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Research Article

Characteristics of the cattle fattening system and body conformation of beef cattle in Bahir Dar Special Zone, Amhara Regional State, Ethiopia

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Abstract: *The study was conducted in the urban and peri-urban areas of Bahir Dar special zone, Amhara Regional State, Ethiopia, with the objectives of characterizing the cattle fattening system and conformation traits of fattening cattle in the area. Data on the fattening systems were collected from 112 cattle fatteners (72 from peri-urban and 40 fatteners from urban areas) who have experience with cattle fattening using a semi-structured questionnaire. The beef cattle conformational traits measurement was carried out on fattening cattle on a total of 60 animals (30 from peri-urban farms and 30 from urban farms) in selected farms under the fattener's management condition. Twelve farms were used for the body conformation measurement of the animals using ICAR guidelines. The survey data was analyzed and summarized using descriptive statistics and index ranking. Conformational trait data were analyzed using the General Linear Model Procedure of SAS 9.1. The overall mean family size, age of household heads, and landholding per household were 8.43, 42.31 years, and 0.77 hectares, respectively. Most of the respondents in the periurban hold cattle for draft power (index = 0.40). The respondents prefer intact and matured bulls in the urban (100%) and peri-urban (93%) areas. The respondents, on average, fatten three times a year (47.3%) with a mean number of 8.08 fattening cattle. The main feed sources in the peri-urban and urban areas were crop residue (index = 0.26) and agro-industrial by-products (index = 0.63), respectively. Most of the cattle fatteners select their fattening cattle based on body conformation (index 0.29) and condition (index 0.21). The mean initial and final body weight of fattening cattle were 348.75kg and 425.33 kg, respectively. In general, the cattle fattening practice needs to be supported by the extension system so as to efficiently use the resources.*

Keywords: *Body conformation, cattle fattening, fattening performance, peri-urban and urban*
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1. Introduction

The livestock sector has been contributing a considerable portion to the economy of Ethiopia, and still promising to rally around the economic development of the country. Ethiopia has the largest livestock inventories in Africa having about 70 million cattle, 42 million sheep, 52 million goats (CSA, 2021) with livestock ownership currently contributing to the livelihoods of an estimated 80 percent of the rural population. Among these,

Amhara Regional State shares 17 million cattle, 10 million sheep, and 7 million goats (CSA, 2021). Livestock has a diverse function for the livelihood of Ethiopian farmers in various farming systems (Anetneh *et al* 2010) and serves as a source of food, traction, manure, raw materials, cash income foreign exchange earning social and cultural identity.

Among the various livestock production activities, beef cattle fattening is one of the potential sources of employment opportunities to increase the volume and quality of meat produced and alleviate poverty in the country (Alemayhu, 2008). Cattle fattening has gained prominence as an important business project of the livestock industry in Ethiopia to make use of cheap and plentiful farm by-products. Fattening offers an opportunity to exploit the vast cattle and meat export market in the region as well as Ethiopia's domestic market (Yesigat, 2012). The fattening activity can be undertaken at any level of the livestock ranging from smallholder farmers rearing livestock to multiple functions (Sarma and Ahmed, 2011), and small-scale commercial fattening to large-scale commercial fattening (Teklebrhan and Urge, 2013) who export live animals and supply fattened animals directly to abattoirs concocting meat for inland and international markets.

A market-oriented agricultural production system requires intensification in management or production system (Tegegne *et al*., 2011). The Government is also trying to expand the sector by motivating producers to meet the growing demand. As a result, meat processing factories and export abattoirs are increasing in number and export earnings from the sector are rising (MORD, 2008). However, inadequate supplies of export quality livestock in terms of the required age and body weight for slaughter, lack of information on an efficient way of feed resources utilization for quick feedlot finishing, and the biological response of indigenous cattle to feedlot fattening have remained to be a bottleneck to increase domestic per capita meat consumption and export (Teklebrhan and Urge, 2013).

Morphometric traits have been used to characterize breeds, evaluate breed performance, and predict the live body weight of animals (ICAR, 2017). The fundamental knowledge of body weight estimation of fattening cattle is often unavailable to farmers due to the unavailability of weighing scales, which are costly to obtain, need technical maintenance and are heavy to transport to farmers' houses, especially in remote and rural areas. Nowadays, animal owners, livestock assistants and cattle traders depend on visual assessment (eyeball judgment) to measure live weight. Hence, the farmers have to rely on questionable estimates of the body of their animals leading to inaccuracies in decision-making and husbandry (Moaeen-ud-Din *et al.*, 2006).

Bahir Dar Special Zone Administration (BDSZA) holds a large human population due to the migration of rural people into urban in search of employment as a result of Urbanization (BDSZA, 2012). Because of this fact, there is a high demand for meat both in quantity and quality which in turn necessitated an increase in butcher shops in Bahir Dar city. In addition, the presence of flour milling plants, oilseeds, and animal feed processing plants found around the study area is an opportunity for the existence of livestock feed agro-industrial byproducts. As a result, cattle fattening has been identified as an effective tool for poverty alleviation and has become an important business sector for those urban and peri-urban cattle-fattening individuals and many smallholder farmers who were displaced due to urbanization (BDSZA, 2012). Therefore, the objective of this research was to characterize the cattle fattening practices and conformational traits of fattening cattle in urban and peri-urban areas of Bahir Dar special zone.

2. Materials and Methods

2.1. Description of the study area

The study was conducted at Bahir Dar Special Zone of the Amhara Regional State, Ethiopia. Bahir Dar Special Zone is located in the northwestern part of Ethiopia 560 km away from Addis Ababa, the national capital. Geographically, the area is located between the latitude of 11°37′ north and longitude of 37°29′ east coordinates at an elevation of 1800 m.a.s.l. The long-term (47 years) average daily minimum and maximum temperatures are 7 °C and 29 °C, respectively. The average annual rainfall calculated for the same period was 1445 mm. The main rainy season spans from June to September (Nigussie *et al*., 2012).

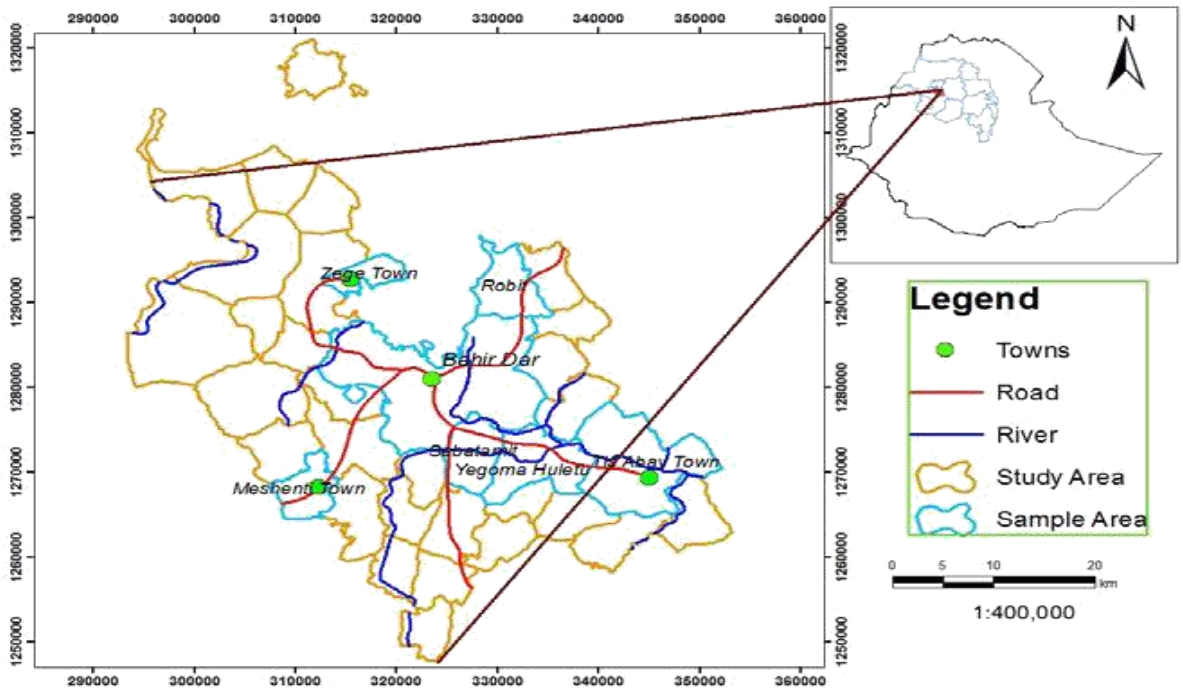

Figure 1: Map of Bahir Dar Special Zone Administration

2.2. Sampling procedure and sample size

Prior to sampling the study kebeles, a series of discussions were held with the Bahir Dar Town Administration Agriculture and Rural Development office. Livestock experts were consulted to get information on the administrative structure, infrastructure, and cattle fattening experience of each kebele. Then, potential kebeles for fattening beef cattle and infrastructure issues were purposively selected. Accordingly, the study kebeles were divided into peri-urban kebeles which contain six kebeles (out of eleven), and urban kebeles consisting of two sub-city kebeles (out of six-sub-city kebele). All the selected kebele areas were selected using a complete enumeration technique to collect necessary survey data due to the manageable number of kebeles. Before sampling individual fatteners, fattener record data of each kebeles were collected through a preliminary survey. After finishing of registered fattener data collection, the sampling frame in this study was designed based on the households who have currently fattening at least two cattle were included. In all kebeles, registered urban fatteners were sampled using a complete enumeration technique due to the presence of a manageable number of urban fatteners.

In the case of peri-urban fatteners, a random sampling technique was applied due to the presence of a large number of cattle fatteners. As a result, in peri-urban kebeles, the sample size (n) was determined using the formula recommended by Yamane (1967) as indicated below [1].

$$n = \frac{N}{1+N(e)2} \quad [1]$$

Where:
n = the sample size.
N = the population size.
e = the level of precision

Finally, a total of 112 cattle fatteners (40 urban and 72 peri-urban) were selected and interviewed and 60 fattening cattle were measured for body conformation traits.

2.3. Sources and collection methods of data

Both primary and secondary data sources were used for data collection. The primary data was collected through a semi-structured questionnaire survey and through measuring conformational traits, and field observations. Secondary data was also collected from both published and unpublished documents available from various sources. In the study area, all sample

cattle fatteners were informed before the start of the actual data collection.

2.3.1. Survey data collection

Survey data needed for the assessment of fattening practices was collected from one hundred twelve (112) beef fatteners using a semi-structured survey questionnaire. The questionnaire was designed to collect information about household characteristics, cattle fattening practices experience, fattening cattle breed types, sex of fattening animals, castration condition of animals, age of animals preferred by fatteners, sources and selection of fattening cattle, housing system of cattle fattening, beef cattle feed source and feeding system and others. In addition, field observation was made on the feeding, housing, and feed resource situation of the study area.

2.3.2. Conformational trait characterization

For the conformational trait characterization, 60 (sixty) beef cattle reared under farmer and fattener management systems were used. The traits were measured based on the International Committee for Animal Recording (ICAR) Guidelines for Conformation Recording of Dairy Cattle, Beef Cattle and Dairy Goats (ICAR, 2017). Both qualitative traits of beef including age, sex and colour of the animals, and quantitative traits include Body length, Back length, Chest width, Thurl width, Body depth, Chest depth, Height at withers, Height a the trump, rounding of ribs conformation traits were measured/recorded two–three times (at the beginning on the fattening, in the middle and final stage of the fattening period).

2.4. Method of data analysis

2.4.1. Survey data analysis

All collected survey data was coded and entered into the Statistical Package for Social Science (SPSS) for Windows, Version 20, 2011 for analysis. Descriptive statistics such as frequency, percentage, range, standard deviation and mean were used to present the result. For all ranking data, the index was calculated using a rank index formula based on the method (Kosgey, 2004).

$$Index = \frac{\Sigma[(n*1st\ rank)+(n-1*2nd\ rank)+\cdots+(1*nth\ rank)\ given\ for\ a\ variable)}{\Sigma(n*1st\ rank)+(n-1+2nd\ rank)+\cdots+(1*nth\ rank) given\ for\ all\ variables} \quad [2]$$

2.4.2. Conformational trait data analysis

Conformation data was collected and handled in Microsoft Excel whereas statistical analyses were done using Statistical Analysis System (SAS, 9.1). The general linear model (GLM) procedure was used to analyse the least square means (LS Means) and Standard errors (SE) for quantitative traits. For qualitative traits, descriptive statistics and percentages were used. The statistical model used was described below [2].

$$Yij = \mu + Pi + Wj + eij \quad [3]$$

Where;

Yij = Response variables of body weight and other quantitative conformation traits

μ = Overall mean

Pi = the effect of i^{th} production system (2= peri-urban, Urban)

Wj = the effect of j^{th} weight group (3 = small, medium, and large)

εij = random error

3. Results and Discussion

3.1. Socio-economic characteristics of households in Bahir Dar Special Zone

3.1.1. Family size and age groups

The family size and age group of the households in the study area are presented in Table 1. The overall mean family size of the study area was 8.43±2.45 persons per household. The mean family size was significantly ($p<0.005$) higher in the urban (10.3±1.56) than in the peri-urban (7.39±2.22) areas. Higher family size in an urban area could create better labour opportunities for cattle fattening practices than peri-urban areas. This finding was comparable with the family size of 7.56±0.21 persons per household reported by Demisse (2016) in Bonke district and 7.12±2.53 persons per household by Beyene (2017) in Horo Guduru district. On the other hand, it was greater than the overall mean family size of 5.15±1.41 reported by Belayneh *et al* (2021) in Dangila Town of Awi Zone, Amhara Region, and 1.82 persons per household in South Omo Zone reported by Alemayehu *et al*. (2016).

The overall mean age of the respondents in the study area was 42.31±3.5 years old (Table 1) which was 41.65±3.41 and 43.50±3.41 years old for the peri-urban and urban areas, respectively. With regard to the age structure of the interviewed households, the largest portion of respondents were in the age group ranging from 29 to 49 years old and there was no respondent below 29 years old. The current result was supported by the finding of Kassa *et al* (2017) who reported that the average age of the respondent household heads was 43.83±1.5 years in Moretna Jiru District and Ahmed (2018) who reported that the average age of the interviewed household head was 38.5±0.8 years in Dessie and Kombolcha town.

3.1.2. Sex and educational status of households

As presented in Table 2, all (100%) of household heads involved in cattle fattening in the study area were male-headed. With regard to the analysis of the educational status of the respondents, 9.8% were illiterate, 23.2% can read and write, 22.3% have religious education, 22.3% completed primary school, 17.86% graduated high school and 4.46% had a certificate and above (Table 2). The educational level of cattle fattening households might be important in identifying and determining the type of development and extension service approaches. This result agreed with the finding of Abebe (2014) who described that farmers who are able to read and understand as compared to non-learned ones can provide better opportunities to implement improved agricultural practices, better management and effective utilization of resources in the Chiro district of West Harerghe Zone. Similarly, this finding agrees with Ahmed (2018) who described that the level of education of the HH heads participated in cattle fattening practices in Dessie and Kombolcha town, particularly, the peri-urban cattle fatteners might not be enough and would have a negative impact in the introduction of modern cattle fattening technology as well as production activities. In general, the educational achievements in the study area had a positive impact on the introduction of modern cattle-fattening technology as well as the adoption of the modern fattening approach.

Table 1: Socio-economic characteristics of households in the study area

Parameter	Fattening system (Mean +SD)			P- value
	Peri-urban (N = 72)	Urban (N = 40)	Overall (N = 112)	
Family size				
Mean	7.39±2.22	10.3±1.56	8.43±2.45	0.000
Range	3-13	8-14	3-14	
Age of HH heads				
Mean	41.65±3.41	43.50±3.41	42.31±3.5	0.007
Range	29-49	38-49	29-49	

N = number of respondents, SD = Standard deviation, HHs = household

Table 2: Sex and educational status in the urban and peri-urban areas of Bahir Dar Special Zone

Parameter	Percentage of respondents in the fattening system					
	Peri-urban (N = 72)		Urban (N = 40)		Over all (N = 112)	
	Frequency	(%)	Frequency	(%)	Frequency	(%)
Sex of HH heads						
Male	72	100	40	100	112	100
Educational status HH						
Illiterate	11	15.3	0	0	11	9.8
Religious education	7	9.7	18	45	25	22.3
Read and write	24	33.3	2	5	26	23.2
Grade 1-8	15	20.8	10	25	25	22.3
Grade 9-12	10	13.9	10	25	20	17.86
Certificate and above	5	6.9	0	0	5	4.5

3.1.3. Landholding and land use pattern per household in the study area

The overall mean landholding per household observed in the current study area was 0.773±0.545 ha (Table 3). The mean landholding size of the respondents in peri-urban and urban areas was 1.134±0.3 and 0.121±0.0625 ha, respectively. The landholding per household was significantly ($p<0.05$) higher in peri-urban than in urban production systems. This was due to higher crop production and natural pasture in peri-urban than urban production systems. This finding was smaller than the overall mean landholding of 1.65±0.11 ha reported by Demessie (2016) in Bonke district of Gamo Gofa Zone. Lack of enough land holding has negative implications on forage development for cattle and forces households to rely on purchased feed.

3.1.4. Livestock holding of the household in the study area

The livestock holdings of the households in the study area are presented in Table 4. The average number of local cattle was 9.57±2.54 heads/household in the peri-urban fattening system. The average number of crossbred cattle was 1.94±1.34 heads/household in the peri-urban fattening system which was greater than that of the urban fattening system. The overall average cattle herd size was 11.46±3.57 heads/household in which, local cattle breeds were more dominant than the exotic and crossbred ones. This result was agreed with the finding of Beyene (2017) as he reported that the average cattle herd size was 11.43±5.59 per household in Huru Guduro Wollega Zone.

Table 3: Landholding and land use pattern per household in the urban and peri-urban area of Bahir Dar Special Zone

Pattern	Fattening system (mean ±SD)			P-value
	Peri-urban (N = 72)	Urban (N = 40)	Overall mean (N = 112)	
Cultivated land	1.00±0.27	0.00	0.647±0.531	0.000
Grazing land	0.08±0.04	0.000	0.0512±0.0515	0.000
Other land	0.078±0.095	0.121±0.0625	0.0875±0.0925	0.011
Total land	1.134±0.3	0.121±0.0625	0.773±0.545	0.000

SD = standard deviation

Table 4: Livestock species and holding of households in the urban and peri-urban area of Bahir Dar Special Zone

Parameter	Fattening system (mean ±SD)			p-value
	Peri-urban (N = 72)	Urban (N = 40)	Overall (N = 112)	
Livestock species				
Total cattle	11.53±3.03	11.33±3.3	11.46±3.569	0.775
Local breed cattle	9.57±2.54	9.48±3.4	9.55±2.86	0.753
Crossbreed cattle	1.94±1.34	1.85±1.79	1.91±1.51	0.830
Sheep	3.527±1.37	0.00	2.27±2.02	0.000
Goat	1.88±1.59	0.00	1.21±1.57	0.000
Equine	1.41±0.78	0.00	0.91±0.97	0.000
Chicken	6.59±1.37	0. 00	4.24±3.36	0.000

SD = standard deviation

3.1.5. Purpose of keeping cattle in the study area

As indicated in Table 5, the purpose of keeping cattle in the peri-urban study area was to provide draught power (index = 0.40) as ranked first followed by income source (index = 0.20) and milk production. The role of animal dung in this sub-system was very important to increase crop production by ameliorating soil fertility and using it as a fuel. In the urban study area, all (100%) of the respondents reported that they keep cattle as an income source. This result was in agreement with the finding of Moreda, (2016) who reported that the primary purpose of keeping cattle was for draught power followed by milk and income generation in the Lume district of the East Shoa Zone.

Table 5: Ranking the purpose of keeping cattle in the peri-urban area in Bahir Dar Special Zone

Parameter	Weight frequency						Index	Rank
	1st	2nd	3rd	4th	5th	6th		
Purpose of keeping cattle								
Source of Power (draft animal)	68	9	6	11	3	0	0.40	1st
Income source	12	5	39	0	0	7	0.20	2nd
Milk and milk product	24	13	10	0	0	0	0.19	3rd
Manure	0	17	3	24	0	2	0.13	4th
Saving insurance	0	5	6	7	15	0	0.08	5th

3.2. Cattle fattening practices in the study area

Based on the survey results, all (100%) the respondents who participated in the cattle fattening practice were male-headed households basically due to cultural issues, the presence of thieves and the intensive labour demand of the activities. Due to this fact, it causes a reduction of job opportunities for females and it makes gender participation difference in the beef fattening sector. The current study was in line with the finding of Belayneh *et al* (2021) who stated that all (100%) of respondents who participated in the cattle fattening practice were male-headed households in the Dangla district, and Kassa *et al*. (2017) who stated that majority (97.5%) of the households participated in cattle fattening are male in Moretna Jiru district of Amhara Regional State. Similarly, Amhed (2018) reported that almost all (93.6%) of household (HH) heads involved in cattle fattening were male-headed in the Dessie and Kombolcha towns of Amhara Regional State.

3.2.1. Experience of cattle fattening in the study area

The survey results indicated that the average cattle fattening experience was 9.17±3.65 years, which was ranging from 2 to 17 years. The average cattle fattening experience in peri-urban areas was 10.23±3.48 years, whereas the average cattle fattening experience in urban areas was 7.25±2.73 years (Table 6). These findings were in agreement with Abebe (2014) who reported that more than 75% of interviewed farmers had long experience of cattle fattening greater than five years in the Chiro district. Dadi *et al*. (2017) reported that feedlot operators had experience of about 1 to 10 years in the business in East Shoa Zone. Ahmed (2018) also reported feedlot operators as having average cattle fattening experience 5.6±3.4 years with ranges of 1 to 13 years in Dessie and Kombolcha town.

3.2.2. Criteria *in selecting* of *animals for fattening in the study area*

The fatteners used criteria to select cattle for fattening purposes based on body size (index = 0.29) and condition (index = 0.21) (Table 7). Large framed with goody body condition animals that are able to fatten are preferred. The health and sex of the animal were also important criteria for selecting fattening animals. This result was similar to the finding of Demissie (2016) and Ayalew *et al.* (2018) who reported that the selection criteria of fattening cattle were frame size of animals in Bonke district and Gondar town, respectively.

Table 6: Experience of cattle fattening practice in urban and peri-urban area

Parameter	Fattening system (Mean ±SD)			P-value
	Peri-urban (N = 72)	Urban (N = 40)	Overall (N =112)	
Experience(year)				
Maximum	17	12	17	0.000
Minimum	4	2	2	
Average	10.24±3.48	7.25±2.73	9.17±3.65	

Table 7: Selection criteria of animals for fattening purpose in the study area

Parameter	Weight of frequency							Index	Rank
	1st	2nd	3rd	4th	5th	6th	7th		
Selection criteria									
Body size	97	10	5	0	0	0	0	0.29	1st
Body condition	45	27	8	9	3	0	0	0.21	2nd
Health	21	33	17	0	6	5	0	0.17	3rd
Sex	15	7	3	38	0	0	0	0.12	4th
Price	0	13	35	0	8	0	0	0.11	5th
Age	9	5	38	3	0	0	0	0.10	5th

3.2.3. Cattle breed type *used for fattening in the study area*

According to the respondents, the cattle breed types used for fattening in the study area were local breeds (64.3%), crossbreeds (9.8%) and both local and cross breeds (16.07 %) as presented in Table 8. This result was in agreement with the findings of Gebremichael *et al. (*2017) and Ayalew *et al. (*2018) as they reported that the majority (86.1% and 58.5%) of the respondents preferred local breed type for fattening purposes in and around Mekelle, and Gonder towns, respectively. This might be due to the easy availability of local breed types than crossbred types in the study area.

Table 8: Type of cattle breed for fattening in urban and peri-urban areas

Parameter	Peri-urban (N = 72)		Urban (N = 40)		Overall (N = 112)	
	Frequency	(%)	Frequency	(%)	Frequency	(%)
Availability of breed type						
Local breed	49	68	23	57.5	72	64.3
Crossbreed	8	11.1	3	7.5	11	9.8
Both breed	14	19.44	4	10	18	16.07

3.2.4. Cattle age selection for fattening in the study area

The most preferred cattle age for fattening in the study area was matured oxen (66.1%) followed by young bulls (18%). However, about 10.5% of the respondents fatten cattle from all age groups. This result is in agreement with the report of Tadesse (2018) and Ayalew (2018) who reported the preferred age type of cattle for fattening were matured oxen in West Hararghe Zone and Gonder town, respectively. However, the results disagree with Moreda (2016) who reported that the most preferred animal for the traditional fattening in the Lume district was older oxen (56.7%).. This might be due to the enforcement of market preference in the study area after finishing of fattening period in order to sell their fatten cattle.

3.2.5. Sex and castration condition of cattle for fattening in the study area

Based on the survey results, all (100%) the respondents preferred male cattle for fattening purposes due to the fact that male cattle fatten within a short period of time and have a higher meat yield than female animals. Female cattle are needed for reproduction purposes, female cattle are not preferred

by farmers due to pregnancy in the middle of a fattening period and less market demand than males. This result is in agreement with the finding of Gebremichael *et al.* (2017) who reported that all (100%) of the interviewed farmers use male animals in and around Mekelle town and Amhed (2018) who reported that cattle fatteners (100%) in the urban and peri-urban kebeles of Dessie and Kombolcha town fatteners did select male cattle for fattening purpose. Similarly, Tadesse (2018) reported that the majority of respondents (88.1%) preferred to fatten male cattle in the West Hararghe Zone.

As to the castration condition, all (100%) of urban and most (93%) of peri-urban cattle fatteners used non-castrated male animals for their fattening program. This is probably due to the current market demand for intact animals rather than castrated animals. This result was consistent with the finding of Fikru (2015) who reported that cattle fatteners prefer to fatten steers and bulls than castrate in the Harshin districts of the Somali region and Tadesse (2018) who reported that most (75%) of the respondents preferred fattening of intact (non-castrated) bulls in Habro woreda. However, this result was inconsistent with the finding of Demisse (2016) who reported that the majority (86.7%) of fatteners were engaged in castrated cattle fattening than non-castrated cattle in the Bonke district. Ahmed (2018) reported that the majority (68.2%) of fatteners in Dessie and Kombolcha towns were engaged in castrated cattle fattening.

Table 9: Sex and castration preference in cattle fattening around urban and peri-urban areas of Bahir Dar Special Zone

Variables	Peri-urban (N = 72)		Urban (N = 40)		Overall (N = 112)	
	Frequency	%	Frequency	%	Frequency	%
Sex of the animal used for fattening						
Male	72	100	40	100	112	100
Castration condition						
Castrated	5	6.9	0	0	5	4.5
Intact	67	93	40	100	107	95.5

3.2.6. Season and duration of cattle fattening in the study area

All the urban respondents (100%) fatten cattle in all seasons of the year. In the peri-urban on the other hand, most of the fatteners (61%) considered spring and winter as the most suitable seasons for their fattening program. This might be due to seasonal patterns of feed availability, suitable environmental conditions and better market demand in these seasons (charismas and Easter). The survey result was in agreement with Dadi *et al.* (2017) who reported that the majority of feedlot operators considered January to March and October to December to be the most suitable seasons to start fattening operation in East Shoa Zone.

The duration of cattle fattening the study area is presented in Table 10. Most of the fatteners (63.4%) fattened cattle for three months. This was in agreement with the findings of Beyene (2017) and Belayneh *et al* (2021) who reported that the majority of fatteners were fattened their cattle for three months. Similarly, Addisu (2016) reported that the duration of fattening in North Western Ethiopia was usually 3 months. However, the current results disagreed with the results of the traditional cattle fattening system in the Ilu Aba Bora Zone of Oromia Regional State where the minimum cattle fattening period was 4 months (Ayalew *et al.*, 2013).

Table 10: Duration of cattle fattening in urban and peri-urban areas in Bahir Dar special zone

Variables	Peri-urban (N = 72)		Urban (N = 40)		Overall (N = 112)	
	Frequency	(%)	Frequency	(%)	Frequency	(%)
Duration of fattening						
One month	3	4.2	0	0	3	2.7
Three month	43	59.7	28	70	71	63.4
Four month	17	23.6	12	30	29	25.9
Above four month	9	12.5	0	0	9	8

3.2.7. Frequency of cattle fattening and when to stop fattening

According to the results of the present study, about 58.3% and 27.5% of the respondents in peri-urban and urban areas, respectively, fattened cattle three times per year while about 67.5% of the respondents in the urban area practices fattening throughout the year. The main reason is due to the fact that the majority of fatteners have butcher shops in Bahir Dar town. Only 6.3% of the respondents in the study area practiced fattening once per year. These results are in disagreement with the findings of Ayelaw (2013) in Ilu Aba Bora and Moreda (2016) in Lume district where the majority of respondents practiced fattening once in a year. Likewise, Ahmed (2018) reported that most of HHs (68.2%) fattened cattle once per year in Dessie and Kombolcha towns.

The majority of the respondents (76.78%) in the study area decided to finish fattening based on the body condition of the animals, which is in line with the report of Demisse (2016) where 90% of the respondents in the Bonke district of Gamo Gofa Zone decided to finish the fattening period based on the body condition of the animals.

Table 11: Frequency of fattening and criteria to stop the fattening period in urban and peri-urban areas of Bahir Dar Special Zone

Variables	Peri-urban (N = 72)		Urban (N = 40)		Overall (N = 112)	
	Frequency	(%)	Frequency	(%)	Frequency	(%)
Frequency of fattening per year						
Once per year	7	9.7	0	0	7	6.3
Twice per year	11	15.3	2	5	13	11.6
Three times per year	43	58.3	11	27.5	53	47.3
Four times per year	12	16.7	27	67.5	39	34.8
Criteria for finishing period						
Body condition	58	80.6	28	70	86	76.78
Anticipated future price	6	8.3	7	17.5	13	11.6
Feeding length	8	11.1	5	12.5	13	11.6

3.2.8. Number of cattle fattened per fattening cycle in the study area

The mean number of cattle fattening per cycle was 8.08±4.096 fattening cattle with a range of 6 to 28 animals. The numbers of cattle fattened per cycle in the study area are presented in Table 12. The mean number of 6.68±3.65 fattening cattle was fattened per cycle per HH with a range of 3 to 20 cattle in the peri-urban areas. Whereas, the average number of 10.6±3.66 fattening cattle were fattened per cycle per HH with a range of from 6 to 28 animals in the urban areas. This result was greater than the finding of Belayneh *et al* (2021) who reported the average mean of 2.24±2.74 fattening cattle per HHs per fattening cycle ranged from 2 to 30 in the study area of the Dangila district and Ahmed (2018) who reported that the average numbers of 4.0±3.1 fattening cattle were fattened once per HHs per fattening cycle ranged from 1 to 19 in Dessie and Kombolcha town. Based on the maximum number of cattle used for fattening

in this study, the cattle fattening practices in the current study areas are categorized under the small-scale cattle fattening category.

Table 12: Number of fattened cattle per fattening cycle in urban and peri-urban areas in Bahir Dar Special Zone

Parameter	Peri-urban (N = 72)	Urban (N = 40)	Overall (N = 112)	P-value
Number of cattle fattened/cycle				0.000
Maximum	20	28	28	
Minimum	3	6	3	
Average	6.68±3.65	10.6±3.66	8.08±4.096	

3.3. Feed resource and feeding system of cattle fattening in the Study Area

3.3.1. Major feed resources

Feed resources used for cattle fattening in the peri-urban areas were natural pasture (grazing), crop residues (millet straw, teff straw, wheat straw and maize Stover), concentrate (wheat bran and Niger seed cake, pea and lentil straw), local brewery by-products (*attela and brint*) and others (browse trees) as presented in Table 13. On the other hand, the major feed resources in the urban areas were agro-industrial byproducts, conserved grass, crop residue, and local beverage. The most important crop residue was maize Stover followed by finger millet (Table 14). Local beverage by-products (*attela and brint*) were occasionally supplemented to improve the utilization of crop residues in both the peri-urban and urban study areas. The present findings are similar to the results of Belayneh *et al* (2021) and Addisu (2016) who reported the use of crop residue for cattle fattening. Similarly, Lijalem *et al. (*2016) reported natural pasture, sugarcane, *frushika*, and crop residues were the major feed sources while during dry season crop residues, *atela*, sweet potato, maize stalker and natural pasture were the major feed sources in the midland of southern Ethiopia.

Table 13: Major feed resource used for cattle fattening in urban and peri-urban areas of Bahir Dar Special Zone

Variables	Weight frequency							Rank
	1	2	3	4	5	6	Index	
Peri-urban farm								
Crop residue	33	14	11	9	5	0	0.23	1st
Natural pasture (grasses)	24	11	9	13	0	8	0.21	2nd
Conserved grass (hay)	18	10	15	16	3	0	0.19	3rd
Local beverage by-product	21	15	12	7	0	0	0.14	4th
Agro-industrial by-product	13	19	17	5	0	0	0.14	5th
Improved forage	0	0	7	22	3	2	0.09	6th
Urban farm								
Agro-industrial by product	10	13	11	4	5	4	0.63	1st
Conserved grass (hay)	3	10	12	5	0	0	0.26	2nd
Crop residue	3	7	3	0	0	0	0.06	3rd
Local beverage	0	0	3	12	0	0	0.06	4th

Table 14: Type of crop residue used in the study area

Variables	Weight of frequency			Index	Rank
	1	2	3		
Type of crop residue					
Maize Stover	72	0	0	0.51	1st
Finger millet	31	0	0	0.22	2nd
Teff straw	0	35	0	0.17	3rd
Oil seed straw	0	0	45	0.11	4th

3.3.2. Cattle feeding system, feed provision and feeding frequency

According to the survey result, all respondents (100%) in urban and peri-urban practiced stall feeding system while fattening their cattle. These results are in line with the findings of Wolde *et al.* (2014) who reported that about 89.54% of respondents provided both basal and supplementary feeds in a stall feeding system in southern Ethiopia. However, the results of the current study are inconsistent with that of Beyene (2017) who reported about 69.01% of the farmers practiced feedlot system/stall feeding during fattening in the Horoguduru Wollega Zone of Oromia Region.

All (100%) the respondents in the study area did not provide feed for fattening cattle based on body weight. With regards to feeding frequency of fattening cattle in the study area, the majority (44.7%) of respondents fed their animal twice per day but the rest (45.5% and 20.5%) of respondents fed their animal three times per day and depending on appetite, respectively.

Table 15: Feed provision, feeding system and frequency during cattle fattening in urban and peri-urban areas of Bahir Dar Special Zone

Parameter	Peri-urban (N = 72)		Urban (N = 40)		Total (N = 112)	
	Frequency	(%)	Frequency	(%)	Frequency	(%)
Feeding system						
Stall feeding	72	100	40	100	112	100
Free grazing	0	0	0	0	0	0
Feed provision for animals						
Body weight based feeding	0	0	0	0	0	0
No body weight based or feeding	72	100	40	100	112	100
Frequency of feeding						
Twice per day	24	33.3	26	65	50	44.7
Three times per day	43	59.7	8	20	51	45.5
Depending on appetite	17	23.6	6	15	23	20.5

3.4. *Housing types used for cattle fattening in the study area*

Housing system used for cattle fattening in the study areas were own constructed houses (29.5%), adjacent houses (42%) and separate rooms from the main house (22.3%). These results disagreed with the findings of Belayneh *et al* (2021) who reported the housing systems for cattle fattening were separately constructed houses (92.5%), adjacent houses (5.5%) and separate rooms from the main house (2.0%) in Dangla district. Similar results were also reported by Beyene (2017) where the dominant housing type commonly used was a separately constructed house (97.9 %) in Horoguduru Wollega Zone. It also disagrees with results of Demissie (2016) where the dominant housing types commonly employed was separated rooms in the family house.

3.5. Monitoring of body measurement of beef cattle in the study area

3.5.1. Morphological measure of beef cattle

The quantitative measure of conformational traits of beef cattle reared under farm management is summarized in Table 16. All morphometric measurements were significantly different ($p<0.05$) among the sample beef cattle population in the peri-urban and urban beef cattle fattening systems.

In the second measuring of final beef cattle body conformation, the overall least-square means of body length, chest width, thurl width, heart girth, back depth, chest depth, height at wither, height at the rump, rounding of rips, body weight were 110.05±0.61 cm, 77.32±1.379 cm, 71.43±0.784 cm, 171.38±3.942 cm, 91.10±0.88 cm, 85.28±1.94 cm, 136.88±0.80 cm, 136.88±0.79 cm, 91.53±0.9 cm, 47.57±0.61 cm, 425.33±20.63 kg, respectively. These measurements were found higher than the initial body conformation measurement values. Therefore beef cattle body conformations in the study area were varied with quantitative body measurement.

All the body measurements, in the peri-urban and urban, also showed $p<0.05$, except body length, chest width, height at the rump, and wither height. These results agree with other reports (Desal *et al.,* 1992; Gilbert *et al.,* 1993).

3.5.2. Live weight change of fattened cattle in the study area

The mean initial and final body weights of the cattle were 348.75±22.12 and 425.33±20.63 kg, respectively. There was a significant difference ($p<0.05$) in final body weight between initial body weight groups. The average initial body weights of animals in -peri-urban and urban fattening systems were 200.93±1.56 kg and 291.2±1.53 kg, respectively.

The mean initial body weight of animals at the beginning of the fattening period in peri-urban fattening farms was significantly lower than that of in urban fattening farms (Table 17). The higher initial body weight of fattening animals recorded in the urban fatteners may be due to the fact that those fatteners prefer to purchase large body frame animals with good body condition at the beginning for fattening. These results are different from Belayneh *et al* (2021) who reported that the mean initial and final body weight of the cattle were 291.4±0.54 and 365.44±1.51 kg, respectively. There was a significant difference ($p<0.05$) in final body weight between initial body weight groups.

Table 16: Initial and final fatten beef cattle body conformation measurement

Morphological trait	Initial body conformation measurement (Mean ±SE)	Final body conformation measurement (Mean ±SE)
Body length	109.22±0.766	110.05±061
Back length	76,.02±1.417	77.32±1.379
Chest width	45.68±1.035	47.57±0.611
Thurl width	67.58±1.425	71.43±0.784
Heart girth	164.35±3.738	171.38±3.942
Back depth	90.37±2.073	91.1±0.88
Chest depth	50.40±0.982	85.28±1.936
Height at wither	131.43±1.217	136.88±0.785
Height at rump	130.80±1.093	136.88±0.8
Rounding of rips	91.49±2.158	91.53±0.9
Body weight	348.75±22.124	425.33±20.63

Table 17: On-farm measuring of live body weight conformational trait on beef cattle

Variables	HH	IBW (kg) (M±SE)	FBW (kg) (M±SE)	TBWG (Kg) (M±SE)
Overall mean	60	348.75±22.124	425.33±20.63	76.58±1.49
Production system				
Peri-urban	30	200.93±10.66	291.53±24.526	81.6±13.87
Urban	30	496.57±19.26	559.13±20.623	62.56±1.36
Weight group				
Small	18	163.44±7.186	269±11	105.56±.82
Medium	10	244.40±10.41	378 .95±13.79	134±3.38
Large	32	485.59±19.598	561.97±17.88	76.38±1.72

4. Conclusions

The average age of households in the study area, 29-49 years, are young and active age groups to participate actively in cattle fattening practice. The participation of female households in cattle fattening activity was insignificant and this might signify how far most of them were at a distance of access for better financial resources. Mature oxen and young intact bulls were the most preferred cattle for fattening. The body conformation and condition of the animals are the prior selection criteria for fattening cattle. Crop residue in the peri-urban and industrial byproducts in the urban area is the most important feed sources for cattle fattening. Both in the peri-urban and urban fatteners use local beverage by-products (*atela* and *brint*) that were occasionally supplemented to improve the utilization of crop residues in the study area. Even though there is a long time of experience, a beef fattening practice should be supported by planning like other agricultural.

Data availability statement

Data will be made available on request.

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Conflicts of interest

The authors declared that there is no conflict of interest.

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