Tropical and Subtropical Agroecosystems, 17 (2014): 539 - 546

FEED RESOURCES QUALITY AND FEEDING PRACTICES IN URBAN AND PERI-URBAN DAIRY PRODUCTION OF SOUTHERN ETHIOPIA

[CALIDAD DE LOS RECURSOS ALIMENTICIOS Y PRÁCTICAS DE ALIMENTACIÓN EN SISTEMAS DE PRODUCCIÓN LECHEROS URBANOS Y PERIURBANOS DEL SUDESTE DE ETIOPIA]

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SUMMARY

The study was conducted in urban and peri-urban areas of Southern Ethiopia to assess the quality of available feed resources and feeding practices in the area. Shashamane city was considered as urban, while Kerara Filicha, Kuyera and Arsi Negele were considered as peri-urban production system. Structured questionnaire, secondary data sources and field observations were employed to generate data. A total of 60 dairy farmers from urban and 60 from peri-urban (Kerara Filicha =20, Kuyera = 20 and Arsi Negele = 20) were selected for the study. Average herd size per farm in urban area was 5.08±0.35 out of which small and medium scale farms had 2.6±0.2 and 7.5±0.29 crossbred cattle, respectively. In peri-urban areas average herd size per farm was 4.7±0.34 crossbred cattle out of which 2.3±0.16 were in small and 7.06±0.24 in medium scale farms. Fifteen major feed types used by dairy farms were identified in the area and categorized into five classes: grazing, green feeds, crop residues, agro-industrial by-products and non-conventional feeds. The result of the study indicated that wheat straw and *teff* straw were the main basal diets in the study area. Laboratory analysis of major feed resources indicated that crop residues had CP, digestibility and metabolizable energy contents of 2.9-5.9%, 46.6% and 5.9-8.7MJ/kg DM, respectively. About 50% of small and 51.7% of medium scale farms use roughage feeds as a major feed source. Therefore, from the current study it was concluded that the quality of available basal roughage feed is generally low and needs strategic supplementation with protein and energy rich feeds.

Key words: Feed quality; feeding practices; urban; peri-urban; dairy production; Ethiopia.

RESUMEN

El estudio se realizó en áreas urbanas y periurbanas del sudeste de Etiopía para evaluar la calidad de los recursos alimenticios y prácticas de alimentación animal en el área. La ciudad de Shashamane fue considerada zona urbana mientras que Kerara Filicha, Kuyera y Arsi Negele fueron considerados zonas de producción periurbana. Se emplearon cuestionarios estructurados, fuentes secundarias de información y observaciones de campo. Se seleccionaron 60 productores de leche de la zona urbana y 60 de la zona periurbana (20 por cada sitio). El tamaño promedio del hato del área urbana fue de 5.08±0.35, contando las granjas pequeñas y de mediana escala con hato de ganado cruzado con un tamaño de 2.6±0.2 y 7.5±0.29 respectivamente. En áreas periurbanas el tamaño promedio del hato fue de 4.7±0.34 y los hatos pequeños y medianos de 2.3±0.16 y 7.06±0.24 respectivamente. Se identificaron 15 tipos de alimentos empleados por los productores de leche, lo cuales fueron categorizados en cinco clases: pastoreo, forraje verde, residuos de cultivo, subproductos agroindustriales y alimentos no convencionales. Los resultados indican que la paja de trigo de teff fueron la principal dieta basal del área. Los resultados de calidad indican que los residuos de cultivos tuvieron un contenido de PC, digestibilidad y energía metabolizable de 2.9-5.9%, 46.6% y 5.9-8.7 MJ/kg MS, respectivamente. Cerca del 50% de las granjas pequeñas y 51.7% de las de mediana escala emplearon forraje como principal alimento. Por lo tanto, se concluye que la calidad del alimentos base disponible es en general de baja calidad y requiere una suplementación estratégica con alimentos ricos en energía y proteína.

Palabras clave: Calidad de alimentos; prácticas de alimentación; producción urbana; producción periurbana; producción lechera; Etiopía.

INTRODUCTION

In Ethiopia, market-oriented urban and peri-urban milk productions are emerging as main suppliers of milk and dairy products to the cities. They possess both indigenous and crossbred dairy animals ranging from 50% to high grade Friesian breeds in small, medium and large sized farms. They depend on purchased roughage and concentrate feeds with limited grazing for milk production (Kelay, 2002; Sintayehu *et al*., 2008, Azage *et al.*, 2013). However, the productivity of these animals is very low due to lack of appropriate nutritional management, health care, marketing system, extension and training (Azage and Alemu, 1998). Lack of appropriate nutritional management indicates that inadequacy of feed in terms of quality and quantity. Livestock feed resources in Ethiopia are mainly derived from natural pasture/grasslands, crop residues, improved pasture, forage crops, agro-industrial by-products and non-conventional feeds (CSA, 2012). The contribution of these feed resources, however, depends up on the agro-ecology, the types of crop produced, accessibility and production system (Seyoum *et al.*, 2001; Ahimed *et al*., 2010). Seasonal variations in quantity and quality of the forages are a major concern especially during the dry season. The crude protein (CP) content of pastures is lower than the forage crude protein content of 7 percent which would cover the maintenance requirements of ruminants (McDonald *et al*., 1995). Deficiencies in nutritive value of natural pasture stress the importance of supplementation with energy and nitrogen especially during the dry season. Different research works point out different percentage on the contribution of various livestock feed resources. This may be due to the wide range of ecological variation between different localities in the country and also variation in time which in turn results with variation in crop species and cropping intensity. So location and time specific feed resource assessment is required in order to know the feed gap between feed supply and feed requirement within specified animal production level.

MATERIALS AND METHODS

Description of the study area

Location: The study was conducted on private urban and peri-urban dairy farms in and around Shashamane city, which is one of the potential areas for milk production in Southern Ethiopia. The area is located at a distance of 230 to 260km south of the capital Addis Ababa. The area relieves an annual rain fall of 800- 1300mm; characterized with different altitude ranges of 1900 and 2200 meters above sea level and average minimum and maximum temperature of 12 and 27°C, respectively.

Sampling methods

A preliminary visit was conducted in the study area to get general picture of the study sites and to identify the target farms. Thus, dairy farms in Shashamane and three associated peri-urban areas were purposively identified based on their potential to produce milk and supply to Shashamane city. For the purpose of this study, the farms were stratified into urban and peri-urban sub-systems. Each production sub-system was further stratified into two based on herd size: small holders (farms with less than four cows) and medium level (farms with 4-10 cows); Ike (2002).

There were a total number of 593 dairy farms keeping crossbred cattle in the study area, of which about 69% were urban and 31% were peri-urban farms. For this study a total of 120 dairy farms, of which 60 were from urban and the remaining 60 were from peri-urban dairy systems, 30 from each farm scale (small and medium size) were purposively selected. Following identification of dairy farms, semi-structured questionnaires were developed and pre tested before commencement of the actual survey. Information was gathered by interviewing the household heads and farm managers.

Feed sampling and chemical analysis

Representative samples of feed resources commonly employed by the farms during the study period were collected monthly and samples of the same feed type were bulked together. They were thoroughly mixed and sub sampled. Wet feed materials were allowed to lose moisture under shed before transportation. The air dried samples were taken to Hawassa University Animal Nutrition Laboratory and dried in an oven at 60^{o}C for 48 hrs and ground in Willey mill to pass through 1mm sieve and allowed to equilibrate at room temperature for 24 hrs. The ground samples were kept in air tight containers pending analysis for chemical composition.

Feed samples were analyzed for DM and Ash using the standard procedures of AOAC (1990). Nitrogen (N) content was determined by Kjeldahl method and Crude Protein (CP) was calculated as N*6.25 (AOAC, 1995). The organic matter was calculated as difference between 100 DM and ash content. Acid Detergent Fiber (ADF), Acid Detergent Lignin (ADL), Neutral Detergent Fiber (NDF), and *In vitro* Digestible Organic Matter in the Dry Matter (IVDOMD) was determined by the modified Tilley and Terry method (Van Soest and Robertson, 1985). Metabolizable Energy (ME) content of a particular feed was estimated from IVDOMD and as per the following equations: ME (MJ/kg DM) =

0.015*IVDOMD (g/kg) (MAFF, 1984). The study was conducted from August to December 2012.

Statistical analysis

Both quantitative and qualitative data collected during the survey were analyzed using Statistical Analysis System software (SAS, 2004). Descriptive statistics such as means, percentages, standard error of mean and frequency distributions were used to describe the qualitative and quantitative variables in the production system.

RESULTS

Occupational status of households

Overall, about 29.2% of interviewed dairy farms owners were owned by dairy cow producers (those whose livelihood depend mainly on dairy cow rearing/that engaged only in dairy production), followed by farmers (21.7%), traders (19.2%), household wives (10.8%), government employees (10.8%), and retired persons (8.3%). Across the two farm scales, 48.3% of medium scale farms and 10% of small scale farms were owned by households that engaged only in dairy production (Table 1). Among the production systems, about 5.3% of urban and 43.3% of peri-urban households were engaged in both dairy production and crop farming activities.

Inventory of feed resources and feeding practices

In this study, fifteen different feed types were identified and categorized into five classes: grazing, green feeds (purchased green grass, green maize stover and elephant grass), crop residues (wheat straw, *teff* straw, haricot bean straw and maize stover), agro-industrial byproducts (wheat bran, linseed cake, brewery waste and mixed concentrates) and non conventional feeds (*atela* and mill byproducts). Two major feeding systems were identified in the study area: semi-intensive and stall feeding/zero grazing. Non conventional feeds, particularly, local liquor residue (*atela*) was highly used as major feed source in peri-urban farms.

Chemical composition of commonly used feed stuffs

The dry matter (DM) content of green feeds varied from 17% in elephant grass to 30.61% in green maize stover. The crude protein (CP) content of different green feeds was 8.2%, 12% and 14% for purchased green grass, green maize stover and elephant grass, respectively. The mean *in vitro* digestible organic matter in the dry matter (IVDOMD) for green feeds was about 54.9%.

The mean DM content of crop residues was 92.3%, which corresponds with Solomon (2004) and Sisay (2006). The CP content of crop residues varied from 2.98% in wheat straw to 5.97% in haricot bean straw. The energy content of crop residues ranged from 5.96 MJ/kg DM in wheat straw to 8.79 MJ/kg DM in maize stover.

Table1: Major occupational status of interviewed households in urban and peri-urban dairy farms in Shashamane milk shed.

	Household head occupation (%)					
Variables	Housewife	Trader	Dairy farming only	Farmer	Civil servant	Pensioner
Production system						
Urban (n=60)	16.7	23.3	28	5.3	15	11.7
Peri-urban (n=60)	5	15	25	43.3	6.7	5
Karara Filicha (n=20)	-	5	25	60	-	10
Kuyera (n=20)	5	25	20	40	10	-
Arsi Negele (n=20)	10	15	30	30	10	5
Herd size						
Small (n=60)	15	26.7	10	23.3	15	10
Medium (n=60)	6.6	11.7	48.3	20	6.7	6.7
Overall (n=120)	10.8	19.2	29.2	21.7	10.8	8.3

n= number of household heads

Table 2: Feeding systems and major feed types used by urban and peri-urban dairy producers in Shashamane milk shed.

Variables	Production sub-systems				
	Urban		Peri-urban		
	Small (n= 30)	Medium (n=30)	Small (n=30)	Medium (n=30)	Overall (n=120)
Feeding systems (% Farms)					
Stall feeding (zero grazing)	100	100	86.7	96.7	95.8
Semi intensive	0	0	13.3	3.3	4.2
Main Feed types (% Farms)					
Grazing/foraging	0	0	3.3	0	0.8
Green feeds	10	6.7	6.7	6.7	7.5
Crop residues	36.7	43.3	50	46.7	44.2
Agro-industrial byproducts	36.7	40	6.7	13.3	24.2
Katikala atela and mill byproduct	16.6	10	33.3	33.3	23.3
Type of mineral supplements					
Common salt	96.7	93.3	93.3	96.7	95
Multi nutrient block	3.3	3.3	0	0	1.7
Boji	0	3.4	6.7	3.3	3.3

n= number of households, *atela* = residue of locally produced beverage, *Boji*= locally available mineral salt.

Table 4: Chemical composition and nutritive value of commonly used feed resources in the study area.

Feedstuff		Chemical composition (% DM)							Nutritive values	
	DM (%)	Ash	OM	NDF	ADF	EE	Lignin	CP	IVDOMD (%)	ME *
Green feeds										
Purchased green	28.02	10.7	89.3	75.8	41	1.3	6.43	8.2	51.58	7.73
Green maize stover	30.61	7.6	92.4	62.3	66.55	1.2	6.24	12	61.7	9.25
Elephant grass	17	16.2	83.8	51.9	57.2	1.5	7.2	14	51.4	7.71
Crop residues										
Wheat straw	92.45	8.8	91.2	78.6	58.1	0.7	12.6	2.98	39.74	5.96
Tef straw	93.9	7.84	92.16	81.5	46.8	1.12	9.23	4.34	43.35	6.5
Haricot bean straw	89.86	7.58	92.42	76.1	63.32	0.9	17.02	5.97	44.57	6.68
Maize stover	93.6	9.29	90.71	82.13	51.72	0.64	9.54	4.56	58.65	8.79
Agro-industrial byproducts										
Linseed cake	93.23	8.5	91.5	25.1	9.52	9.13	5.14	29.8	67.1	10.06
Nouge seed cake	92.2	10.92	89.08	34.75	26.73	5.94	6.98	32.1	63.12	9.46
Wheat bran	90.06	4.28	95.72	38.19	9.39	4.3	2.52	16.98	77.7	11.65
Commercial mix	91.4	6.92	93.08	36.86	25.7	4.5	6.38	22.7	67	10.05
Brewery waste	23.5	4.83	95.17	77.2	38.8	8	9.9	27	61.25	9.18
Non conventional Feeds										
Katikala Attela	17.4	4.9	95.1	58.8	23.5	3.6	10.3	20.6	78.4	9.76
Mill by-products	91.73	10.2	89.8	39.2	35.6	9.2	5.52	19.2	69.02	10.35

Katikala Atela = by-product of local beverage.
*MJ/kg DM

The neutral detergent fiber (NDF) content of crop residues ranged from 76.1% in haricot bean straw to 83.8% in maize stover. Acid detergent fiber (ADF) contents of crop residue varied from 46.8% in *teff* straw to 63.32% in haricot bean straw. Metabolizable energy (ME) content of commonly used energy supplements such as wheat bran, commercial mix, mill byproducts and *atela* varied from 9.18 to 10.05 MJ/kg DM. *Atela* had relatively lower energy content compared to wheat bran and mill by-products. Among the protein supplements, *atela* had slightly lower CP (20.6%) than nouge seed cake (32.1%), linseed cake (29.8%) and brewery waste (27%). Wheat bran and mill by-product had lower CP content of 16.98% and 19.2%, respectively, compared to other supplementary feeds.

Herd size and composition

The average herd size of crossbred cattle per household in the urban area was 5.08±0.35 with medium farms having average of 7.5±0.29 and small farms 2.6±0.2 cattle. In peri-urban area the average herd size was 4.7±0.34 cattle with medium farms having 7.06±0.24 and small farms 2.3±0.16 cattle. In all the systems, farmers possessed dairy cows followed by heifers as their future herd replacement animals. Distributions of cows on their productive state showed that among the total number of cows in urban farms about 37.4% were pregnant and milked, 28.6% milked and non pregnant, 31.7% were dry pregnant and 2.3% were dry and non pregnant, whereas, the values in peri-urban farms were 34.3% pregnant and milked, 33.7% milked and non pregnant, 26.4% dry pregnant and 5.6% were dry and non pregnant. In both cases, higher numbers of cows were pregnant and lactating.

Table 5: Herd size and composition of crossbred cattle in Shashamane milk shed by production sub-system and herd size.

Variables	Production sub-systems					
	Urban			Peri-urban		
	Small (n=30)	Medium (n=30)	Mean ±SE	Small (n=30)	Medium (n=30)	Mean ±SE
Herd size (mean ±SE)	2.6±0.2	7.5±0.29	5.08±0.35	2.3±0.16	7.06±0.24	4.7±0.34
Herd composition (mean ±SE)						
Cows	1.53±0.09	4.1±0.23	2.8±0.21	1.64±0.1	4.3±0.19	2.9±0.2
Milking cows	1.06±0.08	2.6±0.13	1.85±0.12	1.3±0.08	2.9±0.17	2.1±0.14
Pregnant milking (%)	30.4	40	37.4	22	39	34.3
Non pregnant milking (%)	39.2	24.8	28.6	56	25	33.7
Dry cows	0.47±0.09	1.5±0.14	0.95±0.1	0.34±0.08	1.5±0.21	0.9±0.13
Pregnant dry (%)	26	33.6	31.7	16	30.5	26.4
Non pregnant dry (%)	4.4	2.3	2.3	6	5.5	5.6
Heifers (1-3 years age)	0.43±0.09	1.5±0.17	0.9±0.12	0.3±0.08	0.96±0.14	0.6±0.09
Pregnant (%)	38.5	45.7	44	33.3	41.4	39.5
Non pregnant (%)	61.5	54.3	56	66.7	58.6	60.5
Heifer calves (1-11 months)	0.44±0.09	1.2±0.15	0.8±0.09	0.26±0.09	0.8±0.13	0.5±0.08
Male calves (1-18 months)	0.2±0.07	0.4±0.09	0.3±0.06	0.1±0.07	0.8±0.13	0.46±0.09
Breeding bulls	0.0	0.3±0.08	0.15±0.01	0.0	0.2±0.03	0.1±0.02
Dominant cattle breeds (% Farms)						
Friesian crosses	100	96.7	98.3	93.3	90	91.7
Friesian crosses and local zebu	0.0	3.3	1.7	6.7	10	8.3
Presence of other species of animals (sheep, poultry and donkey) (% Farm)	16.7	100	58.3	26.7	100	63.3

n= number of respondents, SE= standard error

DISCUSSION

The involvement of farmers in dairy production in the current report was higher than 13.7% reported for Sebeta Awsa area (Dereje, 2012). Higher involvement of farmers in dairy production in the current report might be related to attractive market access in the area. Generally, the result of this study indicates that dairying is the major occupation for the majority of the interviewed household head dairy producers in area.

Stall feeding practice in urban area might be related to shortage of grazing lands in urban areas. Similar result was reported for Addis Ababa milk shed (Yoseph, 1999) and Dire Dawa city (Emebet, 2006) in which grazing/foraging was not practiced by urban dairy farms.). The lower use of agro-industrial byproducts by peri-urban farms may be related to less availability of these feed types and more availability of local liquor residue (*atela*) in the area. Opposing to the current report, agro-industrial by-products were used as main feed source by 25.8% and 24.2% of peri-urban small and medium farms respectively, compared to 20.9% and 22.6% of small and medium farms, respectively, in urban farms of Sebeta Awas areas (Dereje, 2012). Higher use of non conventional feed in peri-urban farms may be related to high production potential of *Katikala (Areki)* in the area (particularly Arsi Negele and Kuyera areas).

The result of the current study was in agreement with 7.96 MJ/kg DM energy content of green feeds in Sinana area (Solomon, 2004). Crude protein value for wheat straw in the current study was lower than 4.1% reported in Sinana area (Solomon *et al*., 2008). All crop residues evaluated had lower CP contents than the minimum level of 7% CP required for optimum rumen microbial function (Van Soest, 1982). The mean *in vitro* digestible organic matter in the dry matter (IVDOMD) for crop residues was 46.6%, which is lower than the minimum level of 50% required for quality roughages (Mosi and Butterworth, 1985; Seyoum and Fekede, 2008). Lower crude protein contents of crop residues may be compensated with supplementation of feeds rich in protein to improve cattle performance. The NDF and ADF contents of crop residues in the current report was higher than the range of 66.5% to 77.2% for NDF and 42.4% to 54.2% for ADF reported for central Ethiopia (Seyoum and Fekede, 2008). Neutral detergent fiber (NDF) contents of more than 55% limits dry matter intake (Van Soest, 1982). Hence, the crop residues assessed in the current study area could affect feed intake of dairy cattle unless supplemented with feeds having better nutritional content.

The energy contents for crop residues was within the range reported by Zewdie (2010) for central highlands, but higher than reported by Solomon (2004) for Bale highlands. Differences might be due to difference in management practices, soil fertility and/or crop variety used. The energy content of a*tela* (9.76 MJ/kg DM) reported in this study was lower than 11 MJ/kg DM reported by Nega *et al*. (2006) which could be due to differences in the chemical composition and type of grains used as a raw material to produce this by-product.

Similar herd size per farm was reported in Hawassa city (Haile *et al*., 2012) where the average herd size in the urban areas was 5.48± 0.49 cattle. Similarly, Ike (2002) reported average herd size of 6.23±4.39 cattle in peri-urban areas of Hawassa. Higher herd size of 3.2 and 11.3 cattle was reported for small and medium scale farms, respectively, in Dire Dawa city (Emebet and Zeleke, 2007). Higher proportions of pregnant milking cows in urban and peri-urban farms might be related to long lactation length in the area. The proportion of dry cows in this study was higher than the ideal recommended value of 17% set by Radostits *et al*. (1994). Keeping these herds require extra expenses for their feeding and other management. Compared to the current study, high percent (14%) non pregnant dry cows were reported by Mohamed *et al.* (2003) in Harar milk shed.

CONCLUSION

Therefore, from the current study it was concluded that the quality of available basal roughage feeds is generally low and strategic supplementation of protein and energy rich feeds should be required. In relation with the increasing market price of concentrate and roughage feeds, other optional feeds like fruit waste and other non-conventional feed resources should be further considered.

Acknowledgements

The authors are grateful to the Oromia Agricultural Research Institute for financially supporting this study.

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