ENSET (*Enset ventricosum*) BEYOND HUMAN CONSUMPTION: OPPORTUNITIES AND CONSTRAINTS AS LIVESTOCK FEED IN GURAGE ZONE, S-W ETHIOPIA

Minyahel TILAHUN✉

College of Agriculture and Natural resources, Wolkite University, Gubrie, P.O Box 07, Ethiopia

✉Email: minyahel.tilahun@wku.edu.et

ABSTRACT: The objective of this study was to assess Enset (*Enset ventricosum*) plant as livestock feed resource; the opportunities and challenges of using Enset as livestock feed. This study used a descriptive and explanatory study design. A multi sample purposive sampling technique was employed. Ninety households who own livestock above 2 Tropical Livestock Unit from the district i.e., 30 Household respondents from each agro ecology were selected. The collected data were analyzed using SPSS 20 software, and ranked data was analyzed using Microsoft Excel. In addition, logit model [$\alpha = 0.05$] was used to analyze and predict the values of dependent variables (Enset plant with livestock). Enset plant production (86.67%), livestock farming (83.3%) and perennial crop production (81.1%) took the lion share as means agricultural practices of the study area. Though natural pasture (Hebir) was ranked third in the highland of the study area, it was ranked first in the overall data gathered for available feed resource in the study area. Only 30(33.3%) of the respondents tried Enset conservation practices. From different Enset parts, leaf (Bera and Kessa) was ranked first as majorly used as livestock feed; midrib (Chimbina) and pseudo stem (Enkurkina) took second and third rank, respectively. The agro ecological difference estimated coefficient 0.698 (P=0.046) suggested that agro ecology difference decrease the respondents number by 69.8 % to say no for Enset and livestock relationship. Respondents land holding had an estimated coefficient of 2.09 (P=0.01) which suggested an increase in land holding by a timad (quarter of hectare) was increased Enset part use by 8.05%. Similarly, land used for Enset cultivation has an estimated coefficient of -3.37 (P=0.01) which suggested an increase in the proportion of land use for Enset plant cultivation was decreased the use of Enset plant parts by 0.03%. From the different identified constraints of Enset plant use as livestock feed, land shortage, climate change, market access ranked first, second and third, respectively. It can be concluded that Enset is major part of livestock feed; gradual land shortage and other factors are hindering farmers not to use Enset as livestock feed and trust up on other cash crops. Most Enset harvesting is done at main rain season so conservation techniques is must, and has to be scrutinized based on agro ecological difference.

Keywords: Feed resource, Enset, Livestock, Enset Parts, Gurage zone

INTRODUCTION

Like most tropical countries, the major livestock feed resource in Ethiopia are natural pasture and crop residues. Contribution of agro industrial by products and manufactured feed has been much less (Berhanu et al., 2009). Due to livestock's attribute in most activities of farming, currently no one can insure a country like Ethiopia without livestock dependency. However, the significance of natural pasture is gradually declining from 89% in 1985 to 57% in 2013 (Alemayehu, 2017). This is majorly due to the expansion of crop production; population increase based redistribution of communal lands and land degradation (Berhanu et al., 2009). Gradual decline in the principal feed source (i.e., Natural pasture) force farmers and pastorals to focus merely on the amount of feed available rather than on the quality of the feed. The situation become worse on dry seasons hence, most farmers

have not developed feed conservation techniques (Bereda et al., 2014; Tilahun et al., 2016). There are some plants which are adaptable to an area, and have immense importance in tackling feed scarcity in livestock production. Enset (Enset *ventricosum*) plant is the commonly known feed in the life of most Southern Nation Nationality of People Republic states (SNNPRs) peoples and neighboring regions. It is known for its ability to stand alone even in the acute forms of droughts. Lately, drought is common in all parts of Ethiopia with a varying degree between areas, altitudes and production systems (Helland, 2015). Dry time flounces major resources of farmers and pastoralists such as livestock, grown plants and even human beings. In contrast, most SNNPRs districts especially Gurage zone have little history in relation to drought. So, important trends should have to be assessed, strengthen and transfer to adoptable areas by evaluating its significance and correlation with different household characteristics.

Several studies have been conducted on fodder production and use in Ethiopia, both by national and international research organizations, however, the focus of those studies are limited to the agronomic and nutritional characteristics of feed resources, and animal responses to types of feeds and feeding practices Bediye et al. (2001), and most studies forgets Enset plant as livestock feed while assessing other feed resources in Enset based farming s systems (Menbere, 2014). Therefore, considering all these facts and the severity of feed shortage in livestock production in most sub system of the region, it is important to management important feed related problems and available feed resources of the area to develop a proper utilization strategy and to recommend path ways for future studies. However, no enough documentation is found to support this evidence so far. This study was initiated to generate significance evident with regard to contributions of Enset plant as livestock feed.

The objectives of this study were to assess the importance of Enset plant as livestock feed; to assess the relationship between Enset plant and different agro ecologies; to assess opportunities and constraints of Enset plant as livestock feed.

MATERIALS AND METHOD

Study area
Gurage zone is found 158 km from the capital city Addis Ababa, and located about 8^0 33' latitude and 37^0 59'longitudes.The average elevation of the district is 1870 meters. The mean annual Temperature range from 14-24^0c with an average of 20-25^0c and annual rain fall is 1294mm.The soil type of the area heavy vertical around 80% which in organic matter while capability to drain water (CSA, 2017).

Enset based agricultural production system is the identity of the study area with a minor proportion of integration with livestock production. The most important crop grown in this study area includes Maize, Teff, Sorghum, and Enset. The major livestock's keep by rural farmers are cattle, sheep and goat by the degree of proportion and importance, respectively (CSA, 2017).

Household survey
This study used a descriptive and explanatory study design. Those designs were appropriate to address the value of Enset as livestock feed and identifying the hindering constraints about Enset use as livestock. It helped us to describe and explain Enset use difference based agro ecology and household characteristics. In addition, the design also helped us to scrutinize and identify the salient variables that are relevant in deciding the cause for the difference in Enset plant use as livestock feed.

From the whole districts, three kebeles i.e., *Moche*, *Yeferez* and *Ewan* from Highland, Midland and low land were purposely selected, respectively. Based on the information gathered from the Focus Group Discussions (FGDs) we generalized that HHs who own above two TLU had not been selling and slaughtering their stock to cope up with feed shortage. So, for this study, HHs who own above 2 Total Livestock Unit (TLU) were selected. However, households who own less than 2 TLU was used selling or slaughtering as primary option to tackle feed shortage at the time of dry time (Tilahun et al., 2017). A sample of 30 respondents was selected from the three agro ecologies found in the study district. A total of 90 respondents were used for the purpose of this study. Selected household who deliberately refuse to participate in the survey was replaced by the next household. The data was collected in the month of May, 2017.

Both primary and secondary data were collected. Semi structured questionnaire majorly with qualitative questions was prepared and then translated in to the local language '*Guragigna*', and it was administered to selected HHs. In addition, personal observation, Key Informant Interview (KII) and Focus Group Discussions (FGDs) were held to triangulate the information gathered from the main data source (i.e., HH survey). Secondary data was gathered from different written documents, reports, and articles.

Enset plant uses

Enset plant use in different agro ecologies of the study area is presented in Figure 1. Enset is the significant plant which can be used in different activities of Gurage peoples. Enset can be used as food (*Kocho; Bulla;Amicho; Livestock*), as a plat to serve food, as a sheath (*Koba*) for "*chat*". The result indicated that all study area respondents use Enset plant (Corm; Psudo-stem) as household consumption. Eighty five and seventy three percent of households of the study area was used Enset (leaf; midrib; leftover from harvest) as livestock feed and indicated that Enset plant was used as livestock feed and as sheath (Leaf) for harvested chat plant. The use of Enset leaf can be extended to be used as a plate to serve food in different events (Weeding and Grief) of the society. The result indicated that about 53 % of households still use Enset leaf as a plate to serve food in different events of the community.
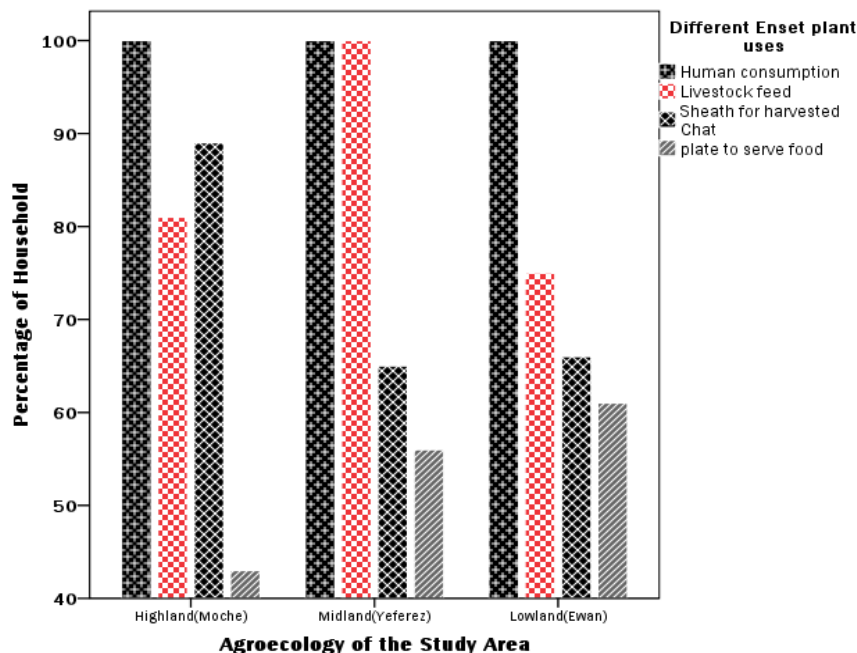
Figure 1 - Different Enset plant uses at different agro ecology of the study area

Data analysis

The raw data were analyzed using descriptive statistics and summarized into tabular and figure formats. In addition, multiple linear regression model [significance level of $\alpha = 0.05$] was used to analyze farmers perception towards Enset part use. The analysis was conducted using SPSS version 20.

$Index = R_n * C_1 + R_{n-1} * C_2 + ... + R_1 * C_n / \sum R_n * C_1 + R_{n-1} * C_2 + ... + R_1 * C_n$; Where R_n = Value given for the least ranked level (example, if the least rank is 6th, then $R_n=6$, $R_{n-1}=5$, and ..., $R_1=1$); C_n= Count of the least ranked level (in the count of the 1st rank = C_1). The opposite matching for R and C value can be presented as follows;

R_1 for R_n, R_2 for R_{n-1}..., R_n for R_1 and C_1 for C_n, C_2 for C_{n-1},..., C_n for C_1.

The qualitative data were first organized and categorized and then interpreted with respect to basic research questions. Finally, both qualitative and quantitative data was integrated to reach in concrete result.

RESULTS AND DISCUSSION

Means of livelihood

Table 1 indicated that major agricultural practices of the study area. Livestock farming (100%), Enset plant production (86.67%), and perennial crop production (81.1%) took the lion share as means of livelihood on the study area. In addition, HHs was involved in others income generation sources such as livestock farming and off farm activities. About eighty three percent of the selected HHs was kept livestock as means of livestock and 76.67% of them involved in integration of livestock with crop production.

The different that were exhibited in the means of livelihood among the three agro ecologies might be attribute to the infrastructure majorly road availability and access to market and support from different Government Organization (GO) and Non-governmental organization (NGOs) in the selected kebeles, and Urbanization and being a neighbor to city made the different in the means of livelihood.

Major Feed resource

Table 2 presented the major feed resource of the study district. Natural pasture was first ranked feed resource in two agro ecologies (midland; lowland) and in overall ranked data. The importance of natural pasture and crop residue in this study is in agreement with Tolera et al. (2012); Belay et al. (2012); Menbere (2014). However, crop residue, ENSET parts and residue and natural pasture ranked first, second and third in the highland of the study district. In addition, the recent national level share of natural grazing pasture as livestock feed resource reduced from 89 % in Alemayehu (1985) to 57% In CSA (2013). This might be attributed to expansion of crop production, population density, redistribution of land and land degradation. This is in line with the result of Berhanu et al. (2009).

Feed resources at different seasons

Available feed resource to an area is the best detector to show the relationship between livestock's and the environment. The result of this study showed that natural pasture (91% in sep- Dec; 85% Jan-Mar; 52% April-May; 89% June-Aug) is the primary feed source in most seasons of the study area. Enset plant is the second choice of respondents based on the average proportion (67%; 71%; 89%; 79%) responses from the study population. Enset plant use as livestock feed becoming highly significant in dry season this might be attributed to lack of natural pasture and crop residue conservation techniques makes Enset plant (especially leaf) to be the prior choice of farmers between the month of April and May. The study result is in line with the study by Bereda et al. (2014) in Gurage zone of Ethiopia which showed that Enset plant were the best feed resource choice in dry season

ENSET parts and their use as feed

Table 3 presented priority given to the different parts of Enset plant as livestock feed on different agro ecologies of the study area. There are different Enset parts leaf from this the commonly used once are pseudo-stem, corm, root, midrib and left over. The result of this study revealed that the leaf part of Enset plant was ranked first as prior Enset plant part; midrib second and pseudo-stem took the third rank. Corm, left over and Root part of Enset plant took fourth, fifth and sixth rank, respectively. No significance different in the choice of Enset parts among the different agro ecologies were revealed. One elder from Moche kebeles stated that Enset plant harvest (*Fike*) mostly done on main rain seasons (i.e., ample of feed choice) so this does not let animals to use Enset plant properly specially the collected left over during harvesting. This result is similar with the study of Fekadu (2009); Mohammed et al. (2013) which stated the drought tolerance of Enset, fresh leaves are a common fodder when other fodder is scarce during the dry season, which can extend for several months. They are especially fed to lactating cows at this time.

Relationship between household characteristics and ENSET parts use as livestock feed

Table 4 was presented the relationship between HH characteristics and Enset parts use. The Estimated coefficient (B) for land owned by farmers 2.09 (p=0.01) which suggest an increase by one timad (1/4 of hectares) of land holding was also increased households' Enset parts use by 8.05%. In contrast, the proportion of land used for Enset plant cultivation has an estimated coefficient of -3.37 (P=0.01) which suggested that an increase in the proportion of land used for Enset plant cultivation was decreased the use of Enset plant parts by 0.03%. Respondents sex difference has an estimated coefficient of 1.35 (P=0.05) which suggested that female headed Households was increased the use of different Enset parts by 3.85% than male headed HHs.

Constraints of ENSET plant use as livestock production

Different constraints towards using Enset plant as livestock feed is presented in Table 5. Land shortage was ranked first in all agro ecologies individually and overall sampled HHs from the selected area. Climate change got perceived from the selected HHs of the study area and ranked second in all agro ecologies. Market access of the agro ecologies ranked third as constraints which hinder the use of Enset part and residue as livestock feed. Household size increase through time results in shrinkage of land, and fragmentation of land so this might be the reason to take land shortage as constraint in use of Enset parts and residue as livestock feed.

The study indicated that highland Enset plant production constraint primarily goes to land shortage and climate change ranked second from the response collected from HH in the study area, and other constraints such as input, poor market, inequality taken the rest ranks, respectively. According to the respondent the first and the second constraints are similar in all agro ecology. One FGD participant from the High land agro ecology mentioned that "Gradual land shortage and fragmentation are letting farmers to convert their Enset land to other cash crop land, and also, farmers gradually decrease spending their time and effort on Enset from time to time. This is because most Enset varieties take above seven years to give yield."

Table 1 - Means of livelihood in the study area.

Agricultural practices	Agro ecology						Overall (N=90)	
	Moche (n=30)		Yeferez (n=30)		Ewan (n=30)			
	Freq	%	Freq	%	Freq	%	Freq	%
ENSET plant production	27	96.67	22	73.3	29	96.67	78	86.67
Perennial Crop production	24	80	23	76.6	26	86.67	73	81.1
Irrigation based Crop production	9	14.4	19	63.3	23	76.67	51	56.67
Livestock Farming	30	100	30	100	30	100	90	100
Mixed farming	21	83.3	23	76.67	25	83.3.	69	76.67
Off-farm activities	12	40	23	76.67	20	66.67	55	61.1

Note that off farm activities represents casual labor, Trade, employment etc; the study purposely sampled HHs who own livestock above 2 TLU.

Table 2 - Major feed resource in the study district (N= 90; n=30)

Feed resources	Agro ecologies						Over all (N= 90)	
	Moche (n=30)		Yeferez (n=30)		Ewan (n=30)			
	N(index)	Rank	N(index)	Rank	N(index)	Rank	N(index)	Rank
Natural pasture (*Hibir*)	83(0.27)	3	110(0.36)	1	105(0.39)	1	299(0.33)	1
Crop residue	86(0.29)	1	86(0.29)	2	99(0.37)	2	271(0.30)	2
ENSET parts and residue	85(0.28)	2	65(0.21)	3	39(0.14)	3	200(0.22)	3
Formulated feed	46(0.15)	4	40(0.13)	4	27(0.10)	4	130(0.14)	4
Conservation Practice	5*	33.3**	3*	10**	7*	23.3**	15*	33.3**

Table 4 - Enset plant parts and its relationship with different household's characteristics

HH Characteristics	B(S.E.)	Wald	Sig.	Exp(B)
Agro ecology(1=highland)	0.27(0.36)	0.57	0.45	1.31
Age of respondent	-0.05(0.04)	1.16	0.28	.95
Sex of respondent(1=female)	1.35(0.70)	3.73	0.05	3.85
Marital status(1= married)	0.46(0.56)	0.67	0.41	1.58
Education(1=literate)	0.53(0.43)	1.50	0.22	1.70
Training	-0.49(0.54	0.83	0.36	.61
HH family size	0.05(0.29)	0.03	0.86	1.05
Land owned per HH	2.09(0.75)	7.70	0.01	8.05
Land used for Enset plant	-3.37(1.33)	6.40	0.01	0.03
Livestock owned	-0.16(0.26)	0.38	0.54	0.85

Cox and Snell R^2 = 0.20
Nagelkerke R^2 = 0.30

Table 3 - Priority given to different Enset plant parts as livestock feed.

ENSET parts	Agro ecology						Overall	
	Moche (n=30)		Yeferez (n=30)		Ewan (n=30)			
	N(index)	Rank	N (index)	Rank	N (index)	Rank	N(index)	Rank
Leaf (*Bera/Kessa*)	173(0.27)	1	173(0.28)	1	168(0.26)	1	514(0.27)	1
Pseudo-stem(*Enkurkina*)	102(0.16)	3	102(0.17)	3	104(0.16)	3	308(0.16)	3
Corm(*Weheta*)	97(0.15)	4	97(0.16)	4	95(0.15)	4	289(0.15)	4
Root(*Heler*)	47(0.07)	6	47(0.10)	6	50(0.07)	6	144(0.07)	6
Midrib(*Chimbina*)	154(0.24)	2	154(0.24)	2	159(0.25)	2	467(0.24)	2
Left over(*Yerchiye*)	53(0.08)	5	53(0.11)	5	51(0.08)	5	157(0.08)	5

Leaf represents all leaf (Bera and Kessa) and leaf sheath (Weficho)

Table 5 - Constraints faced in using ENSET as livestock feed

Constraints	Agro ecology						Total (N=90)	
	Lowland (n=30)		Midland (n=30)		Highland (n=30)			
	N(Index)	Rank	N(Index)	Rank	N(Index)	Rank	N(Index)	Rank
Land shortage	204(0.24)	1	208(0.25)	1	203(0.24)	1	615(0.24)	1
Poor market	113(0.14)	4	104(0.12)	3	122(0.14)	3	339(0.13)	4
Input	130(0.16)	3	141(0.17)	2	114(0.13)	4	385(0.15)	3
Information	80(0.10)	6	75(0.09)	6	79(0.09)	6	237(0.09)	7
In equality	88(0.11)	5	93(0.11)	4	75(0.08)	7	255(0.10)	6
Environmental degradation	68(0.08)	7	85(0.10)	5	96(0.11)	5	258(0.11)	5
Climate	154(0.18)	2	141(0.17)	2	150(0.17)	2	442(0.17)	2
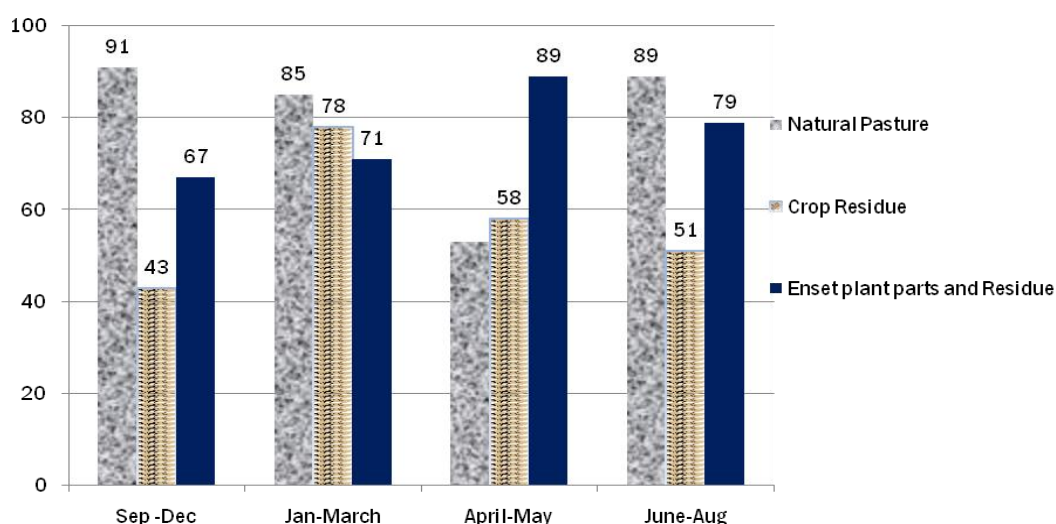
Figure 2 - Feed availability on different seasons of the study area

Table 6 - House hold characteristics of the study area.

HH characteristics		Agro ecology			Total (N=90)
		Moche (n=30)	Yeferez (n=30)	Ewan (n=30)	
		Mean± SD	Mean± SD	Mean± SD	Mean± SD
Age		40.56±12.41	42.43±12.60	43.93±11.88	42.3±12.24
Sex	Male	22(73*)	24(80*)	22(73*)	23(75*)
	Female	8(27*)	6(20*)	8(27*)	7(25*)
Marital status	Married	28(93.3*)	26(76.67*)	26(76.67*)	80(86.33*)
	Single	2(6.67*)	2(6.67*)	2(6.67*)	6(6.67*)
	Widowed	0*	1(3.33*)	1(3.33*)	2(2.2*)
	Divorced	0*	1(3.33*)	1(3.33*)	2(2.2*)
Education(illiterate)		93.3*	73.3*	90*	85.53
HH age distribution	Less than 10 years old	1.2±0.92	1.26±0.90	1.33±0.84	1.27±0.88
	Between10 and18	1.13±1.07	1.30±0.91	1.56±1.07	1.33±1.02
	Between18 and 65	2.06±0.78	2.26±0.78	1.97±0.61	2.10±0.73
	Above 65 years old	0.20±0.48	0.10±0.30	0.27±0.69	0.18±0.51
HH size		4.60±2.03	4.93±1.96	5.03±1.67	4.85±1.88
Livestock ownership		5.34±1.66	5.17±0.81	5.48±1.27	5.33±1.29
Land owned		2.04±0.91	2.50±0.67	2.50±0.63	2.31±0.77
Land for ENSET		0.68±0.44	0.70±0.33	0.73±0.38	0.70±0.39

*represents percentage

CONCLUSION AND RECOMMENDATIONS

Livestock's are the major source of feed and power in different societies of the world. In the context of Ethiopia, we can say that the country does not exist without livestock due to their attribute in most activities of farming such as food source; source of insurance in the time of household crisis etc. Feed availability, management systems and conservation techniques are the prominent factor while considering livestock production. Currently, most highlands of Ethiopia are prone to the effect of climate change and drought. Conversely, areas like Gurage zone and most part of SNNPR which have been dependent on Enset (Enset *ventricosum)* plant as their staple food and as means of livestock feed has been resilience, and the damage to the population and animals on these areas have been quite few. This study tries to assess the opportunity and constraints of Enset plant use in relation to livestock survival. Most respondents of the study use perennial crop production (81.1%), Enset production (86.67%) and livestock farming (83.3%) as means of income generation. Respondents from Midland (*Yeferez)* and Lowland (*Ewan)* Kebeles ranked natural pasture first as major source of livestock feed, however, the Highland (*Moche)* respondents ranked crop residue as the prior feed resource. Our study revealed that all the agro ecologies prioritize leaf, midrib and pseudo-stem parts as first, second and third, respectively. Farmers land holding has a positive relationship 2.09(p=0.01), however, land use for Enset cultivation has negative -3.37 (p=0.01) relationship with Enset parts use. Households with female head has a positive relationship 1.35 (p=0.05) with Enset part use. Land shortage, climate change and lack of inputs are identified as major constraint, and the constraints show complete similarity in all agro ecologies.

Based on the findings of this study, we can recommend that Enset has immense significance in tackling feed shortage. Adopting different conservation technique will help farmers in filling the identified gaps which mostly farmers lack and become hindered in feed shortage at dry season. Government intervention in developing a training program might fill the gap in improving and sustaining a resilience society in the changing climate. The input used and the labor demand of the plant is higher in comparison to other cash crops is somewhat higher i.e., labor is demanded for seven continuous years till harvest. Different variables such as land availability, farmer's skill and education and agro ecological difference should be considered while planning to use Enset plant as livestock feed. Further studied which focus on nutritional difference between Enset parts should have to get emphasis and studied to come up with a solution to feed shortage.

Author's contribution

The author conducted the field research, designed the research, analyzed the data, interpreted the results, and drafted the manuscript and write-up the manuscript. At last the author revised the manuscript, and read and approved the final version.

Conflict of interest

The author declare that he has no competing interests.

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