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Assessment of Dairy Feed Resources and Feeding Frequencies in Selected Urban and Peri-Urban Areas of Central Highlands of Ethiopia

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Abstract: The study was conducted to assess available feed resources, feeding and watering frequencies of dairy cows. Four districts from urban and peri-urban areas of Assela, Bishoftu Holetta and Sululta were purposively selected based on their high potential for dairy production. Informations were collected from 160 randomly selected dairy farmers using pre-tested semi-structured questionnaire. When data were analyzed ninety five percent of farmers from urban Bishoftu, 90% from urban Sululta, 85% urban Holetta, 75% from peri-urban Bishoftu and 55% from urban Assela claimed shortage of land to expand from dairy and for grazing. Fifty five percent farmers from peri-urban Assela and 45% from peri-urban Sululta used land for crop production and mixed crop production and grazing. Crop residue/s and concentrates were frequently used dairy feeds in urban Bishoftu as reported by 65% interviewed farmers. Grass hay, crop residue/s and concentrates were regularly used dairy feeds in urban and peri-urban Sululta as indicated by 55% of the interviewed farmers. However, 35% of interviewed farmers from urban Holetta indicated their use communal pasture for grazing and supplement hay, crop residue/s and concentrates to their dairy. Thirty of interviewed farmers from peri-urban Sululta responded they have private pasture and hay, crop residue/s and concentrates were used as supplements. In urban Assela, Holetta and peri-urban Sululta 50%, 45% and 40%, respectively of the respondents mainly feed wheat and barley straws for dairy cattle. The daily feeding frequencies of supplements were twice in urban Sululta, peri-urban Holetta, urban Holetta, urban Bishoftu, peri-urban Bishoftu and peri-urban Sululta and three times in urban and peri-urban Assela. Watering was mainly once and twice per day. It could be concluded that shortage of land for cultivation of modern dairy feed, for grazing and dairy expansions was a limiting factor to farmers. The feed resources used and feeding frequencies showed great variation among the farmers in the study areas. Continuous creation of awareness on feeding dairy cows should be given to farmers.

Key words: Concentrate · Crop Residue · Dairy Farmers · Land Use · Water

INTRODUCTON

The majority of the cattle population is found in the highlands of Ethiopia where about 44% of the agricultural human population is residing [1]. The livestock serve as a source of food, income and foreign exchange to the Ethiopian economy and contributes 12 and 33% of the total and agricultural gross domestic product (GDP), respectively and accounts for 12-15% of the total export earnings [2]. In Ethiopia the introduction of high yielding dairy breeds mainly Holeistain Frisian and Jersey from abroad and crossbreeding with indigenous cattle has been pursued to improve milk production [3, 4].

Livestock feed resources in Ethiopia are mainly obtained from natural and improved pastures, crop residues, forage crops, agro-industrial by-products and non-conventional feeds [1]. Additionally, Adugna *et al*. [5] stated that in Ethiopia the mainly available livestock feed resources include natural pastures, crop residues, cultivated forage and pasture crops as well as agro industrial by-products.

Urban and peri-urban dairy production is developed in and around major cities and towns located mainly in the highlands of Ethiopia and depends on purchased concentrate and roughage feeds with limited grazing [6]. The authors further stated that urban dairy systems in

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general are located in cities and/or towns for production and sale of fluid milk, with little or no land resources, using the available human and capital resources mostly for specialized dairy production under stall feeding conditions. The system comprises small and medium sized dairy farmers that own crossbred dairy cows. Milk production is dependent on season due to the rainfall pattern that influences feed availability [7].

As the Ethiopian highlands are inhabited by huge human and livestock populations more efficient utilization and management of available feed resources may help to improve livestock production in sustainable manner. Therefore, the objective of the present study was to assess available feed resources, feeding and watering frequencies of dairy cattle.

MATERIALS AND METHODS

Descrption of Study Areas: The assessments of existing feed resources, feeding and watering frequencies were conducted in Assela, Bishoftu, Holetta and Sululta towns.

Assela town is located in Oromia region, Central Ethiopia and the capital of Arsi zone. It is located at about 175 km Southeast of Addis Ababa at 7°57'N and 39°7'E with an altitude of 2430 meters above sea level. Agricultural production system of the study area is of mixed crop and livestock production. Dairy farming using improved breeds is a common practice in urban and peri-urban areas [8].

Bishoftu is located at 45 km along the Southeast of Addis Ababa, the capital of Ethiopia at 9°N latitude and 40°E longitude and at 1850 meters above sea level. The annual rainfall is 866 mm, of which 84% are in the long rainy season from June to September. The annual average temperature ranges from 12.3°C to 27.7°C with an overall average of 18.7°C [9].

Holetta is among the places that are known to be potentially high for dairy production, located between 38.5 E longitude and 9.8°N latitude and an elevation of 2400 meters above sea level. It is situated in the central highlands of Ethiopia. The average annual rain fall and temperature is about 1200 mm and 18°C and the average monthly relative humidity is 60%. The seasons are classified into dry, short rainy and long rainy which last from October to February, March to May and June to September, respectively [10].

Sululta district is one of the six districts of Oromia Special Zone Surrounding Finfinne of Oromia National Regional State. The districts' capital town, Chancho, is 40 kms away from Addis Ababa towards the North-west. It lies on the geographical coordinates of 9° 11' 0" N latitude, 38° 45' 0" E longitude. The area is characterized by shallow valley with an elevation of 2500 meters above sea level, almost completely surrounded by mountains with numerous small rivers which drain into the Muger River. The average annual temperature in Sululta is 14.7 °C with an average rainfall of 1119 mm [11].

Sampling Procedures and Sample Size Determination: A cross sectional study involving non probability selection of study sites but probability type of dairy farms and farm owners from the urban (Town) and peri-urban (Around the town) areas were conducted. The four towns, namely Asella, Bishoftu, Holetta and Sululta towns and their peri-urban areas were purposively selected as they have large number of dairy farms. The sampling frame of smaller administrative area (Locally kebele) and dairy farms were obtained from respective district's livestock and agriculture development offices of each area. Depending on the frame lists and information obtained two smaller administrative areas from each production systems were purpesively selected based on the availability of crossbred dairy cattle and dairy production experiences. Dairy farms were then randomly selected from each Keble and questioned. Before the formal survey, a pre-test survey was conducted to collect general background information about the study areas. The information that was collected in the pre-test survey helps to guide the development of actual survey questionnaire.

The sample size was determined according the formula given by Arsham [12] for survey studies: $N=0.25/SE^2$ Where, N = sample size; SE = Standard error of dairy farms. Accordingly, by considering standard error of 3.95% with 95% CI (confidence interval) as follows, $N=0.25/(0.0395)^2$ =160; a total of 160 dairy farms were selected by random sampling method from all study sites.

Data Collection and Analysis: A comprehensive open-ended and close-ended type semi-structured questionnaire was prepared and used to collect information. The information that was collected includes land use and ownership, dairy feed type, feed availability, feeding and watering fequencies. The collected data was analyzed using SPSS [13] version 20 and descriptive statistics was used to present results.

RESULTS AND DISCUSSION

Land Use and Ownership: Ninety five percent of dairy farmers from urban Bishoftu and 90% from urban Sululta responded they totally don't have separate land for dairy

production. Details of land availability and use are indicated in Table 1. In Bahir Dar and Gondar Yitaye *et al*. [14] also reported that in urban areas, 70% of the farmers do not have access to farm land which was lower than the current values in urban Bishoftu, Holetta and Sululta areas. The differences could be attributed to the recent rapid population growth and urbanization in urban areas. The current results highlighted that higher proportion of the available owned land in peri-urban areas was used for crop production, forage production and grazing systems. Comparable to these results, in West Shoa zone of Oromia region, Bainesagn [15] indicated that land holding for crop which was owned and rented in rural and per-urban areas was higher than in urban areas. Similarly, the author further stated that land for grazing and forage and irrigation was higher in peri-urban and rural areas.

Common Feed Resources: According to the response obtained from the respondents, in urban Bishoftu, peri-urban Bishoftu, urban Assela, peri-urban Assela as well as urban and peri-urban Sululta crop residue/s and concentrates and hay, crop residue/s and concentrates, respectively were the commonly available feed resources used for dairy cattle (Table 2). In urban Holetta, communal pasture, hay, crop residue/s and concentrates were reported as frequent feed resources. On the other hand, private pasture, hay, crop residue/s and concentrates were common dairy feed resources in peri-urban Sululta.

Crop residues, concentrates (mainly from agro industrial by-products), hay, communal pasture, private pasture, improved forage and backyard forage were the commonly used dairy feed resources in the present study areas. Comparable to the current results, in Bahir Dar town and Dangla areas the major sources of livestock feed resourses were natural pasture, hay, crop residues and concentrates [16]. Yitaye *et al.* [17] and Azage *et al*. [6] also noted that the major roughage feed resources for dairy animals across all the different Ethiopian production systems include natural pasture/grasslands, grass hays, crop residues and non-conventional feed resources. Sintayehu *et al*. [18] in Shashemene area, Yitaye [19] Northwest Ethiopia and Kechero *et al*. [20] in Jimma Zone further reported that natural grazing lands, crop residues, pasture, forage crop and agro-industrial by-products were the main livestock feed resources. In Meta Robi district, West Showa Zone, natural pasture and crop residues such as wheat straw, barley straw were the dominant feed resources but agro-industrial by products such as noug seed cake, linseed cake, molasses, brewery by products, non-conventional feed and improved forage were uncommon and rarely used [21]. These were not similar to the present results which could be due to feed availability, price and management systems.

Types of Available Crop Residues: As summerized in Table 3, in urban Assela, urban Holetta and peri-urban Sululta, respectively wheat and barley straws were the main crop residues used as basal diet for dairy cattle. Additionally, in urban and peri-urban Bishoftu, urban Assela and peri-urban Holetta were used wheat straw as a basal diet for their dairy cattle. Wheat and teff straws were also used in peri-urban Bishoftu. Interviewed farmers in urban Sululta stated that teff straw as the main crop residue used in dairy feeding practices.

In the present study, wheat straw, barely straw and teff straw were the main crop residues. Similarly, Solomon and Alemu [22] reported that teff, wheat and barley straws were the major crop residues available in the highlands. In Gondar town crop residues such as wheat, barley, teff straws and maize thinning were used by farmers as basal diets for dairy animals [23]. Abate *et al*. [24] as well noted that straw from maize, sorghum and teff were used mainly during the dry season in south eastern parts of Ethiopia. In urban Assela, urban Holetta and peri-urban Sululta of the current study wheat and barley straws were the dominantly used crop residues. However, around Ziway barley straw was the most preferred feed by dairy owners followed by maize stover [25]. The differences could be attributed to the variations in availability and farmers awareness.

Frequency of Providing Feed Supplements: According to the response obtained from the present study, most of the respondents in urban Sululta, peri-urban Holetta, urban Bishoftu, urban Holetta and peri-urban Bishoftu, respectively practiced feeding supplements twice a day for dairy cattle. While, farmers from urban Assela, peri-urban Assela, peri-urban Sululta, peri-urban Bishoftu, experienced feeding supplements three times per day (Table 4).

As described in DeVries *et al*. [26] increasing the frequency of feed delivery has been shown to modulate the feeding patterns of lactating dairy cattle with cows fed more frequently, spending more time feeding, increase the distribution of feeding time over the course of the day and improve access to fresh feed for all cows and this idea help the current feeding practiced in the study areas.

Table 1: Land use and ownership in the study areas

		Study areas							
		Assela		Bishoftu		Holetta		Sululta	
Variables	Responses (%)	U n=20	PU n=20	U n=20	PU n=20	U n=20	PU n=20	U n=20	PU n=20
Land use	No land	55	15	95	75	85	55	90	40
	Crop production	40	55	0.0	25	15	15	0.0	15
	Forage production	0.0	0.0	5	0.0	0.0	0.0	0.0	0.0
	Crop and forage production	0.0	25	0.0	0.0	0.0	15	0.0	0.0
	Crop production and grazing	5	5	0.0	0.0	0.0	5	10	45
	Crop and forage production, grazing	0.0	0.0	0.0	0.0	0.0	10	0.0	0.0
	Overall	100	100	100	100	100	100	100	100
Land ownership	No access to land	55	15	95	75	85	55	90	40
	Own	45	80	5	10	15	35	10	55
	Lease	0.0	5	0.0	15	0.0	10	0.0	5
	Overall	100	100	100	100	100	100	100	100

n = number of respondents; U= Urban; PU= Peri-urban

Table 2: Main feed resources used for dairy cattle in urban and peri-urban areas

		Study areas							
		Assela		Bishoftu		Holetta		Sululta	
Variables	Responses (%)	U n=20	PU n=20	U n=20	PU n=20	U n=20	PU n=20	U n=20	PU n=20
Common feed resources	Crop residue/s and concentrates	40	35	65	45	0.0	0.0	0.0	0.0
	Hay, crop residue/s and concentrates	10	10	0.0	0.0	25	25	55	55
	Backyard forage (e.g. enset), crop residue/s and concentrates	50	5	20	25	0.0	0.0	10	0.0
	Hay during winter, crop residue/s and concentrates	0.0	15	5	0.0	0.0	0.0	0.0	0.0
	Improved forage during spring and summer, crop residue/s and concentrates	0.0	15	5	5	0.0	0.0	0.0	0.0
	Concentrates, crop residue/s and wet grass in summer time	0.0	0.0	5	0.0	0.0	5	0.0	0.0
	Communal pasture, hay, crop residue/s and concentrates	0.0	5	0.0	15	40	0.0	0.0	0.0
	Private pasture, hay and concentrates	0.0	0.0	0.0	5	10	0	0	5
	Hay and concentrates	0.0	0.0	0.0	0.0	10	15	20	0.0
	Private pasture, hay, crop residue/s and concentrates	0.0	15	0.0	0.0	10	20	15	30
	Communal pasture, private pasture, crop residue/s and concentrates	0.0	0.0	0.0	0.0	5	5	0.0	5
	Private pasture, hay, improved forage, crop residue/s and concentrates	0.0	0.0	0.0	5	0.0	30	0.0	5
	Overall	100	100	100	100	100	100	100	100

n = number of respondents; U= Urban; PU= Peri-urban; Concentrates or agro-industrial by-products (Mainly by-products of different agro-industries including flourmills, oil mills and industrial brewery residues)

Table 3: Types of crop residues used by the dairy owners in each area

		Study areas							
		Assela		Bishoftu		Holetta		Sululta	
Variables	Responses (%)	U n=20	PU n=20	U n=20	PU n=20	U n=20	PU n=20	U n=20	PU n=20
Types of crop residue/s	Wheat and barley straws	50	15	25	10	45	15	5	40
	Wheat straw	40	25	50	40	15	35	5	5
	Barley straw	0.0	0.0	0.0	0.0	5	10	0.0	10
	Wheat, barley and teff straws	0.0	60	10	5	0.0	20	15	20
	Wheat and teff straws	0.0	0.0	15	45	5	5	0.0	5
	Wheat straw, barley straw and bean haulms	10	0.0	0.0	0.0	5	0.0	0.0	5
	Teff straw	0.0	0.0	0.0	0.0	0.0	0.0	55	5
	No use of crop residue/s	0.0	0.0	0.0	0.0	25	15	20	10
	Overall	100	100	100	100	100	100	100	100

n = number of respondents; U= Urban; PU= Peri-urban

Table 4: Frequency of feeding feed supplements for dairy cattle in the study areas

		Study areas							
		Assela		Bishoftu		Holetta		Sululta	
Variable	Responses (%)	U n=20	PU n=20	Un=20	PU n=20	U n=20	PU n=20	U n=20	PU n=20
Supplements feeding frequency	Once per day	0.0	5	0.0	0.0	0.0	0.0	0.0	0.0
	Twice per day	10	25	70	65	70	90	95	55
	Three times per day	85	60	30	35	30	10	5	45
	Four times per day	5	5	0.0	0.0	0.0	0.0	0.0	0.0
	No supplements	0.0	5	0.0	0.0	0.0	0.0	0.0	0.0
	Overall	100	100	100	100	100	100	100	100

n = number of respondents; U= Urban; PU= Peri-urban

Table 5: Frequency of water provision for dairy cattle in the study areas

		Study areas							
		Assela		Bishoftu		Holetta		Sululta	
Variable	Responses (%)	U n=20	PU n=20	U n=20	PU n=20	U n=20	PU n=20	U n=20	PU n=20
Frequency of water provision	Roam freely	5	0.0	55	30	10	10	0.0	5
	Once per day	45	90	15	5	25	10	40	15
	Twice per day	15	10	20	35	30	65	45	65
	Three times per day	35	0.0	10	30	30	15	15	15
	Four times per day	0.0	0.0	0.0	0.0	5	0.0	0.0	0.0
	Overall	100	100	100	100	100	100	100	100

n = number of respondents; U= Urban; PU= Peri-urban

In Fafan town, Somali region (Ethiopia) 52.08% and 41.67% respondents were provided feed two times per day for lactating and non-lactating dairy cattle, respectively [27]. The authors further revealed that 41.67% and 20.83% of the farmers in the same area provide with feed three times a day for lactating and non-lactating dairy cattle which was comparable with the present results in urban and peri-urban Assela, peri-urban Sululta, peri-urban Bishoftu, respectively. However, 6.25% and 37.5% of respondents in Fafan town supply once a day for lactating dairy cattle and non-lactating dairy cattle, respectively. Nikkhah [28] also mentioned that feed delivery once per day is labor effective and most desirable for many small and mid-size farms. The differences could be related to varations in feed availablity, management systems and geographical location.

Frequency of Water Provision: As shown in Table 5, many dairy farmers in urban Bishoftu provide water freely for dairy cattle. In peri-urban Assela, urban Assela and urban Sululta, respectively more respondents provide water once a day for their dairy cattle. Futhermore, majority of the respondents in peri-urban Holetta, peri-urban Sululta and urban Sululta, respectively stated the frequency of water provision for dairy cattle was twice a day.

Similar to the water provision in peri-urban Holetta, peri-urban Sululta and urban Sululta of the current study, in the Highland production system (Debre Birhan, Jimma and Sebeta), dairy farmers mostly provide water twice a day for cattle [25]. As reported by Bernabas *et al*. [29] in Alefa district of North Gondar zone, 66.7% of the respondents were also watered their dairy cattle twice per day. About 90% of the respondents in peri-urban Assela of the current study provide water once a day. Comparable to the results, a study in Mekelle city noted that 65.6% of respondents were watered their animals once a day [30]. About 38% of the respondents in Quara district of North Gondar zone were watered their dairy animals once, twice and three times a day, respectively which were similar to the present results in urban Sululta [29]. Overall, respondents in urban (17.5%) and peri-urban (11.3%) areas of the present study provide water *adlibitum* for dairy cattle. Inconsistent to these current

results, a study in Adigrat, Tigray by Alemshet [31] noted that 28.9% respondents in urban and 15.25% respondents in peri-urban areas provide water *adlibitum* for dairy animals. The differences might be attributed to differences in feed type and water availablity.

CONCLUSIONS

There is shortage of land in the study areas particularly in urban dairy production system. Crop residues, concentrates, hay, communal pasture, private pasture, improved forage and backyard forage were the common feed resources used for dairy cattle. Wheat straw, barely straw and teff straw were the main crop residues. Provision of feed supplements and water was mainly practiced twice a day. Dairy cattle require close management attention to give better productivity. Therefore, further activities must be done by all stakeholders with regard to proper use of available feed resources, feeding and watering practices by creating awarness as well as introducing facilities to dairy producers.

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