

Research Article

Characterization of Cattle Production System in East Gojjam Zone of Amhara Regional State, Ethiopia

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Abstract

Survey was conducted in four Districts of East Gojjam Zone Amhara Regional state of Ethiopia (Sinan, Dejen, Gozamen and Machakel). The objectives of the survey were to characterize cattle production systems, asses feed resources of cattle in eastern Gojjam and identify major constraint of cattle production in the zone. A total of 160 household heads were randomly selected and interviewed using a structured questionnaire. The study revealed that the average cattle herd size was 7.55 ± 0.31 heads per household and were significantly different ($P < 0.01$) among districts. In the study districts, cattle are primarily kept for draught power followed by income source and milk production. According to the respondents, crop residue, hay and local brewery by-products are the main feed resources ranked in order of importance as first, second and third, respectively in dry season. Similarly, crop residue, cut and curry system and communal grazing are important feed sources in wet season (ranked as first, second and third, respectively). The study also shows that feed shortage was the main constraint affecting livestock production and productivity across the districts. In availability of appropriate cattle genotype and disease were identified as second and third important constraints. Due to shrinkage of grazing areas, farmers are shifting cattle rearing from permanent free grazing into tethering and semi-grazing systems. The total livestock number in the zone was estimated to be 7.55 TLU unit which is directly related to carrying capacity of the grazing feed resources in the area. Thus, the study implies that there is a need to improve fodder production, crop residue utilization, efficiency and utilization of artificial insemination to increase the number of improved cattle genotype and improve delivery of veterinary services in a smallholder cattle production system of the zone.

Keywords

Cattle Production System, Free Grazing, Feed Shortage

1. Introduction

Livestock are raised within diverse cultural and environmental production systems around the globe, where they are playing a critical role in global food and nutrition security, Draught power, transportation, and manure; [1, 2]. Similarly, in developing countries, livestock production and its products serve as an economic and social engine through providing

food security and nutrition, employment and other multiplier effects to local economies [3].

In line with the international convention, the livestock classification systems according to [4] study is the main organizing principle in the study and this report. Under this classification, the first criterion concerns the origin of feed as follows: A graz-

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ing system: a system in which more than 90% of the dry matter (DM) fed to animals comes from rangelands, pastures and annual forages. A mixed system: A system in which at least 10% of feed comes from crop residues.

Moreover, Ethiopia is endowed with large number of livestock consisting 70.3 million cattle, 42.9 sheep 52.5 million goat and 57 million poultry. Similarly, Amhara national regional state has contributed 17.3million cattle,10.4 million sheep and 7.1 goats to the national livestock population [5]. Livestock accounts about 25.3% of the total GDP of Ethiopia by considering direct contribution and indirect contribution of traction and organic fertilizer. Livestock accounts about 45% agricultural GDP of Ethiopia.

Cattle production are major farming activity for the livelihoods of many of the world's poor people; providing nutrient-dense food and draught power, fuel, fibre, economic safety and social standing [6, 7]. Cattle are the dominant species for 70–90% of the livestock holding households in Ethiopia [8]. Among livestock production cattle farming remains the most predominant livelihood activity and source of income of sub-Saharan African (SSA) rural households [9]. East Gojjam Zone is one of the Amhara national regional states having 2.17 million cattle, 1.11 million sheep, 250,630 goat, and 1.4million poultry.

East Gojjam zone is characterized as a high potential area with surplus agricultural production. Crop agriculture is mainly rainfed smallholder production system. Tef is the most dominant cereal crop accounting for nearly 23% of the total food grain production while covering about 30% of the total food grain cultivated land. Other important crops in terms of area coverage include wheat (22.5%), maize (13.7%), barley (9.5%), faba bean (5.3%), sorghum (5%), sesame (3%), haricot bean (2.7%), and triticale (2%). In the zone, cattle are the main power source for ploughing, trashing and other farming activities [10].

To understand the current cattle production system and set out sustainable solution an up-to-date and location specific information on production systems of cattle. Understanding the cattle farming activity, production characteristics, identifying constraints and opportunities and designing practical production strategies are required to improve livestock productivity and market success of producers. Therefore, this study was proposed with the following objectives.

1. To characterize cattle production systems in Eastern Gojjam
2. To asses feed resources of cattle in Eastern Gojjam
3. To identify major constraints of cattle production across different production systems

2. Materials and Methods

2.1. Description of the Study Area

East Gojjam is one of the administrative zones of the ANRS located in the Blue Nile basin of Ethiopia. Currently, it is structured with sixteen Weredas (Districts) and four urban administrations. The total area of the zone is estimated at 14,010 sq. km which is equivalent to 1.40 million hectares [11]. However, the data from zone office of agriculture indicated the total land area as 1.46 million hectares which has been characterized by different land use patterns (Figure 1). About 45% of the total land is arable while there is an additional 8% irrigable arable land suitable for irrigation. The different forest coverage and grazing land occupied 13% and 11% of the total land of the zone, respectively.

The survey was conducted in four districts (Sinan Dejen Gozamen and Machakel), East Gojjam zone of Amhara national regional state. It is found between 9 °30'0" to 11 °28'0" N longitude and of 37 °0'0" to 37 °30'0" E latitude.

2.2. Sampling

Secondary information from Districts and Zonal Agricultural Rural Development offices was used for the selection of district and kebeles. Production and farming systems of the four districts were assessed to characterize production system, feed resources, and identify major constraint of cattle production. A total of 8 kebeles were selected from four districts based-on their cattle production potential, experience and agro-ecology. From the 8 kebeles, a total of 160 respondents, 20 farmers from each kebele were selected randomly from the list of farmers who own cattle.

Data were collected using structured questionnaire. Focused group discussions were also conducted with key informants in each district to gain additional insights about the cattle production scenario in the area. Secondary information was also collected from zonal bureau of agriculture.

2.3. Data Collection and Analysis

Qualitative data was analyzed using descriptive statistics in an SPSS software version 20. Analysis of variance was performed to analyse quantitative data. Purpose of cattle keeping, importance, farming activity, feed resources in dry and wet season and cattle production constraints were ranked by using an index in the following way:

Index = $\sum N / \text{sum of weighted variables}$, according [12], where N= total number of variables considered

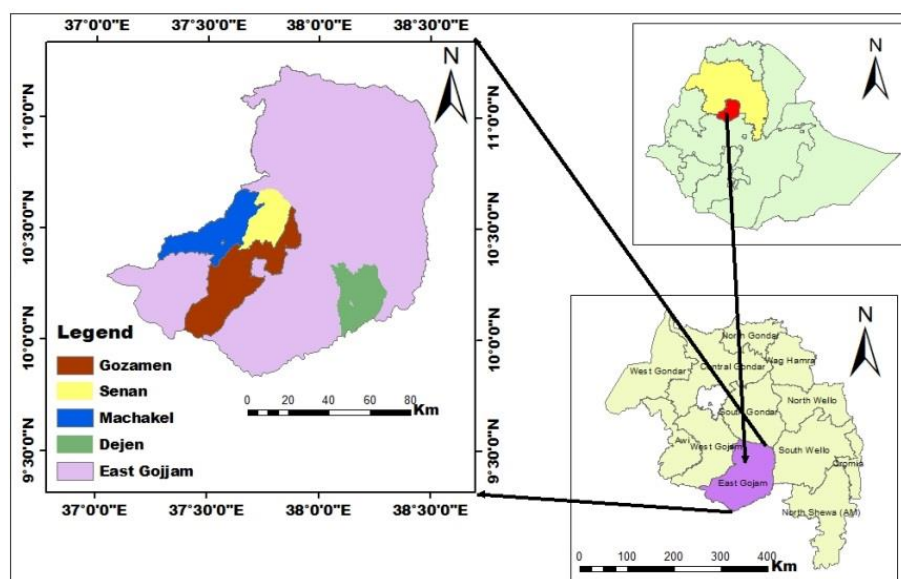


Figure 1. Map of study Area.

3. Result and Discussion

3.1. Household Characteristics

The demographic characteristics of respondents in study area are presented in Figure 2 (a, b, c, d) and Table 1, respectively. About 10% of the respondents in Dejen district were female

headed, whereas in the rest districts, all respondents were male headed households. The highest level of illiteracy was observed at Sinan district (35%). On the other hand, most of the respondents (47.5%) at Machakel district were able to read and write while more than half of the respondents in Dejen District had attended elementary school. The number of respondents who attended high school level of education were low in all studied districts.

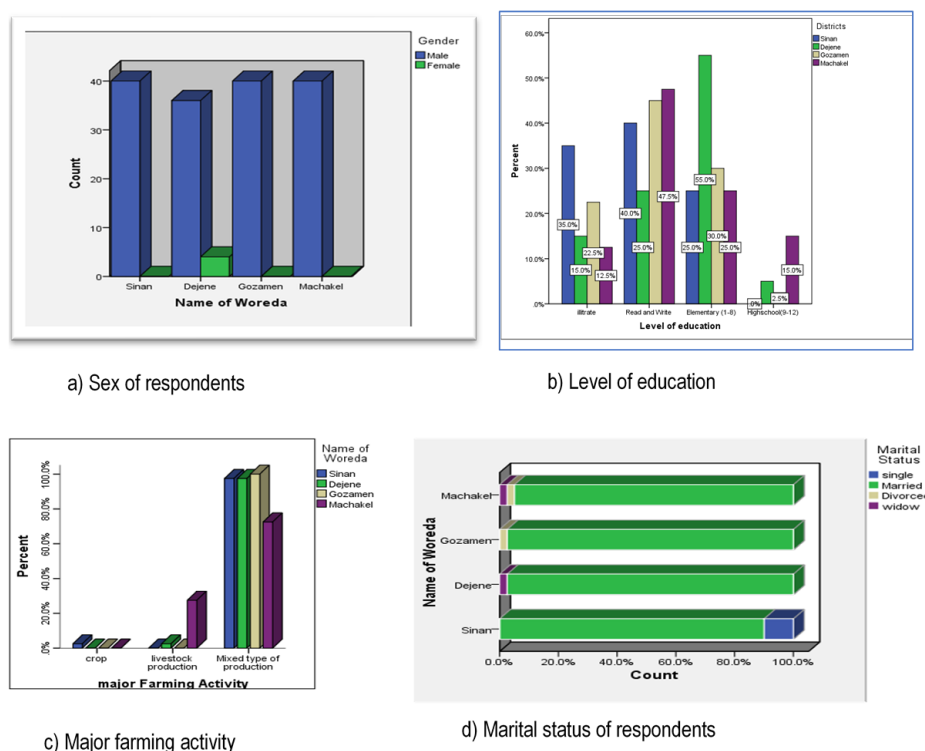


Figure 2. Demographic characteristics of the respondents.

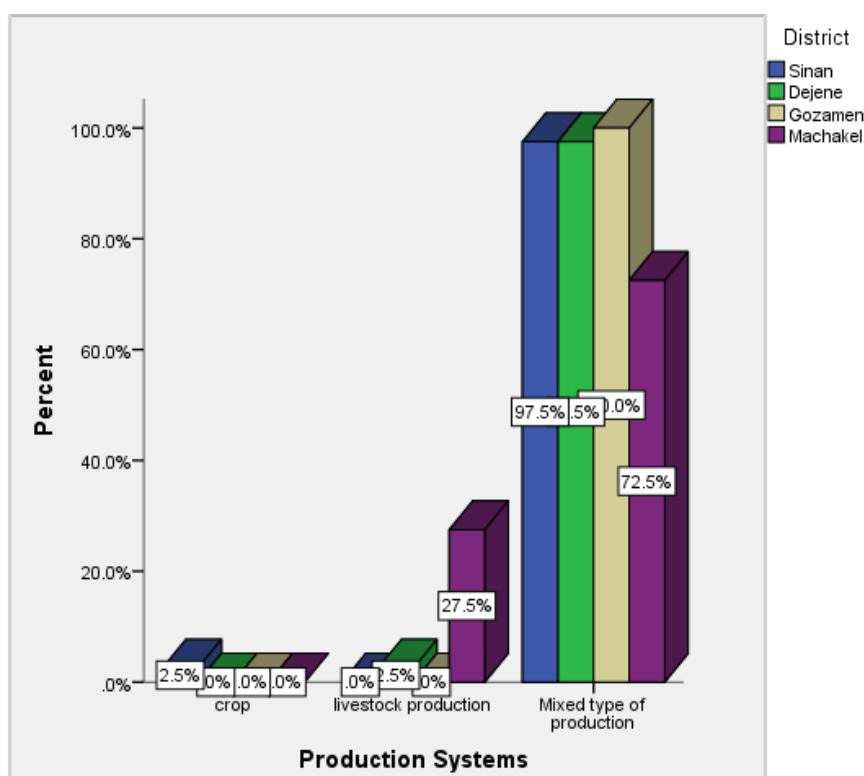
Table 1. Household characteristics of the sampled households in the study area.

Variable	Sinan		Dejene		Gozamen		Machakel		Overall	
	N	Mean \pm SE	N	Mean \pm SE	N	Mean \pm SE	N	Mean \pm SE	N	Mean \pm SE
Age of HH	40	46.7 \pm 1.37	40	46.13 \pm 1.58	40	45.35 \pm 1.46	40	45.23 \pm 1.60	160	45.85 \pm 0.75
Family size	40	6 \pm 0.26	40	5.50 \pm 0.22	40	5.48 \pm 0.32	40	5.53 \pm 0.29	160	5.62 \pm 0.14)

HH= Household head, N= number of observations

Household family size and age are presented in Table 1. The average family size per household head was 5.62 people. The average age of respondents was 45.85. However, the age of a household head and average number of families per

household did not markedly ($P>0.05$) vary between districts. The age range (24-69) of respondents obtained in the present study may be categorized as productive age group.

**Figure 3.** Types of production systems in East Gojjam zone.

3.2. Major Production System

The overall farming system of east Gojjam is regarded as mixed crop – livestock production system (Figure 3). At Machakel district, about 35% of the interviewed respondents were predominantly rely on livestock production while respondents in the three districts (Sinan, Dejen and Gozamen) practiced both livestock and crop farming. The availability of a number of homemade local brewery industries might contribute by-product feeds for increasing number of respondents

engaged in fattening and dairy production activities at Machakel district.

3.3. Land Holdings

In the study zone, the available land is utilized for crop production, livestock (grazing), wood production and fallow land (Table 2). The mean landholding between the districts was similar ($p>0.05$). However, land used for crop and grazing significantly ($P<0.05$) varied across districts. A large size of land is allocated for crop production in Machakel district

compared to the rest districts.

Table 2. Size of land holding.

Variable	Sinan		Dejene		Gozamen		Machakel		Overall	
	N	Mean \pm SE	N	Mean \pm SE	N	Mean \pm SE	N	Mean \pm SE	N	Mean \pm SE
Crop (ha)*	36	0.87 \pm 0.08 ^b	39	1.05 \pm 0.12 ^b	38	1.20 \pm 0.13 ^b	28	1.78 \pm 0.39 ^a	141	1.19 \pm 10
Fallow Land(ha)	2	0.25	2	4.01 \pm 3.99	-	-	2	0.38 \pm 0.13	6	1.55 \pm 1.29
Grazing Land (ha)*	35	0.22 \pm 0.02 ^a	11	0.22 \pm 0.07 ^a	21	0.15 \pm 0.02 ^b	16	0.30 \pm 0.05 ^a	83	0.22 \pm 0.02
Plantation (eucalyptus tree) (ha)	24	0.37 \pm 0.06	2	0.06 \pm 0.04	-	-	2	0.19 \pm 0.06	28	0.33 \pm 0.05
Total land (ha)	38	1.26 \pm 0.13	40	1.29 \pm 0.21	38	1.29 \pm 0.13	29	1.77 \pm 0.36	145	\pm 0.10

^{ab*} = Means with in the same row are significantly different ($p < 0.05$), N= number of observations

Cattle production, field crop production, sheep production, wood plantation, vegetable production, apiculture, trade, poultry, goat production, hand craft, employee, remittance and carpentry activities support the livelihood of the community

in the area (Table 3). Of these activities, respondents ranked that cattle production, field crop production and sheep production as first, second and third major sources of food and income.

Table 3. Major livelihood activities in the study area.

Source of livelihood activity	Ranking order							Index	rank
	1	2	3	4	5	6	7		
Cattle production	459	632	161	36	5	0	0	0.19	1
Field crop production	855	312	28	6	10	0	0	0.18	2
Sheep production	36	144	343	60	10	8	0	0.09	3
Wood Plantation	27	8	14	0	0	0	474	0.08	4
Vegetable production	45	24	77	72	20	12	0	0.04	5
Apiculture	0	8	91	36	45	8	0	0.03	6
trade	9	48	70	42	15	0	3	0.03	6
Poultry	0	24	63	84	5	0	3	0.03	6
Goat production	0	8	7	6	0	0	0	0.003	9
hand craft	0	0	14	0	0	0	0	0.002	10
Employee	0	8	0	0	0	0	0	0.001	11
Remittance	0	0	7	0	0	0	0	0.001	11
Carpenter	0	0	7	0	0	0	0	0.001	11

3.4. Purpose of Cattle Production

The purposes of keeping cattle in the study area are presented in Table 4. The households in East Gojjam kept cattle primarily for draught power and followed by income source and milk production, respectively.

Table 4. Major objective of livestock Breeding.

Variable	Order of Top three objectives			Index	Rank
	1	2	3		
Draught power	204	68	33	0.32	1
Income	162	92	45	0.31	2
Milk	111	138	34	0.30	3
Meat	3	14	17	0.04	4
Manure	0	6	12	0.02	5
Wealth status	0	0	4	0.004	6
Dried dung	0	2	0	0.002	7

Table 5 shows degree of importance of livestock species to respondents. Cattle are the most preferred livestock species in the study zone. The contribution of cattle in the area is high compared to other livestock species. It is clear that the zone is

one of the major crops growing area in the region where cattle are mainly involved in crop farming activities such as ploughing, trashing and compaction and labeling of an agricultural field for planting.

Table 5. Order of livestock species based on their importance

Species	Order of importance			Index	Rank
	1	2	3		
Cattle	152	8	0	0.49	1
Sheep	6	73	17	0.19	2
Equine	1	36	49	0.13	3
Poultry	1	25	42	0.10	4
Beehive	0	8	10	0.03	6
Goat	0	2	2	0.006	7

The average livestock holding per household head in study districts are presented in Table 6. The major livestock species in the study areas are cattle, sheep, donkey, horse, mule and chicken. The overall livestock holding per household across districts was about 5.13, 7.05, 11.02 and 7.01 TLU in Sinan, Dejene, Gozamen and Machakel, respectively. Gozamen district had the largest livestock holding per household. Numbers of cattle possessed by participant farmers were statistically different ($P < 0.05$) between districts. The average

cattle holding per household (TLU) was higher in Gozamen (9.14 ± 0.59 TLU). By contrast the lowest number of cattle was kept in Sinan district. The number of goats and cattle per household in the lowland area was higher than that of highland part of the zone. Sheep holding per household at Machakel is less than in Gozamen and Sinan. Donkey is a common equine species in all districts. However, mules are rarely raised in the study areas.

Table 6. Average livestock holding of household.

Livestock species	Sinan		Dejene		Gozamen		Machakel		Overall	
	N	Mean±SE	N	Mean±SE	N	Mean±SE	N	Mean±SE	N	Mean±SE
Cattle*	40	3.43 ±0.20 ^d	40	6 ±0.44 ^{bc}	40	9.14 ±0.59 ^a	40	6.72 ±0.58 ^{bc}	160	6.32 ±0.29
Sheep*	36	0.59 ±0.06 ^{bc}	19	0.43 ±0.08 ^c	26	0.76 ±0.16 ^{ab}	9	0.26 ±0.04 ^{cd}	90	0.57 ±0.06
Goat	-	-	1	0.09	2	0.09	2	0.41 ±0.14	5	0.22 ±0.09
Donkey*	2	0.90 ±0.54 ^a	39	0.68 ±0.05 ^b	33	0.76 ±0.067 ^c	16	0.43 ±0.04 ^d	90	0.67 ±0.04
Mule	2	0.36	-	-	-	-	4	0.36	6	0.36
Horse	35	1.2571 ±0.10	3	2.13 ±0.27	17	1.74 ±0.30	-	-	55	1.46 ±0.11
Chicken*	24	0.07 ±0.01 ^b	12	0.06 ±0.01 ^b	33	0.10 ±0.01 ^a	20	0.05 ±0.01 ^b	89	0.07 ±0.01
Total livestock*	40	5.13 ±0.26 ^d	40	7.05 ±0.52 ^{bc}	40	11.02 ±0.67 ^a	40	7.01 ±0.60 ^{bc}	160	7.55 ±0.31

TLU for Calf = 0.2, Heifers =0.5, Bull =1.1, Ox =1.1, Local Cows =0.8, Crossed cows =1.1, Shoat =0.09, Donkey =0.36, Mule = 0.36, Horse = 0.8, Chicken = 0.01, ^{abcd*} = significantly different (p= 0.05)

3.5. Cattle Production and Management

3.5.1. Feed Resource Availability

Feed resources commonly available in the study areas across different seasons are presented in Table 7. The quantity and quality of available feed resources for animals primarily depend on the climatic and seasonal factors [13]. Available livestock feed resources are, crop residue, communal grazing

land, private grazing land, after math grazing, fallow land, cut and carry, browse trees, improved forage, concentrate diet, hay and conventional brewery by-products are the common supplement feeds. According to the participants response, crop residue, hay and conventional brewery-byproducts are first, second and third ranked feeds, respectively in dry season. In wet season the first, second and third ranked feed resources for livestock are, crop residue, cut and curry and communal grazing, respectively.

Table 7. Major feed resource in dry and wet seasons.

Feed Resources	Rank of fees in dry season			Index	Rank	Rank of feeds in wet season			Index	Rank
	1	2	3			1	2	3		
crop residue	378	30	14	0.44	1	174	80	25	0.29	1
communal Grazing Land	18	22	19	0.06	5	129	42	17	0.20	3
Private Grazing land	6	4	0	0.01	8	36	28	11	0.08	4
Grazing After Math	6	20	13	0.04	6	-	-	-	-	-
Grazing Fallow land	0	2	1	0.003	10	6	0	2	0.008	8
Cut grass and browse	0	6	0	0.006	9	99	96	27	0.23	2
Improved forage	0	12	5	0.018	7	3	8	6	0.018	9
Concentrate	0	50	26	0.08	4	0	20	20	0.04	7
Hay	57	132	30	0.23	2	12	26	11	0.05	6
Local brewery	15	42	50	0.11	3	18	16	31	0.068	5

3.5.2. Feeding Systems in Dry and Wet Seasons

Feeding methods in the study area is shown in Figure 4. About 51% of the respondents in wet and 39.49 % in dry seasons, respectively keep their cattle on grazing lands. Communal grazing lands are used in the morning and after-

noon times of a day for limited hours. The pasture in the communal grazing lands is not sufficient enough to meet the requirement of animals and hence, the farmers often keep their cattle around the homestead and feed them crop residue with some cut and carry system. A large number of respondents are also practicing zero grazing/tethering in both seasons.

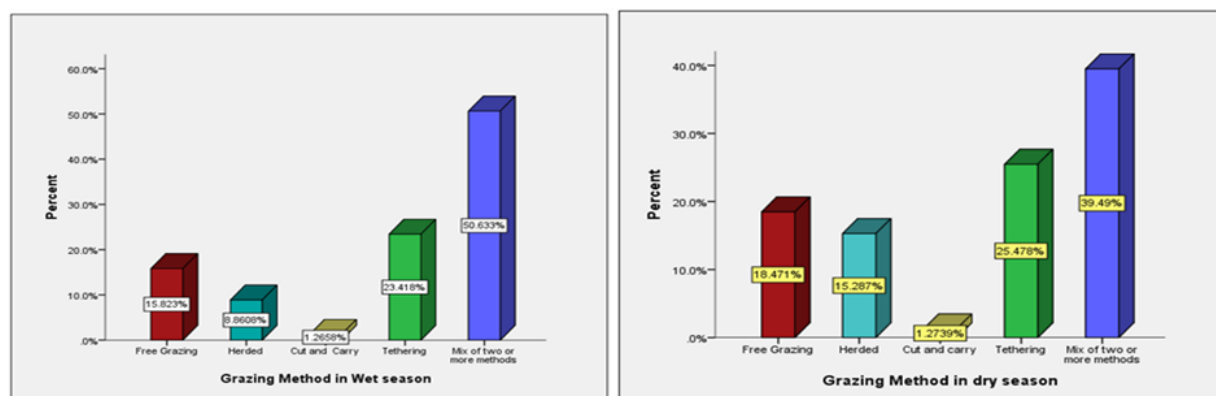


Figure 4. Feeding systems in wet and dry seasons.

3.5.3. Water Availability

The main sources of water were illustrated in figure 5. Rivers, pipe/tap water, wells, streams, pond and handpumps were the main sources of water for different livestock species in the study area. In most of the districts, river is the major

drinking water source for indigenous and crossbred cattle. However, well is the main source of drinking water for both indigenous and cross cattle at Gozamen district. Tap water and borehole water brought by a handpump are additional source of water for cattle species in all districts.

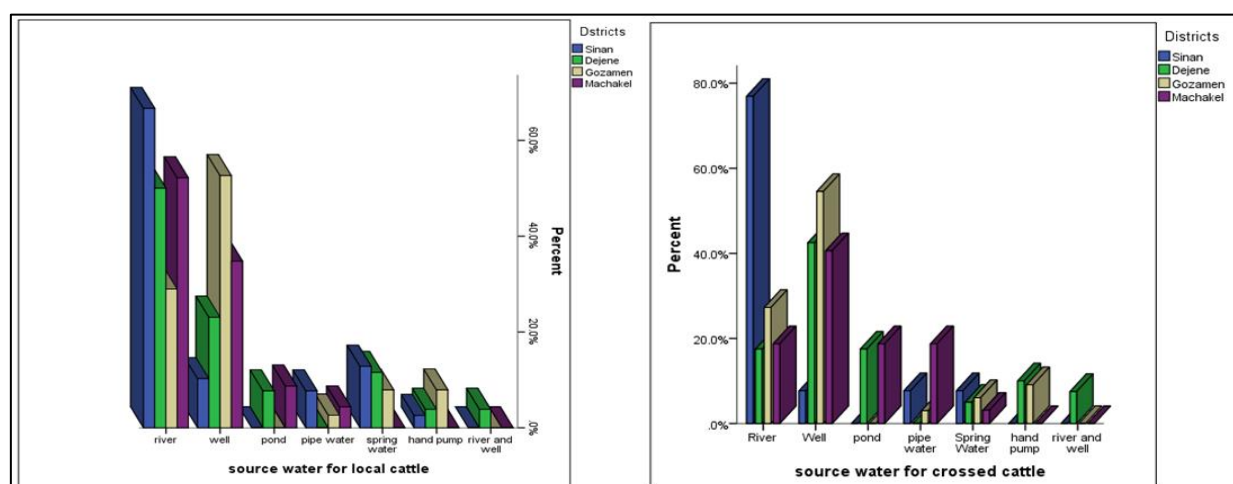


Figure 5. Source of water for cattle.

3.6. Livestock Housing and Management

Overall housing situation for livestock in East Gojjam is presented in Table 8. Livestock housing and management have positive effect on livestock production and productivity

[14, 15]. Besides protecting the cattle from bad weather conditions and predator, housing to a large extent can also serve as a deterrent for cattle theft [16]. Barn and mud house are constructed to keep animals against predators during night time.

In the zone, most of the respondents used separate cattle

house, which is a bit far from their living room. The highest proportion of respondents in Sinan district keep cattle together with the families' living room but portioned with walls. Both humans and cattle share common gate in this type of house. In general, some of the respondents constructed flat soil bed houses with shade in Sinan area. Concrete floor and open side

shade houses were used for cattle in Machakel, Side open. On the other hand, open shade muddy floors were commonly available in Dejen in area. Most of the respondents responded that house cleaning is practice on daily basis but some few clean twice a day.

Table 8. Livestock Housing condition and frequency of barn cleaning.

Variable	Sinan		Dejene		Gozamen		Machakel		Overall	
	N	%	N	%	N	%	N	%	N	%
Is there separate house construction?										
Yes	40	100	40	100	40	100	40	100	160	100
No	-	-	-	-	-	-	-	-	-	-
Are calves housed together with other cattle?										
Yes	8	20.5	5	12.5	2	5.0	12	30.0	27	17.0
No	31	79.5	35	87.5	38	95.0	28	70.0	132	83.0
Do you clean cattle house?										
Yes	39	97.5	40	100	40	100	39	100	157	99.4
No	1	2.5	0	0	0	0	0	0	1	0.6
Are cattle housed together with other animals?										
Yes	6	15	2	5	8	20	5	12.5	21	13.1
No	34	85	38	95	32	80	35	87.5	139	86.9
Type of animals housed together with cattle										
Sheep	1	14.3	0	0	2	22.2	1	33.3	4	19
Equine	1	14.3	2	100	7	77.8	2	66.7	12	57.1
All species	5	71.4	0	0	0	0	0	100	5	100
Frequency of house cleaning										
once a day	37	92.5	24	60	33	82.5	11	27.5	105	65.6
Twice a day	2	5	16	40	5	12.5	17	42.5	40	25
3 times a day	0	0	0	0	0	0	10	25	10	6.2
4 times a day	0	0	0	0	0	0	1	2.5	1	0.6
Once a week	1	2.5	0	0	2	5	1	2.5	4	2.5

N= number of observations

3.7. Major Constraints to Cattle Production

Main constraints associated with cattle production in the study areas are summarized in Table 9. Feed shortage is the primary problem affecting production and productivity of

livestock across all districts. Similarly, lack of appropriate cattle genotype is the second most important constraint. Whereas livestock disease is ranked as the third problem ranked by respondents. Lack of available inputs for livestock production, drought and water shortage are also important problems affecting livestock production in the zone.

Table 9. Cattle production constraints in study district.

Constraints	Top three production constraints			Index	Rank
	1	2	3		
Livestock disease	33	32	29	0.1	3
Feed Shortage	285	68	17	0.39	1
Water shortage	24	18	8	0.05	6
Labour shortage	0	6	6	0.013	9
Market problem	6	22	7	0.04	7
Predator	0	2	0	0.002	13
Genotype	66	116	39	0.23	2
Lack of input	9	34	26	0.072	4
Lack of Extension Service	0	2	3	0.005	10
Drought	48	10	6	0.067	5
Lack of Grazing Land	3	0	1	0.004	11
AI Technician problem	3	0	0	0.003	12
shortage of land	0	2	0	0.002	13

4. Conclusion

Crop- livestock production is the major production system in East Gojjam zone. Cattle were mainly reared for draught power and milk production purpose. The most abundant feed resource for livestock production is crop residue in dry and wet seasons. Green grasses, browse trees and pasture grazing are also utilized in wet season. Conventional feeds such as local brewery-by-products ('atela') and concentrate feeds are supplied in all seasons based on their availability. Permanent rivers and wells are the main sources of water in the study areas. The livestock production system in the study area is highly constrained by feed shortage, lack of suitable cattle genotype and disease. In a nutshell, this work calls a due attention on technical interventions targeted to improve fodder production, improve crop residue utilization, improve efficiency and utilization of artificial insemination and improve delivery of veterinary services in the zone.

Abbreviations

FAO : Food and Agricultural Organization
 DM: Dry Matter
 GDP: Gross Domestic Product
 CSA : Central Statistical Authority
 BoFED: Bureau of Finance and Economic Development
 TLU: Tropical Livestock Unit

Conflicts of Interest

The authors declare no conflicts of interest.

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