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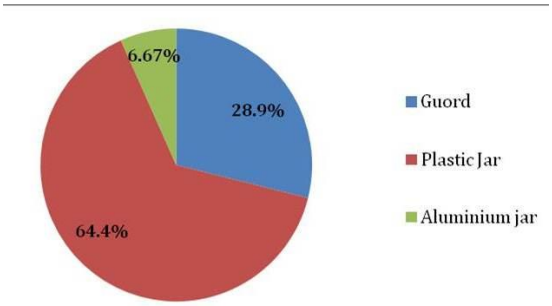
Research Paper

Handling, Processing and Utilization of Milk and Its Products in Gondar Town, Ethiopia.

Addisu Sh, Muhammed A and Haile N.
J. Life Sci. Biomed., 6 (6): 120-126, 2016;
pii:S225199391600020-6



Abstract
The study was conducted from November to May, 2016 with the objective to assess the handling, processing and marketing of milk and its product in Gondar town. Data were collected with the three representative kebeles (kebele 18, 19 and 20) purposively. The study was carried out through informal and formal surveys. From those kebles a total of 45 respondents were taken randomly. From the respondents majority of them were male (86.7%). 42.2% of the respondents were keep dairy cow under the age of 47-62. In the study area, the overall average family size was 5.7%. The equipments used for milking were gourd (28.9%), plastic jar (64.4%) and aluminum jar (6.67%). Equipments used for milk processing were gourd (48.89%), cream separator (15.5%), clay pot (11.11%) and others (24.4%). More than half of the respondents had not used refrigerator for handling of milk and its products. All milkers were washed their hands before milking however, only 62% of the respondents were washed the cow udder before milking. 60% of the respondents were processed the milk in traditional way. Preferred milk processed products were skim milk (48.89%), butter (40%), yogurt (6.67%) and the remaining were cheese (4.44%). Half of the respondents were used yogurt for household consumption however, 77.77% of the respondents were selling milk in the market. Generally milk production in Gondar town is contributing a role for the household livelihood improvement however, handling, processing and utilization of milk and its products should need further improvement.

Keywords: Gondar, Handling, Processing, Utilization of MilK

[Full text-PDF] [XML]

Research Paper

Phenotypic Characterization of Indigenous Cattle Populations in West Gojjam Administrative Zones, Amhara National Regional State, Ethiopia.

Tenagne A, Mekuriaw G and D Kumar.
J. Life Sci. Biomed., 6 (6): 127-138, 2016;
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Abstract
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Keywords: Body Weight, Cattle, Characterization, Indigenous, Linear Body Measurement

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Handling, Processing and Utilization of Milk and Its Products in Gondar Town, Ethiopia

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ABSTRACT: The study was conducted from November to May, 2016 with the objective to assess the handling, processing and marketing of milk and its product in Gondar town. Data were collected with the three representative kebeles (kebele 18, 19 and 20) purposively. The study was carried out through informal and formal surveys. From those kebles a total of 45 respondents were taken randomly. From the respondents majority of them were male (86.7%). 42.2% of the respondents were keep dairy cow under the age of 47-62. In the study area, the overall average family size was 5.7%. The equipments used for milking were gourd (28.9%), plastic jar (64.4%) and aluminum jar (6.67%). Equipments used for milk processing were gourd (48.89%), cream separator (15.5%), clay pot (11.11%) and others (24.4%). More than half of the respondents had not used refrigerator for handling of milk and its products. All milkers were washed their hands before milking however, only 62% of the respondents were washed the cow udder before milking. 60% of the respondents were processed the milk in traditional way. Preferred milk processed products were skim milk (48.89%), butter (40%), yogurt (6.67%) and the remaining were cheese (4.44%). Half of the respondents were used yogurt for household consumption however, 77.77% of the respondents were selling milk in the market. Generally milk production in Gondar town is contributing a role for the household livelihood improvement however, handling, processing and utilization of milk and its products should need further improvement.

Author Keywords: Gondar, Handling, Processing, Utilization of Milk

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INTRODUCTION

Demand for milk and dairy products has increased in the tropical areas where peoples growing. However, despite milk's contribution to gross domestic products and its value as a food, sub-Saharan Africa in general and Ethiopia in particular has failed to attain self-sufficiency in dairy production [1]. Dairy processing plants are few in numbers, much of the milk produced by rural small holders is processed on farm using traditional technologies and milk processing is based on sour milk [2]. This is due to high ambient temperature, small daily quantities of milk produced, consumer preference, the better shelf life of fermented milk as well as the type and capacity of the locally available processing materials and methods used. Ethiopians, like other countries, have been using milk as part of their diet for centuries. Milk is used for rearing calves and children and the surplus is soured for Ergo (Ethiopian naturally fermented milk) and/or butter and Ayib (Ethiopian cottage cheese) making. Arera (defatted sour milk) is used for human consumption or for Ayib-making.

In Ethiopia, there is no standard hygienic condition followed by producers during milk production. The hygienic conditions are different according to their production system. In most of the cases under smallholder condition, the common hygienic measures taken during milk production especially during milking are limited to letting the calf to suckle for few minutes and/or washing the udder before milking. The quality of the water used for cleaning purpose (washing the udder, milk equipment, hands), however, is not secured [3]. Milk production under Ethiopian smallholder condition can therefore generally be characterized as free from poisoning. Dairy products are manufactured and consumed in many parts of the country. Fresh whole milk, whole sour milk (Ergo), butter, Arera (defatted sour milk) and Ayib (a traditional cottage cheese) are the major dairy products produced and consumed in many parts of the country [4-6]. Many of these products are produced using artisanal technologies on-farm and the types and processing steps of these dairy products can vary considerably from one area to the other.

The mainstay of the population in the Amhara region is rain-fed subsistence agriculture. About 73% of the smallholders practice mixed crop-livestock farming, 19% practice crop cultivation, while the remaining 8%

undertake livestock rearing [7]. Like in other regions of Ethiopia, milk production is an integral part of the farming system. Local milk production is mainly from indigenous Zebu cattle which are kept by about half a million smallholder farming households [8] most of whom are poor. In Gondar town dairy production play a significant role in the household income as well as home consumption and also the demand of milk and milk products increased from time to time in the area due to increasing human population, urbanization and other factors. So that identification and understanding of traditional dairy products, handling, processing and utilization of milk and milk products were essential in order to devise appropriate development interventions that would result in improved production and quality of dairy products. Therefore, the overall aim of this study was to assess the practices of handling, processing, and utilization of milk and milk products in Gondar town.

MATERIALS AND METHODS

Description of the Study Area

The study was conducted from November to May, 2016 in Gondar town which was found in Amhara Region state in North Western Ethiopia. The area is located at a distance of 737 km north of Addis Ababa. The area lies between an altitude of 12°35'60''N and longitude of 37°28' 20''E and has an elevation of 2300 meters above sea level (masl). Gondar has a varied landscape, dominantly covered with ragged hills and plateau formations. The annual average temperature was 19.7°c and its annual rainfall was 1772 mm. It could be categorized under woyna-dega climatic zone. The area is also classified mainly in to two seasons, the wet season, from June to September and the dry season from October to May. [9].

Figure 1. Map of study the area.

Data collection and sampling techniques

Data to be collected from the three kebeles namely Kebele 18, 19, and 20 were employed by using purposive sampling techniques. A total of 45 respondents were purposively selected. Both primary and secondary data sources were used for the study. Primary data sources included the household heads and dairy cooperatives in the respective districts. The secondary data was taken from zonal ARDO, NGO operating and from documents that have been written about the study area.

Statistical Analysis

The data was subjected to statistical analysis using statistical package for social sciences (SPSS) software, version 16.0. Descriptive statistics such as frequency, distribution and percentages were used.

RESULT AND DISCUATION

Demographic Characteristics of Respondents

Demographic characteristics of respondents in the study area were showed in Table 1. In the study areas majority of the respondents were male 86.7% and only 13.3% were female. Major of the respondents (42.2%) were found at the age between 47- 62, and the remaining 13.3, 35.6 and 13.3% were found at the age group between 15-30, 31-46 and greater than 62 years old, respectively. Their educational level showed that, 46.7% were read and write and others were illiterate (15.6%), attending elementary education (13.33%), secondary school (8.89%), attend above secondary school (11.11%) and spiritual or religious education (4.4%). Their marital status showed that 91.11% were married, 6.7% were divorced and the remaining 2.22% were single.

Table 1. Demographic characteristic of respondents in Gondar town

Gender	**N**	**%**
Male	39	86.7
Female	6	13.3
Total	45	100
Age		
15-30	6	13.3
31-46	16	35.6
47-62	19	42.2
>62	6	13.3
Total	45	100
Educational Level		
Illiterate	7	15.6
Read and Write	21	46.7
Elementary	6	13.33
Secondary	4	8.89
Above secondary	5	11.11
Spiritual	2	4.44
Total	45	100
Marital status	**N**	**%**
Single	1	2.22
Married	41	91.11
Divorced	3	6.7
Total	45	100

Family Size

The average family size and percentage of male and female in the study area were shown in Figure 2 and 3, respectively. Based on the information obtained from the respondents the overall average family size in the study area was 5.7. From the total of the population male and female population showed that 47.85% were females and 52.15% were males. From this result it could be conclude that males are more engaged in the dairy production than females.

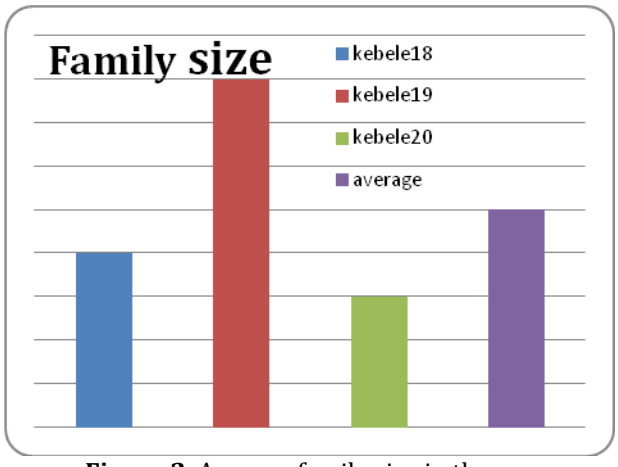

Figure 2. Average family size in the study area

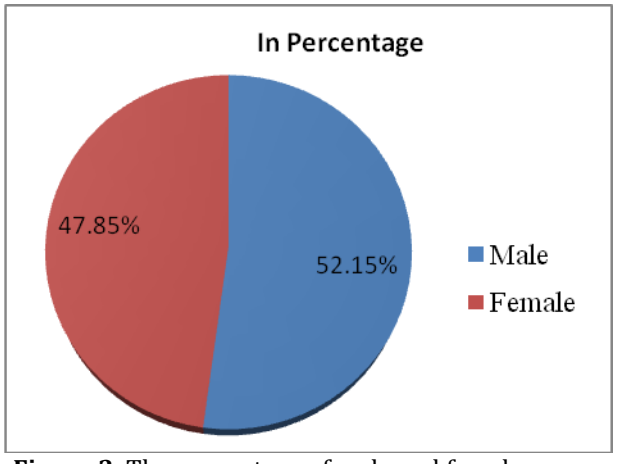

Figure 3. The percentage of male and female in the study area

Cattle Population in the study area

The overall cattle population in the study area was shown in Table 2. Based on the information obtained from the respondents the overall cattle population in the study area was 419, of which 55 local cows, 138 crossbred cows, 16 local heifers, 27 crossbred heifers, 37 local bulls, 26 crossbred bulls, 33 local calves and 87 crossbred caves.

According to the report of the present study the main milk sources of the area were gain from cross breed dairy cows. However, the study was in agreement with that of the finding of Yilma et al. [10] which stated that milk production depends mainly on indigenous livestock genetic resources especially true in developing countries where production dominated by small holder farmer; more takes place under cattle. The indigenous breeds accounted for 99.19 percent, while the hybrids and pure practices. Thus, farmers and all who handle milk before exotic breeds were represented by 0.72 and 0.09 percent, respectively.

Table 2. The overall cattle population in Gondar town

Kebeles	Number of Cattle Population							
	Cows		Heifers		Bulls		Calves	
	Local	Cross	Local	Cross	Local	Cross	Local	Cross
Kebele 18	18	69	5	8	25	3	14	33
Kebele 19	15	39	3	8	4	7	11	31
Kebele 20	22	30	8	11	8	13	8	23
Total	55	138	16	27	37	26	33	87
Average	18.33	46	5.33	9	12.33	8.66	11	29

Equipment used for milking and storage in the study area

Equipment used for milking and storage were shown in Figure 4. In the study area respondents were used different milking materials for milking and storage of milk. Majority of them were used plastic jar which was 64.4% and 28.9% use gourd and 6.67% of them were used aluminum jar.

The result was agreed with the study of [5, 6] the use of gourd as a churn and a storage vessel. However, it was in agreed with the finding of O'Mahony et al. [11]. In general, the use of clay pot for storage of various dairy products and its use for churning observed.

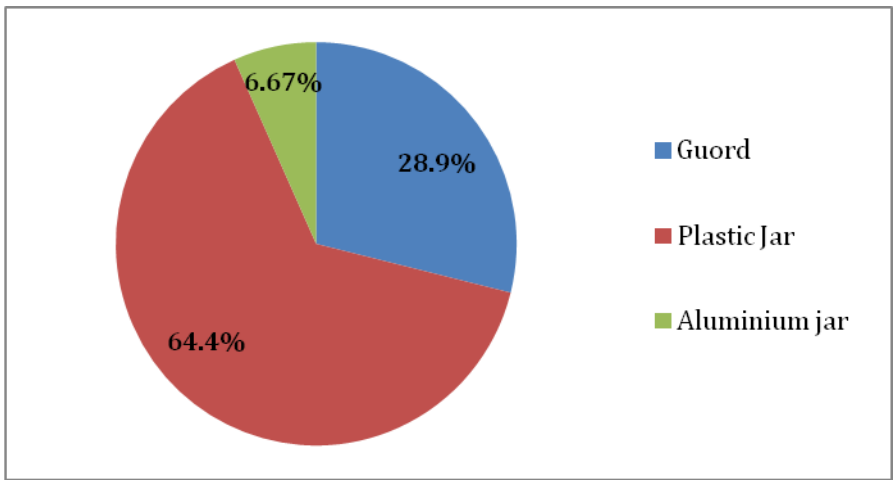

Figure 4. Equipment used for milking and storage.

Milking and handling of milk and its products

Milking and handling of milk and its product in Gondar town were shown in Table 3. All respondents were washing their hand before milking the caws and 62.2% were washing the udder of the caw before milking and 37.8% were not wash the udder's of cow. After washing, drying of udder was highly recommended. But 66.7% of them were not drying of the udder before milking. In the study area, 55.6% was not properly handled milk and its products in the refrigerator which was the main reason for loss and wastage of milk and its products in the area. However, the remaining 44.4% of respondents were used refrigerator for milk and milk product.

Milk processing materials used in the study area

Milk processing materials in Gondar town were shown in Table 4. In the area respondents were processing milk both in traditional and modern ways. Major of respondents 48.89% were used traditional material i.e gourd and 11.11% were used clay pot whereas some 15.5% were processing milk by using cream separator. The

remaining 24.5% were used other material for processing of milk. The present study was agreed with the study of [5, 6] gourd was the major milk processing container.

Milk processing practice in the Study Area

Milk processing practice in Gondar town was shown in Table 5. Majority of the producers (60%) were follow traditional method of milk processing, and 17.78% were using modern processing materials and the remaining 22.2% were no further processed the milk.

The present study was in line with the report of Duguma and Janssens [15] in Jimma town the traditional milk processing materials were used and methods used in the study area were time consuming, laborious and inefficient in terms of fat recovery.

Table 3. Milking and handling of milk and its product in Gondar town

Variable	N	%
Wash hand	100	100
wash udder	27.99	62
not wash udder	17.01	37.8
Total	45	100
Dry udder	29.7	66.70
Not dry udder	15.3	33.70
Total	45	100
Use refrigerator	19.98	44.40
With no refrigerator	25.02	55.6
Total	45	100

Table 4. Milk processing materials in Gondar town

Milking Processing Equipment	N	%
Cream Separator	7	15.5
Gourd	22	48.89
clay pot	5	11.11
other	11	24.5

Table 5. Milk processing practice in Gondar town

Processing	N	%
Traditional	27	60.00%
Modern	8	17.78%
no process	10	22.2%
Total	45	100%

Preferable Milk processed products in the Study Area

Preferable Milk processed products in Gondar town were shown in Table 6. In the study area skim milk, butter, cheese, whey and yogurt were the preferred milk processed products. In the study area skim milk and butter were more required by respondent. From the respondents 48.89 and 40% were highly preferring milk and butter for household consumption as wells for marketing purposes respectively.

The processed products of the present study was in line with the report of Duguma and Janssens [15] the major products of the traditional milk processing were naturally fermented milk, traditional butter, butter milk, cottage cheese, whey and ghee.

Milk utilization

Milk utilization in Gondar town is indicated in Table 7. Respondent were used different milk product for house hold consumption such as yogurt, milk, cheese, whey. The majority of respondents (51.11%) were preferred to use yogurt for consumption.

The result was in line with the finding of Yilma et al. [13]. Ergo is one of the most common traditionally made fermented milk products in Ethiopia. The result also agreed with Duguma and Janssens [15] the majority of the respondents were process milk into sour whole milk (ergo), cottage cheese (Ayib), butter and ghee.

Table 6. Preferable Milk processed product in Gondar town

Variable	N	%
Skim milk	23	48.89
Butter	18	40
Cheese	2	4.44
Whey	0	0
Yogurt	3	6.67

Table 7. Milk utilization in Gondar town

Variables	N	%
Yogurt	23	51.11
Milk	5	11.11
yogurt and milk	8	17.77
Cheese	1	2.22
Whey	2	4.44
All	6	13.33
Total	45	100

Marketing of milk and milk products

Milk product used for marketing is indicated in Table 8. In the study area milk producers were selling milk to consumers. major of respondents 77.77% were selling milk to consumer, 11.11% were selling milk and butter, 6.66% were by converting milk into butter and they sell butter, the remain 4.44% were selling all milk product to the society.

The study was not agreed with the reports of Beyene [4] in the southern region, Yilma et al.[13] in the central highlands of Ethiopia, Tola [5] in eastern Wollega and Fita [6] in the east Shoa zone of the Oromia region, where most of the farmers do not sell fresh milk but sell butter. On the other hands this result were in line with the finding of Belachew et al. [14] which stated that the producers deliver milk to consumers or consumers may collect it at the producer's gate. Studies also indicated that in terms of volume 71% of intra-urban producers sell milk directly to consumers.

Table 8. Milk product used for marketing

Variable	N	%
Butter	3	6.66
milk and butter	5	11.11
milk	35	77.77
All	2	4.44
total	45	100

CONCLUSION AND RECCOMENDATION

Generally the overall results of the present study indicated that the handling, processing and utilization of milk and its product in Gondar town were lay in traditional and modern way. Milk was processed into different products such as butter, cheese, whey and yogurt. Milk processing was important for household consumption and marketing. In this area producers were consume yogurt in majority. Whereas milk were major product that were highly required for market. Handling of milk and its products were largely in traditional way. Generally in this area large number of respondents was do not have milk and its product processing material adequately, such as refrigerator and other modern material were not accused. Based on the above conclusion the following recommendations were forwarded; government should be try to fulfill the requirement of electric power in different rural kebeles for the use of refrigerator, the government should be offered extension service for the dairy producers for quality of milk, the producers should be used modern milk processing machinery rather

processing in a traditional way, milk collection and processing center should additionally establish and milk pasteurizing and packaging training should be given to the milk produce.

Competing interests

The authors declare that they have no competing interests.

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Phenotypic Characterization of Indigenous Cattle Populations in West Gojjam Administrative Zones, Amhara National Regional State, Ethiopia

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Author Keywords: Body Weight, Cattle, Characterization, Indigenous, Linear Body Measurement

Abbreviations: CSA: Central Statistical Agency; DA: Development Agent; DAGRIS: Domestic Animal Genetic Resource Information System; FAO: Food and Agricultural Organization; GLM: General Linear Model; LBM: Linear Body Measurements Masl: MetereAbove Sea Level; Mm: Milimetere; °C Degree centigrade; WAO: Woreda Agricultural Office

INTRODUCTION

Ethiopia has served as a gateway to domestic animals from Asia to Africa and its diverse ecology favored diversification of these resources [1]. The country is endowed with huge livestock resources of varied and diversified genetic pools with specific adaptations to a wide range of agro-ecologies [2, 3]. Among livestock species, cattle have significant contributions to the livelihoods of the farmers. They serve as a source of draught power for the rural farming population, supply farm families with milk, meat, manure, serve as source of cash income, and play significant role in the social and cultural values of the society. Cattle contribute nearly all the draught power for agricultural production at smallholder level in Ethiopia [4].

The total number of cattle in all regions of the country except the non-sedentary population of three zones of Afar and six zones of Somali region was estimated to be 57 million, has the largest population in Africa [5]. The majority of these cattle (98.95 percent) are indigenous breeds which are kept under extensive management [1]. This is because indigenous cattle have been naturally selected for years towards adaptive traits as tolerance and resistance to diseases, high fertility, unique product qualities, longevity and adaptation to harsh environments and poor quality feeds [6]. However, a large proportion of indigenous livestock populations in the developing world have not yet been characterized or evaluated at phenotypic and genetic levels [7]. In order to ensure proper conservation and utilization of indigenous breeds, it is necessary to evaluate genetic variations that exist within

and among breeds. Accordingly, proper identification, evaluation, and maintenance of different traits of animal genetic resources are necessary to make them available and relevant for future use without compromising their current utilization [8]. Phenotypic as well as genetic characterization of indigenous livestock genetic resources provides the basis for any livestock development intervention. Clearly, sustainable utilization of local breeds is the best means of conserving these genetic resources. The first essential step towards sustainable utilization of these resources is to identify the major breed types, establish their population size as well as their geographical distribution and describe their typical qualitative and quantitative phenotypic traits [9].Recognition of breeds' potential depends on the availability of accurate and comprehensive information on their characteristics and their production and marketing environments. Such information can only be obtained through well-designed characterization studies that include pertinent and well thought-out analysis and interpretation of the data collected [10]. However, the genetic diversity and the genetic merits of most Ethiopian indigenous cattle populations are not yet well understood and exploited. Consequently, some of the indigenous cattle populations are already extinct and endangered, while the risk status of many of them is unknown [11]. Despite the significant contribution of cattle to the country, little attention is given to identify, characterize and conserve the diversity of the various classes of livestock. The current state of knowledge on characterization of cattle genetic resources in Ethiopia shows that there is inadequate breed level characterization information [12].

West Gojjam zone is one of the administration zone Amhara National regional State which has high cattle population potential and suitable weather conditions for cattle production. Even though the area has suitable environment and great potential for cattle production, there was a gap in utilizing its maximum potential and proper conservation and utilization of indigenous cattle breeds. Therefore in the study area; there was a need to conduct phenotypic characterization to solve the existing problems in the area. The objective of the study was to characterize phenotypic characteristics of local cattle population in the study area

MATERIALS AND METHODS

The study was conducted in 3 districts of West Gojjam zone of the Amhara National Regional State, Ethiopia. West Gojjamzone is one of administrative zone found in Amhara regional state and which is located on the southern border of Lake Tana. The districts included in the study sites were North Achefer, Sekela and Jabitenan (Figure 1).

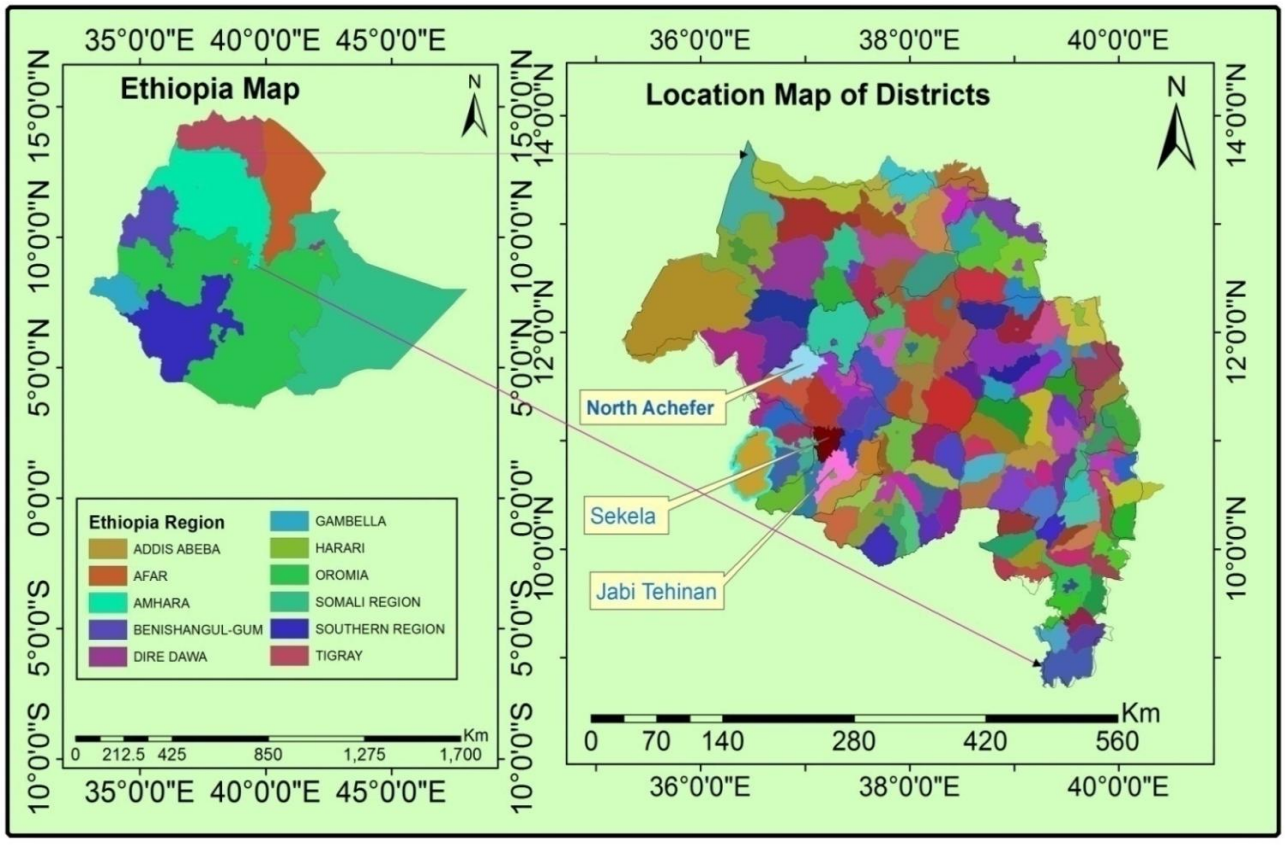

Figure 1. Map of the study area (Ethiopia; Amhara National Regional State; study districts)

Sampling Technique and Procedure

Multi-stage purposive sampling technique was employed to select the districts and kebeles for the study. Study districts were stratified based on agro ecology in to three strata; lowland, midland and highland. Three kebeles were selected from each stratum purposively based on cattle population potential and agro ecology (Table 1). Finally, 30 households (cattle owners) that have more than 2 head of cattle for interview and 67 animals (cattle) for measurement were selected randomly from each kebele. The sample size was calculated based on [13].

Table 1. Sampling Frame of Study areas

Districts	Agro-ecology of districts	Sample kebeles	Sample House holds	Sample Animals	Altitude Masl & Rain Fall
Semen Achefer	M.L	0	0	0	
	L.L	3	90	200	<1500&<800mm
Sekela	H.L	3	90	200	>2500&1200-2200mm
	M.L	0	0	0	
Jabitenan	M.L	3	90	200	1500-2500&800-1200mm
	L.L	0	0	0	
Total		9	270	600	

M.L= mid land, L.L = low land, H.L= high land

Data Collection

General information of the area, topography, climatic data and population size were obtained from secondary data from districts agricultural development offices. In each sampling site, the selected cattle owners were briefed about the importance and objectives of the study before the commencement of the actual data collection. Visual observation was made and morphological features were recorded based on breed morphological characteristics descriptor list [14, 15]. Linear body measurements were taken using a standard textile measuring tape and standard steel tape. Qualitative and quantitative traits were recorded through prepared check list from 192 mature males and 408 mature females. A total of 12 qualitative traits were examined and recorded: body hair color pattern, body hair coat color, udder size, horn presence, horn shape, horn orientation, ear orientation, hump size, navel flap (for cows), preputial sheath (for bulls), facial (head) profile and tail length.

A total of 11 quantitative traits were measured and recorded: heart girth, body length, height at withers, height at rump, pelvic width, ear length, horn length, cannon bone circumference, mouth circumference and body weight. The morphological variables recorded in this study were adapted from the standard cattle breed descriptor list [7] and extensively used in Ethiopia [15- 17]. Every animal to be measured was identified by sex and study site.

Data Management and Analysis

Qualitative and quantitative body measurement data were first entered into Excel 2007 computer software and analyzed using SPSS version 20. Qualitative data were analyzed using the frequency procedure of SPSS. While quantitative data were analyzed using the Generalized Linear Model (GLM) procedure of SAS. Sex and district (agro ecology) were fitted as fixed effects while linear body measurements were fitted as dependent variables. When analysis of variance declares significance, least square means were separated. Pearson's correlation coefficients were estimated among body weight and linear body measurements and between linear body measurements for females and males (SPSS version 20). Correlations (Pearson's correlation coefficients) between body weight and the linear measurements were computed for the population within each sex. To quantify the effect of independent variables (site and sex) on the linear body measurement (dependent variables) of the sample populations, the GLM procedure of SPSS 20 was employed. The model fitted for linear body measurements for sample populations was, $Yijk = \mu + Ai + Sj + eijk$

Where,

Yijk = Observed value of the trait of interest

μ = Overall mean

Ai = Fixed effect of ith agro ecology (sites)

Sj = Fixed effect of jth sex

eijk = Residual random effect

RESULTS AND DISCUSSION

Phenotypic Characterization

On farm phenotypic characterization of cattle breed includes all the qualitative description and morphological measurements of the animal. It is a primary and low cost animal genetic resource characterization as compared to the on-station [18].

Qualitative trait of indigenous cattle types found in Low land, High land and Mid land agro-ecologies are presented in Table 2. The most frequent color patterns observed in the study area were plain 63.17%, patchy 18.5% and spotted 18.33%. Out of the 63.17% (largest), plain coat color pattern, 39.67% light red, 21.33% black, 17% dark red, 14.33% grey and 7.67% fawn were the dominant color types (Figure 2). Comparably in Fentalle district the dominantly observed coat colour patterns for Kereyu cattle were 31.7%, 33.3% and 35 % for plain, patchy and spotty, respectively [19]. And in mursi areas frequently observed coat patterns were plain 52.0%, pied 36.0% and spotted 12.0% [20]. Light red coat colour was mostly observed in the study area Table 2 Similar to Raya Sanga [16]. In contrast to this, for Boran cattle white was dominant coat color [8], white and black frequently observed coat colour for Mursicattle breeds [20] and Grey color was the most observed forkereyu cattle breeds [19].

In the study area among the sampled cattle population the majority (96.83%) of cattle had horn, whereas, 3.17% were polled. Out of 96.83% horned cattle population 58.5% straight, 36.67% curved and 4.17% lyre were mainly observed horn shapes in the study areas. 47.5% of horns were oriented tips pointing laterally, 25.5% upwards, 25.5% forward and 1.5% down wards (Figure 3). Hump size difference were observed between male and female population in each district (Table 2 and 3).

Figure 2. Different coat colour of local cattle in Mid and Low land agro-ecologies respectively.

Figure 3. Hump size and horn orientation of local cattle in the study areas

Table 2. Qualitative trait description of male animal in West Gojjam zone

Districts (agro ecology) / Phenotypic variables	Low land	High land	Mid land	Overall mean
	N(%)	N(%)	N(%)	N(%)
Coat color Patter				
➢ Plain	45(65.2)	26(50.0)	44(62.0)	115(59.9)
➢ Patchy	14(20.3)	12(23.1)	13(18.3)	39(20.3)
➢ Spotted	10(14.5)	14(26.9)	14(19.7)	38(19.8)
		X^2value = 60.97*		
Hair Coat color				
➢ Black	14(20.3)	8(15.4)	16(22.5)	38(19.8)
➢ Dark red	7(10.1)	11(21.2)	9(12.7)	27(14.0)
➢ Light red	36(52.2)	21(40.4)	27(38.0)	84(43.8)
➢ Fawn	3(4.3)	5(9.6)	6(8.5)	14(7.3)
➢ Grey	9(13.0)	7(13.5)	13(18.3)	29(15.1)
		X^2value = 75.3*		
Horn presence				
➢ Horned	67(97.1)	49(94.2)	69(97.2)	185(96.4)
➢ Polled	2(2.9)	3(5.8)	2(2.8)	7(3.6)
		X^2value = 165.0*		
Horn shape				
➢ Straight	47(68.1)	29(55.8)	41(57.7)	117(60.9)
➢ Curved	20(29.0)	20(38.5)	24(33.8)	64(33.3)
➢ Lyre-shape	1(1.4)	2(3.8)	6(8.9)	9(4.7)
➢ Loose	1(1.4)	1(1.90	0	2(1)
		X^2value = 180.3*		
Horn orientation				
➢ lateral	30(43.5)	21(40.4)	40(56.3)	91(47.4)
➢ Upward	22(31.9)	13(25.0)	16(22.5)	51(26.6)
➢ Downward	1(1.4)	0(0)	2(2.8)	3(1.6)
➢ Forward	16(23.2)	18(34.6)	13(18.3)	47(24.5)
		X^2value = 80.9*		
Ear orientation				
➢ Erect	0	1(1.9)	0	1(0.05)
➢ Lateral	67(97.1)	51(98.1)	70(98.6)	188(97.9)
➢ Drooping	2(2.9)	0	1(1.4)	3(1.6)
		X^2value = 360.3*		
Hump size				
➢ Small	11(15.9)	4(7.7)	14(19.7)	29(15.1)
➢ Medium	43(62.3)	17(32.7)	30(42.3)	90(46.9)
➢ Large	15(21.7)	29(55.8)	27(38.0)	61(31.8)
		X^2value = 99.4*		
Perpetual Sheath (bull)				
➢ Small	14(20.3)	12(23)	8(11.3)	34(8.3)
➢ Medium	31(44.9)	26(50.0)	37(52.1)	94(48.9)
➢ Large	24(34.8)	14(26.9)	26(36.6)	64(15.7)
		X^2value = 119.4*		
Facial (head)				
➢ Straight	60(87.0)	48(92.3)	63(88.7)	1171(89)
➢ Concave	3(4.3)	3(5.8)	3(4.2)	9(4.7)
➢ Convex	6(8.7)	1(1.9)	5(7.0)	12(6.3)
		X^2value = 268.4*		
Tail length				
➢ Short	1(1.4)	0	1(1.4)	2(0.1)
➢ Medium	2(2.9)	0	1(1.4)	3(1.6)
➢ Long	66(95.7)	52(100)	69(97.2)	187(97.4)

Pr. = perpetual, facial = facial profile

Table 3. Qualitative trait description of female animal in West Gojjam zone

Districts (agro ecology) / Phenotypic variables	Low land	High land	Mid land	Overall mean
	N(%)	N(%)	N(%)	N(%)
Coat color Patter				
➢ Plain	84(64.1)	87(58.8)	*93(72.1)*	264(64.7)
➢ Patchy	21(16.0)	28(18.9)	23(17.8)	72(17.96)
➢ Spotted	26(19.8)	33(22.3)	13(10.1)	97(23.8)
		X²value = 179.3*		
Hair Coat color				
➢ Black	33(25.2)	32(21.6)	25(19.4)	90(22.0)
➢ Dark red	15(11.5)	38(25.7)	22(17.1)	75(18.4)
➢ Light red	60(45.8)	41(27.7)	53(41.1)	154(37.8)
➢ Fawn	5(3.8)	23(15.5)	4(3.1)	32(7.8)
➢ Grey	18(13.7)	14(9.5)	25(19.4)	57(13.9)
		X²value = 103.2*		
Horn presence				
➢ Horned	128(97.7)	141(95.3)	127(98.4)	396(97.1)
➢ Polled	3(2.3)	7(4.7)	2(1.6)	12(2.9)
		X²value = 165.0*		
Horn shape				
➢ Straight	79(60.3)	83(56.1)	72(55.8)	234(57.4)
➢ Curved	40(30.5)	60(40.5)	56(43.4)	156(38.2)
➢ Lyre-shape	11(8.4)	4(2.7)	1(0.8)	16(8.3)
➢ Loose	1(0.8)	1(0.7)	0	2(0.5)
		X²value = 365.6*		
Horn orientation				
➢ lateral	66(50.4)	65(43.9)	63(48.8)	194(47.5)
➢ Upward	26(19.8)	42(28.4)	34(26.4)	102(25)
➢ Downward	2(1.5)	0	4(3.1)	6(1.5)
➢ Forward	37(28.2)	41(27.7)	28(21.7)	106(26)
		X²value = 171.3*		
Ear orientation				
➢ Erect	0	7(4.7)	0	7(1.7)
➢ Lateral	130(99.2)	141(95.3	119(92.2)	390(95.6)
➢ Drooping	1(0.8)	0	10(7.8)	11(2.7)
		X²value = 708.0*		
Uder Size				
➢ Small	26(19.8)	27(18.2)	26(20.2)	79(19.4)
➢ Medium	64(48.9)	85(57.4)	59(45.7)	208(50.9)
➢ Large	41(31.3)	36(24.3)	44(34.1)	121(29.7)
		X²value = 212.6*		
Hump size				
➢ Small	122(93.1)	109(73.6)	125(96.	356(87.3)
➢ Medium	9(6.9)	35(23.6)	4(3.1)	48(11.8)
➢ Large	0	4(2.7)	0	4(0.9)
		X²value = 537.6*		
Navel flap				
➢ Small	29(22.1)	46(31.1)	24(18.6)	99(24.6)
➢ Medium	75(57.3)	72(48.6)	71(55.0)	218(53.4)
➢ Large	27(20.6)	20(13.5)	34(26.4)	81(19.9)
		X²value = 624.9		
Facial (head)				
➢ Straight	114(87)	143(96.6	117(90.7)	374(91.7)
➢ Concave	10(7.6)	2(1.4)	9(7.0)	21(5.1)
➢ Convex	7(5.3)	3(2.0)	3(2.3)	13(2.0)
		X²value = 629.6*		
Tail length				
➢ Short	2(1.5)	0	1(0.8)	3(0.07)
➢ Medium	2(1.5)	12(8.1)	4(3.1)	18(4.4)
➢ Long	127(96.9	136(91.9	124(96.1)	390(95.6)
➢		***X²value = 697.7****		

Hump size of male cattle population were 15.9% small, 62.3% medium and 21.7% large in Low land, 7.7% small, 32.7% medium and 55.8% large in High land and 19.7% small, 42.3% medium and 38% large in Mid land agro-ecology. Whereas, for cow 93.1% small and 6.9% medium in Low land, 73.6% small, 23.6% medium and 2.7 % large High land and 96.9% small and 3.1% medium in Mid land agro-ecologies.

The overall facial profile of the three districts was 90.83% straight 5% concave and 4.17% convex. Likewise, their ear orientations were 1.3% erected, 96.33% laterally oriented and 2.3% dropping oriented. A total of both male and female cattle population in the study areas having tail length of 95.67% long (blow the hocks, 3.5% medium (about the hocks) and 0.83% short (above the hocks) (Figure 4). The perpetual sheath of male sample population were 20.3% small, 44.9% medium and 34.8% large in Low land, 23.1% small, 50% medium and 26.9% large in High land and 11 .3% small, 52.1% medium and 36.6% in Low land agro-ecology.

From the total female cattle population evaluated, udder size of 19.8% them were small, 48.9% medium and 31.3% large in Low land, 18.2% small, 57.4% medium and 24.3% large in High land and 20.2% small, 45.7% medium and 34.1% large in Mid land agro-ecology (Figure 5). Similarly navel flap for cows were 22.1% small, 57.3% medium and 20.6% large in Low land, 31.1% small, 48.6% medium and 13.5% large in High land and 18.6% small, 55% medium and 26.4% large in Mid land agro-ecologys. As shown in Table 2, all of qualitative traits were significantly different among districts and this difference might be due to the agro ecological difference of the three districts.

Figure 4. Perpetual sheath and tail length of the bull in Mid land and Low land agro-ecology respectively.

Figure 5. Udder size and naval flap of cow respectively in High land agro-ecology

Table 4. Body measurements (cm) of adult local cattle population in the study area (LSM±SE)

Variables	MC		HL		EL		HW		BL	
	N	LSM±SE	N	LSM±SE	N	LSM±SE	N	LSM±SE	N	LSM±SE
Over all	600	38.9±0.07	600	22.84±0.42	600	19.83±0.06	600	114.5±0.24	600	115.41±0.24
Agro-ecology	--	*		NS		*		NS		*
Low land	200	38.3±0.12	200	22.4±0.66	200	19.4±0.09	200	115±0.4	200	116.7±0.3
High land	200	39.2±0.12	200	22.6±69	200	19.8±0.1	200	114±0.4	200	114.4±0.3
Mid land	200	39.2±0.12	200	23.5±0.67	200	20.2±0.09	200	114.5±0.4	200	115±0.3
Sex	--	*		*		*		*		*
Male	192	40.07±0.12	192	23.9±0.7	192	20.2±0.1	192	116.2±0.4	192	117.06±0.3
female	408	38.8±0.08	408	21.8±0.5	408	19.5±0.07	408	112.8±0.3	408	113.7±0.2

NS= Non significant; N = number of household; LMS =least square mean; SE = standard error

Table 4. (Continued)

Variables	HG		PW		TL		RH		CBC		*BW*
	N	LSM±SE	N	LSM±SE	N	LSM±SE	N	LSM±SE	N	LSM±SE	N(LSM±SE)
Over all	600	146.04±0.27	600	36.5±0.09	600	78.6±0.22	600	115.8±0.25	600	20.3±0.06	*600 (266.8*±2.3*)*
Agro- ecology	--	*		*		NS		NS		*	*
Low land	200	144.8±0.43	200	36.3±0.14	200	78.8±0.35	200	115.8±0.42	200	20.3±0.09	*200 (260*±2.18)
High land	200	147.2±0.4	200	36.4±0.15	200	79±0.4	200	115.8±0.43	200	20±0.09	*200 (272.2*±2.4)
Mid land	200	146.±0.44	200	37±0.14	200	78.1±0.35	200	115.9±0.4	200	20.5±0.09	*200 (268.3*±2.2)
Sex	--	*		*		*		*		*	*
Male	192	151.8±0.44	192	37.08±0.15	192	79.6±0.36	192	117.2±0.14	192	21.14±0.09	*192 (300.7*±4.3)
female	408	140.3±0.30	408	35.98±0.1	408	77.7±0.24	408	114.5±28	408	19.5±0.06	408 (243.6±2.3)

NS= Non significant; N = number of household; LMS =least square mean; SE = standard error

Table 5. Coefficient of correlations between body weight and linear body measurements (Above diagonal for male and below diagonal for female)

	MC	HL	EL	HW	BL	HG	PW	TL	RH	CBC	BW
MC		0.210**	0.304**	0.479**	0.259**	0.566**	0.309**	0.368**	0.293**	0.567**	0.564**
HL	0.215**		0.002 ns	0.212**	0.332**	0.116 ns	0.100 ns	0.163*	0.117 ns	0.409**	0.123 ns
EL	0.440**	0.047		0.187**	0.169ns	0.406**	0.377**	0.316**	0.125 ns	0.318**	0.393**
HW	0.198**	0.101**	0.117**		0.530**	0.431**	0.290**	0.337**	0.537**	0.462**	0.439**
BL	0.310**	0.172**	0.171**	0.276**		0.330**	0.303**	0.283**	0.303**	0.415**	0.339**
HG	0.452**	0.057ns	0.244**	0.275**	0.385**		0.547**	0.497**	0.324**	0.510**	0.984**
PW	0.393**	0.136**	0.482**	0.187**	0.238**	0.301**		0.370**	0.245**	0.368**	0.547**
TL	0.366**	0.215**	0.268**	0.278**	0.314**	0.477**	0.355**		0.324**	0.382**	0.496**
RH	0.386**	0.176**	0.162**	0.588**	0.480**	0.509**	0.222**	0.436**		0.368**	0.322**
CBC	0.413**	0.069 ns	0.282**	0.285**	0.445**	0.430**	0.278**	0.304**	0.397**		0.504**
BW	0.439**	0.066 ns	0.235**	0.278**	0.379**	0.994**	0.293**	0.467**	0.507**	0.423**	

ns non- significance; MC= Mouth Circumference, HL= Horn Length, EL= Ear Length, HW= Height at Wither, RH= Rump Height, BL= Body Length, HG= Heart Girth, PW= Pelvic Width, TL= Tail length, RH= Rump height and CBC= Cannon bone circumference

Morphological measure of adult cattle population

The quantitative measures of some phenotypic traits of local cattle population are summarized in (Table 4). The overall least squares means and standard error values of mouth circumference, horn length, ear length, height at wither, body length, heart girth, pelvic width, tail length, rump height and cannon bone circumference were 38.9±0.07cm, 22.8±0.42cm, 19.83±0.06 cm,114.5±0.2cm, 115.4± 0.2cm, 146±0.27cm, 36.5±0.09cm, 78.6±0.22cm, 115.8±0.25cm and 20.3±0.6 cm, respectively. All phenotypic measurements listed on the above were significantly different (P<0.05) between male and female cattle. Most body measurements of cattle like heart girth, body length, pelvic width, ear length, cannon bone circumference, mouth circumference and body weight were also significant difference (P<0.05) among Low Land, High Land and Mid Land locations. The possible reason for the difference may be agro ecological difference among districts. But horn length, tail length, height at whither and rump height were did not shows significant difference (P<0.05) among the three agro ecologies. Body length, chest girth, and wither height of the male cattle were measured to be 117.6±0.3, 151.8±0.44, and 116.25±0.4 cm, respectively. These measurements were found lower than body measurements reported on the same sex for Boran cattle breeds [8], Mursi cattle breeds [20] and for Wollocattle [16] except heart girth. But heart girth of this result was aligned with that reported [16] for Wollo cattle breed. Like other local zebu cattle populations, the male and female of this result showed significantly different for most of morphological measurements and all linear measurement male value greater than female's. Different reports revealed that the mean value of on-farm morphological traits measurement on local male and female cattle result that males are usually greater than their counter female groups [21, 22, and 19]. Therefore cattle populations in the study areas were varied with qualitative and quantitative traits from former findings of Fasil and Dereje [17, 16] respectively and there was no sufficient evidence to classify either of them.

Correlation between Body Weight and Linear Body Measurements

Pearson's correlation coefficient between body weight and linear body measurements for male and female were calculated and presented in the (Table 5). In males all of linear body measurements have positive association with body weight and strong association was found between body weight and chest girth (r=0.984), whereas mouth circumference (r=0.56), tail length (r=0.5), pelvic width (r=0.55) and cannon bone circumference (r=0.5) had moderate correlation with body weight. Wither height (r=0.44), body length (r=0.34), rump height (r=0.32) and ear length (r=0.39) showed mild correlation with body weight. But horn length for both sex male (r=0.12) and female (r=0.002) did not showed significant correlation with body weight. These linear body measurements that showed moderate and mild correlation were may not significantly affected by the change in body weight; hence, they are not more important in prediction of live body weight of the animal**.** In females also all of linear body measurements have positive association with body weight and strong association was found between heart girth and body weight. Rump height showed moderate correlation (r=0.50), with body weight. Height at wither (r=0.28), body length (r=0.38), mouth circumference (r=0.44), tail length (r=0.48), pelvic width (r=0.29) and cannon bone circumference (r=0.42)were showed mild correlation, whereas ear length (r=0.24) had weak correlation with body weight. Generally as the result of correlation showed heart girth (chest girth) was the most important than other linear body measurement for both male and female to estimate body weight.

Estimated Mature Body Weight of the Sample Population by sex

The estimated average mature body weight as used conversion of from heart girth were 300.7±4.3 for male and 243.6± 2.3 kg for female with at rang of (214-388 kg) for male and (164-381kg) for female. These Variations were observed among individuals which were compared to other local cattle [19] ranging from 196.9 to 333.6 for females and from 178.1 to 428.2 kg for males. Based on the estimated body weight of the individual animals the following linear regression equations (body weight on heart girth) were developed separately for both sexes.

Ym= -481.55 + 4.89*x* for bulls and

Yf = -405.22 + 4.64*x* for cows

Where:

Yf = estimated body weight of mature female cattle (kg)

Ym= estimated body weight of mature male cattle (kg)

x = heart girth.

CONCLUSIONS AND RECOMMENDATIONS

The most dominant coat colour pattern was plain and frequently observed coat colour type being light red. The majority of cattle were possessed horn with straight shape and tips pointing lateral orientation. Sample population of bulls had medium hump size and perpetual sheath whereas cows possessed medium udder size and naval flap. Sex of animals had significant effect ($P<0.05$) on body weight and all of the body measurements. District (agro ecology) also had significant effect on body weight and all of the body measurements except height at whither, horn length, tail length and rump height ($P<0.05$). Among the body measurements of sample population moderate and significant ($P<0.05$) positive correlation was found. Chest girth was the most important linear body measurement to estimate body weight.

Overall, cattle populations in the study areas were varied from former local cattle bred that were identified in Gojjam and Wollo areas. Therefore further characterization of local cattle in the study area at molecular level should is duly required.

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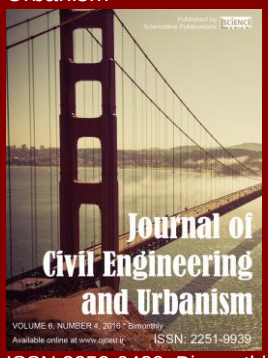

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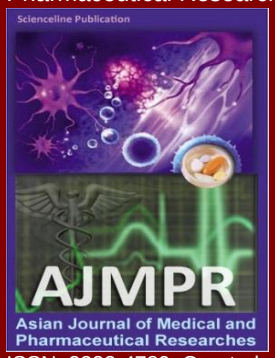

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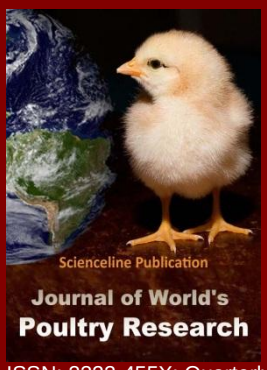

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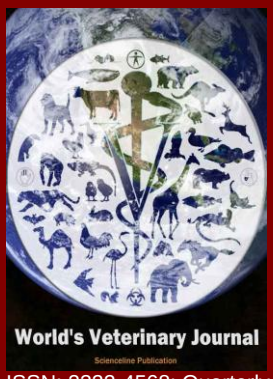

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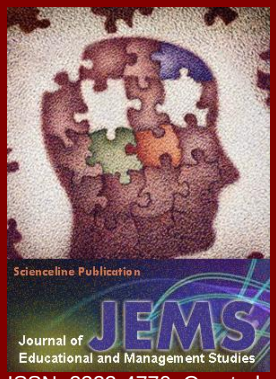

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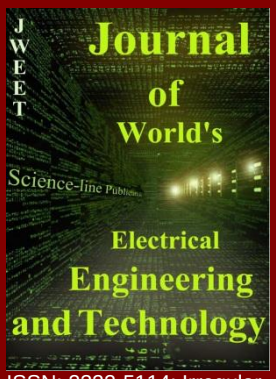

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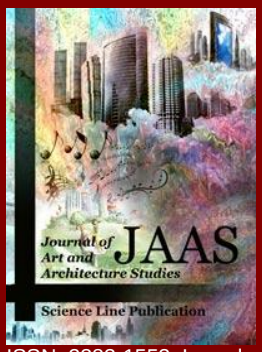

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