available to cattle feeding. The aforementioned reasons attributed for differences in cattle manure chemical composition on different agroecologies are in agreement with the report of Lupwayi et al. (1999) who stated that manures collected from experimental stations contained significantly more N, P, K, than the manure rom smallholder farms, probably due to differences in the type and quality of available feed and other factors. Snijders et al. (2009) on their report also indicated the existence of large variation in nitrogen (N), phosphorus (P), potassium (K) and carbon (C) contents of cattle manures from Africa. The same authors also indicated that manure quality strongly varies, due to variation in feed supply and intake, ration quality, addition of organic material to excreta, losses during collection and storage and contamination with soil.

The composition of organic matter estimated in the manure samples analyzed in the laboratory in the current study was 51.89% for manure samples taken in highland and 44.82% for midaltitude agroecology which is significantly important to assure the sustainability of the system. Similarly, the main mineral nutrients that were incorporated in the samples of cattle manure were identified and the gram of nitrogen (N), phosphorus (P) and potassium (K) kg^{-1} DM of manure, respectively, were 26.8, 16.5 and 1.6 in the case of highland and 22.4, 12.6 and1.2 for midaltitude agroecology which are very important in the improvement of soil contents and thereby the production and productivity of the systems. The result of current study corresponded with the report of Risse et al. (2006) who stated cattle manure as an excellent source of plant nutrients such as nitrogen, phosphorus and potassium as well as the secondary nutrients that plants require.

The results of the current study in the contents of manure in highland is much higher than the contents of manure in midaltitude which could mainly be due to the availability of more legumes and other feed resources with better nutrients and mineral components in highland areas than the midaltitude. This report is in agreement with the report made by Snijders et al. (2009) who indicated that contents in farm yard manure particularly

the nitrogen from temperate countries are often higher, probably due to higher protein contents in feed rations and more favorable collection and storage conditions, including lower temperatures that relatively reduces microbial activities.

The gram of nitrogen and phosphorus kg^{-1} DM of cattle manure reported in the current study is also much higher than the result of 18.9 g N and 6g P kg^{-1} DM of manure reported by Ferew (2012) and the average result of 18.3 g N, 4.5 g P kg^{-1} of cattle manure on dry matter basis by Lupwayi et al. (1999). However, the gram of potassium obtained kg^{-1} DM of manure samples in the current study is extremely lower than the reported value of 21.3 g potassium kg^{-1} DM of cattle manure by Lupwayi et al. (1999) which needs special attention in the future.

The organic matter in cattle manure in the current study is dependent on the percent organic carbon found in the cattle manure. It was indicated by the household respondents and group discussants of the study that the application of cattle manure increases the amount of organic matter and thereby determining physical and chemical nature of soil. The result of the current study corresponded with the report of Risse et al. (2006) who stated that the application of cattle manure increases the level of soil organic matter. Soil organic matter is known to affect a number of soil chemical properties such as the cation exchange capacity and the soil buffering capacity that enable manure treated soils to retain nutrients and other chemicals for longer periods of time.

Conclusion

The primary objective of rearing cattle in the study areas of Gurage zone of Ethiopia is for high demand of manure to fertilize crop land particularly *enset* fields and milk production to supplement *enset* product (*kocho*) which is low in protein in the nutrition of the farmers. Households in this *enset*-cattle based mixed production system have perceived the existence of strong linkage between cattle and *enset* production and considered cattle manure as basic source of soil nutrients (N,P,K) to be used by field crops. Cattle manure has the greatest value towards improving crop production; however, the households in the study areas are not in a position to produce manure sufficient to fertilize their crops. Reduction in grazing lands and cattle number per individual household, worsened household's ability to produce manure enough to fertilize crop garden. Therefore, appropriate interventions in cattle production and forage development are the prime necessity to realize sustainability in *enset* production and households' food security.

CONFLICT OF INTERESTS

The author has no declaration of any conflict of interests.

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