

Analysis of Fluid Milk Value Chains at Two Peri-Urban Sites in Western Oromia, Ethiopia: Current Status and Suggestions on How They Might Evolve

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Abstract: The study was conducted to analyze fluid milk value chains at two peri-urban sites in western Ethiopia. The objectives were to determine the characteristics of the dairy farm households, map the fluid milk value chains prevailing in the areas and identify actors involved and their roles and pinpoint value chain constraints and finally suggest interventions required for improving the performance of the value chains. Data on household attributes indicated the majority of the farms to be male headed, with an overall mean of 90%. As to educational status, 50% of them fell in 7-12 grades range, 23% being diploma holders and 10% with BA/BSc degrees and above. A respective 29% and 75% of the respondents at Nekemte and Bako practice crop and livestock mixed farming, with dairying used as source of addition income for the family. The key value chain stages identified were: input supply, production, marketing (distribution), processing and consumption. No formal fluid milk value chains were observed to prevail. Among the key inputs used, feed was found to be very critical; improved forage production was observed to be low; with farmers depending more on low quality roughages and purchased concentrates. The study also revealed the existence of inefficient breeding and veterinary services. Few private veterinary drug suppliers existed, but they are only limited to veterinary drug vending. Shortage of land was also observed to be one of the factors hindering successful evolution of the value chains at both sites. Women were observed to be highly involved in diverse dairy related activities, mainly milking and milk processing. Both local and cross-bred animals are kept, mean daily milk yield of local breeds being 1.79 lts day⁻¹ at Bako and 1.78 lts day⁻¹ at Nekemte. Daily milk yields of crosses were 6.54 lts day⁻¹ and 9.79 lts day⁻¹ at Bako and Nekemte, respectively. In general, no formal milk marketing system exists in both areas. Generally, productivity of dairy animals was poor at both sites, being attributed to various technical and non-technical factors and potential strategic directions to alleviate the challenges and lead to improvement of the value chains were finally suggested.

Key words: Peri-urban dairy • Value chain • Value chain actors • Technical constraints • Value chain framework • Enabling environment.

INTRODUCTION

Ethiopia has a huge potential for dairy development, with the number of milking cows estimated to be around 9.9 million heads [1]. Cattle milk constitutes the larger proportion of the milk produced nationally (83%), with the remainder coming from goats and camels [2].

The sub-sector is facing a number of constraints: pure and cross-bred dairy cattle account for less than 1%; their productivity is low [1] and the quantity and quality of feed resources used in feeding them is inadequate [3]. A recent study [4] also indicated that only 0.15% of farmers practice on farm improved forage production and use of protein and energy feeds is negligible (0.8%).

Similarly, market-orientation of the sub-sector was reported to be limited due, among others, to high transaction costs [5].

Urban and peri-urban dairy production is one of the dairy production systems prevailing in Ethiopia. It involves the production, processing and marketing of milk and milk products channeled to urban centers [6]. The system has evolved in response to ever increasing demand for milk in urban areas, induced by expanding urbanization, rising per capita income and increasing cost of imported milk and milk products [7]. The sub-sector contributes to overall development through income and employment generation, food security, asset accumulation, poverty alleviation and improved nutrition [4].

Value chain in the present context is used to refer to a range of actors and activities from production to consumption and the dynamic relationships between actors involved in peri-urban dairy production systems [8, 9]. Value chain framework facilitates the mapping and characterization of the activities and actors and their interactions along a commodity value chain and focuses on issues of value creation and market opportunities and linkages. In Ethiopia, use of this framework for analyzing implementation processes of sub-sectoral livestock development interventions under varying contexts has received little attention among practitioners, except for some efforts made to improve the clarity of the concept recently [10] and few case studies reported from rural production settings of the country [9, 11]. Based on the nature of dairy production system being studied, milk value chain may consist of various stages which, among others, can include: input supply, production, processing, marketing and consumption. It may also encompass a range of value chain enablers interacting within the border of a given commodity value chain or beyond borders in different ways to sustain the operation of the entire chain than dealing with specific inputs required at a given stage of the chain.

These necessitates visualization of the whole value chain segments from input supply to consumption through a value chain lens and analyze it using a value chain framework to better understand the constraints embedding in the chain and be able to initiate holistic value chain development interventions. To clarify, feed technical inputs for example are very important in ensuring the sustainability of dairy value chains. Research and development programmes in Ethiopia have thus endeavored to alleviate feed related challenges over the past four decades through generation and

dissemination of improved feed technical innovations like forage varieties [11]. Despite these efforts, a number of studies showed limited evidence of adoption of these technical interventions [11-13]. This has often been attributed to limited knowledge of farmers on improved forage production, low level of technical support provided to them, low priority given to forage development compared to staple crops and limited availability of forage seeds, among others [14]. Over years the main focus has been on dissemination of feed technical interventions, with less consideration given to other constraints of the value chain.

While the contribution of feed technical options in improving the efficiency of a given livestock commodity value chain is incontestable, existing evidences indicate that specific technical interventions alone may not be sufficient unless accompanied by other matching interventions other than feed and considerations of non-technical factors influencing performance of value chain of interest [11, 13, 15]. This suggests the need for employing comprehensive system assessment tools like value chain framework to diagnose the whole segments of the chain and propose holistic intervention strategies [9, 11, 14, 15]. Furthermore, it is now widely accepted that technological interventions are better adopted when they are integrated with other complementary interventions than when trickled down in a piecemeal manner [9, 11].

The objective of this study was to analyze the peri-urban fluid milk value chains prevailing at the two case study sites using a value chain framework and identify the key value chain segments and the actors involved in various activities along the chains. It was further endeavored to assess constraints embedded in the chains to be able to suggest realistic value chain improvement strategies.

MATERIALS AND METHODS

Location: The study was conducted at Nekemte and Bako peri-urban areas, respectively located in Guto Gida and Bako Tibe districts of East Wollega and West Shoa Zones of Oromia Regional State, Ethiopia. At these districts, peri-urban dairy development interventions have been going on for the past two decades and farmers owning crossbred dairy cattle and channeling milk to the urban centres are increasing from time to time.

Bako is located at a distance of 256 Km to the west of Addis Ababa. The site receives an annual rainfall of around 1,200mm, 90% of which falls between June and September and located at an altitude of 1560 masl.



Fig. 1: Map showing the locations of the surveyed peri-urban sites

Temperature averages 27°C with a range of 22°C to 31°C. Similarly, Nekemte is located at 331 Km West of Addis Ababa. Based on information obtained from nearby weather station, the altitude of Nekemte is around 1770, ranging from 1,200 to 2,342 masl. The area is characterized by high mean annual rainfall, with values ranging of 1376 - 2037mm and mean minimum and maximum temperature of 15°C and 27°C, respectively [16]. Dominant soil types in both areas are Nitosols with fertile alluvial soils in valley bottoms. Maize, “tef” (*Eragrostis tef*), “noug” (*Guizotia abyssinica*), sorghum and finger millet are the main cereal crops grown in both areas and cattle and small ruminants are important livestock species at both sites. Map showing the study sites is give in Figure 1.

Data Collection: Both primary and secondary data were gathered through a combination of techniques; key informant interview, focused group discussion and personal farm visits and discussion with farmers using semi-structured questionnaires between May 2013 and July 2013. A total of 51 peri-urban dairy farmers innovating with integrated feed and dairy breed interventions were identified in both sites in collaboration with livestock experts, out of which 48 were interviewed for gathering farm level primary data. Two farmers at Nekemte and one farmer from Bako site were excluded from the interview as they have already quit dairy farming and pursued other business activities.

The key informants consulted include heads of zonal and district Agricultural Development Bureaus and Livestock Development and Health Agencies, district level livestock extension experts and AI technicians, livestock researchers at Bako Agricultural Research Centre, heads of zonal and district public veterinary service providers and heads of pertinent NGOs operating at the two sites. A value chain framework was used to identify actors involved and their core functions [10]. Secondary sources of information relevant to the subject were collated from various published and grey literatures and were reviewed to extract additional information to complement the primary data. The qualitative information was systematically summarized and presented by thematic areas and the quantitative data sets were analyzed using descriptive statistical procedures in Statistical Analysis System [17].

RESULTS

General Household Characteristics: Summary of data on selected general household characteristics is presented in Table 1. The majority of households surveyed are male headed (92% at Nekemte and 88% at Bako), with the overall mean for male headed households being close to 90%. The mean age of household head was 48 and 46 years at Nekemte and Bako, respectively. The average family size of respondent farmers was similar across the two sites, being around 7 persons. The majority of the

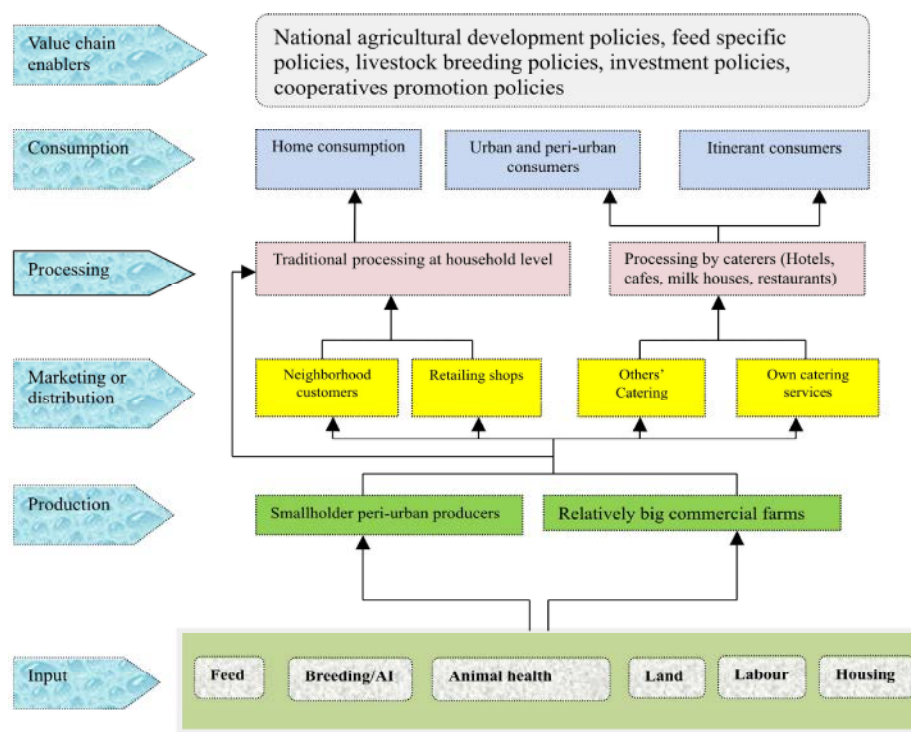


Fig. 2: A generic schematic diagram representing fluid milk value chain at Nekemte and Bako

Source: By authors based on information gathered from the field study

Table 1: Characteristics of the surveyed peri-urban dairy farm households at the two case study sites (Bako N=24; Nekemte N= 24)

Variable		Nekemte	Bako	Overall
Household head [?]	Male	91.67	88.00	89.79
	Female	8.33	12.00	10.21
Age of household head [†]		48.29	46.17	47.23
Family size [#]		7.42	7.25	7.33
Education [?]	Read and write	0.00	8.33	4.16
	1-6 grade	8.33	16.67	12.50
	7-12 grade	33.33	66.67	50.00
	Diploma	41.67	4.17	22.92
	≥ BA/BSc	16.67	4.17	10.42
Career history [?]	Retired employee	12.5	4.17	8.33
	Gov. employee	12.5	8.33	10.41
	Mainly dairying	16.67	0.00	8.33
	Dairy and crop	29.17	75.00	52.08
	Trader	29.17	12.5	20.83

Note: [†]in years; [#] number of persons; [?]% of respondents

household heads are educated, with 50% of them falling in 7-12 grades range, around 23% of them being diploma holders and 10% of them having BA/BSc degree and above. Concerning the career history of the respondents, 13% at Nekemte and 4% at Bako are retired government employees, while 13% of the respondents at Nekemte and 8% at Bako were active government employees. Around 17% of the respondents at Nekemte

are largely reliant on dairying for their livelihood, whereas a respective 29% and 75% of the respondents at Nekemte and Bako are involved in both crop and livestock production systems. The proportion of respondents involved in trade is 29% at Nekemte and 13% at Bako.

Fluid Milk Value Chain Mapping: A generic schematic diagram representing the fluid milk value chain at Nekemte and Bako peri-urban sites and charted based on information gathered in the course of the field study is presented in Figure 2. At both sites, the main value chain segments identified were: input supply, production, marketing (Distribution), processing and consumption. The key actors along the chain include input suppliers, producers, (Traditional) processors and consumers. Under the input supply segment, inputs like feed, heifers and breeding and animal health services, land and labour and housing inputs were found to be important and thus considered in the study. Under milk production segment, prevailing production sub-systems, dairy cow ownership pattern and milk production performance of cows were appraised. Market outlet options for fluid milk and processing and consumption issues were dealt with as well.

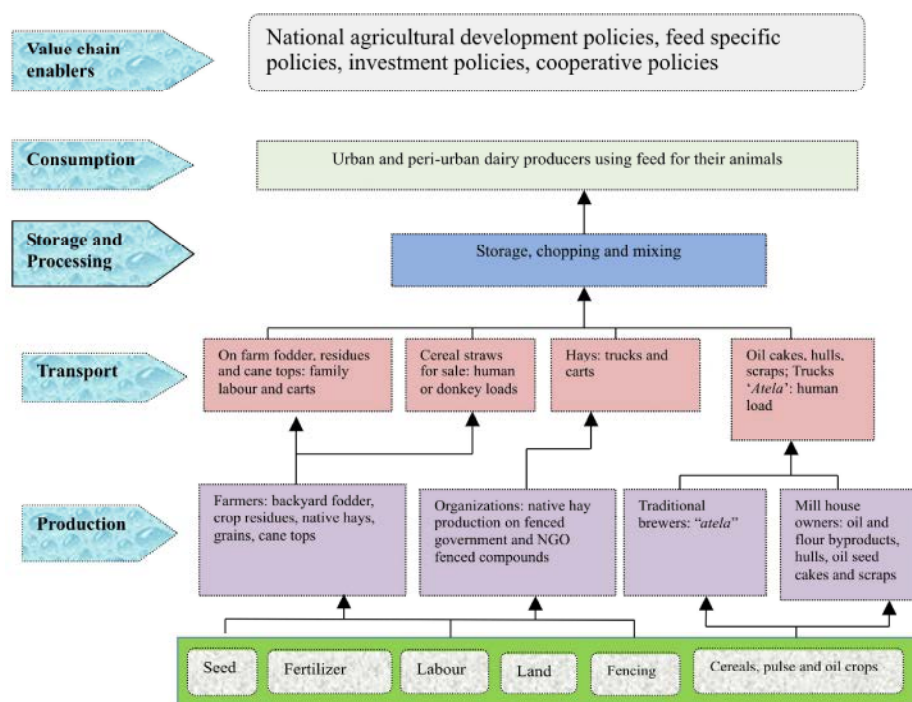


Fig. 3: Peri-urban dairy feed supply chains at the two peri-urban study case study areas
Source: By the authors based on information gathered from the field study

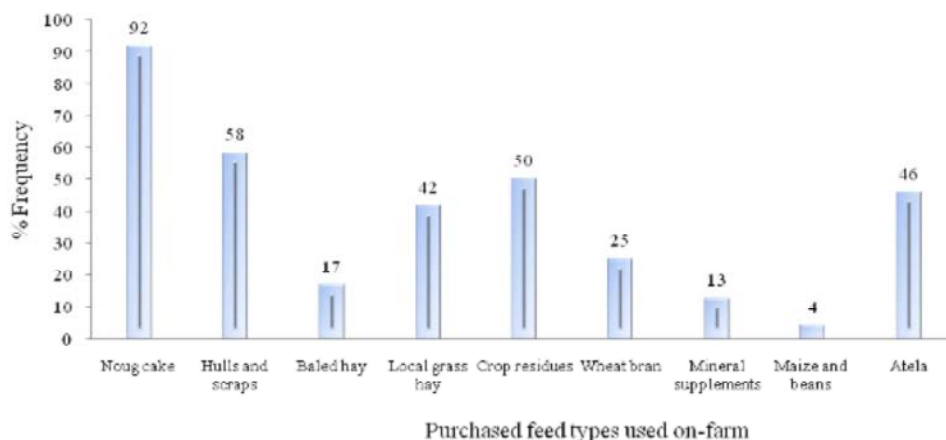


Fig. 4: Percentage frequency of occurrence of purchased feeds across the visited farms at Nekemte

Input Supply

Feed: At both peri-urban sites, feed resources for dairy cattle were observed to be acquired in two ways (Figure 3); on-farm production (For improved forage species and crop residues) and through purchases, in case of oil seed cakes, hulls, mill house scraps and native grass hays.

Grass hays are supplied by native hay producing farmers in nearby rural sub-districts; and by opportunistic hay producers (individuals and organizations) that grow native pastures on their fenced land for sale to peri-urban

dairy producers. Small scale oil and flour processing mills also supply ingredients like oil seed cakes, hulls and mill house wastes. Noug cake is the major concentrate ingredient used as protein supplement. The hulls are mainly sourced from processing of pulse crops mainly faba bean, field pea, chick pea and lentil. The percentage frequency of feeds acquired through purchase across the visited farms at Nekemte is given in Figure 4.

The study showed that noug cake, hulls and scraps from mill houses, cereal straws, mainly of tef and finger millet, 'atela' and local grass hays are the commonly

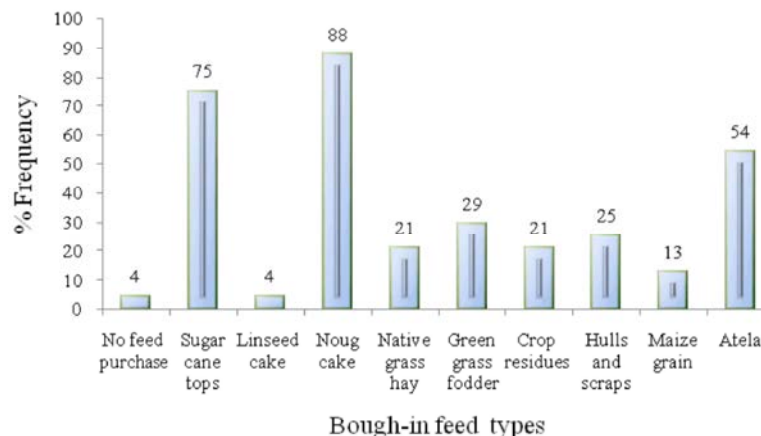


Fig. 5: Frequency of occurrence of different bought-in dairy feeds in Bako peri-urban area (% of respondent farmers; n=24)

Table 2: Some aspects of on farm improved fodder production by peri-urban dairy farmers at Nekemte and Bako (% of respondents; n=48)

Issue	Response	Nekemte	Bako
Do you practice on farm fodder production? (% of all farmers interviewed in each site)	Yes	58.33	66.67
	NO	41.67	33.33
What type of fodder? (% of farmers who practice on farm fodder production)	Private native hay land	28.57	6.25
	Improved fodder species	71.43	93.75
Area of land allocated (ha) forage production	Private native hay land	0.68	0.25
	Improved forage species	0.43	0.44

purchased feeds with a respective frequency of 92%, 58%, 50%, 46% and 42%. The use of wheat bran, baled hay and mineral supplements other than common salt and feed grains was negligible and these are mainly used on relatively big farms with better resources to acquire the ingredients from Addis Ababa area, where a formal and moderately well structured feed supply chain prevails. Maize and soya bean grains primarily obtained from private commercial farms operating in Nekemte area were observed to be used by 4% of the farms; and entirely all visited farms indicated to use common salt as a mineral supplement.

The various feeds purchased for dairy feeding in Bako area are presented in Figure 5. Noug cake (88%), sugar cane tops (75%) and 'atela' (54%) were the widely used feeds at this site. Green grass fodders sold at open market points (29%), native grass hay (21%) and crop residues (21%) are also important at this location. Maize grain was observed to be used on 13% of the farms, where as 4% of the respondents indicated to use linseed cake, indeed purchased and transported from location other than Bako and 4% of the respondents indicated not to use any purchased feed on their farm.

Improved forage species were also important as peri-urban dairy development package element at both sites. Some attributes of improved forage production related activities are presented in Table 2. Accordingly, a respective 58% and 67% of the farmers at Nekemte and Bako claimed to practice improved fodder production on-farm. Their biomass contribution, however, was generally viewed to be negligible. Discussions made with the key informants showed that though considerable commitment for growing improved forage production is expressed by farmers at the time of receiving the feed and breed packages, a tendency of gradually backsliding from improved forage production is often observed. At Nekemte, out of those farmers practicing on farm feed production, 28.6% and 71.43% are involved in native grass hay and improved forage production, respectively; with the area of land under native grass hay and improved forages being 0.68 and 0.43 hectares, respectively.

Similarly, 6% of the farmers at Bako have reported to produce hay on an area of around 0.3 hectares, while 93.8% of them own some land allocated for improved forages, with a mean area of 0.4 hectares. At both sites, improved forage seeds were reported to be sourced from

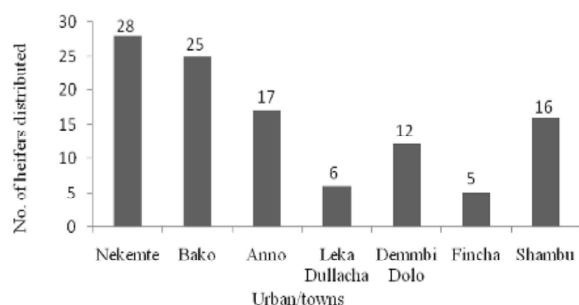


Fig. 6: Number of in-calf heifers distributed to urban/rural towns in the area by BARC

Bako Agricultural Research Center and district level public livestock extension service providers. The forage species commonly used are: Rhodes grass, elephant grass, Sesbania and Leucaena. Absence of irrigation water, prevalence of free grazing and sesbania leaf beetle and intensive management requirement of improved forage crops and labour shortage were mentioned to be the main constraints that farmers face.

Generally, entirely all respondents (100%) pointed out that feed shortage is a critical issue. Lack of land, unavailability of improved seed, low technical knowledge on forage husbandry and shortage and high price of concentrates were challenges that farmers reported to face with regard to feed. Although demand for concentrates is rising, no actor was found to be involved in production or retailing of these feeds in both areas. Some producers were observed to use partial grazing on nearby open grazing sites and these indicated the following problems to be critical: high termite and weed infestation, advance of urban area in to the urban-rural fringe and massive construction works (Residential quarters, stores, teaching and health institutions), among others.

Heifer Distribution and Breeding Services: The Bako Agricultural Research Center is the main actor involved in the supply of cross bred dairy heifers for market oriented peri-urban dairy development in both areas. But the center indicated that it lacks the capacity to engage in this role currently. Indeed, most of the previous initiatives were supported by other external partners like Association for Agricultural Research in Eastern and Central Africa and regional office of the United Nations Development Program. A further challenge that the center is facing at the moment is that the on-station breeding stock maintained for multiplication of cross-bred heifers is fatigued by an outbreak of Contagious Bovine



Fig 7: Liquid N production and semen freezing facilities at Nekemte liquid N production and distribution centre

Pleuro-pneumonia, resulting in interruption of the production and distribution activities of cross-bred heifers.

The number of dairy heifers distributed by the centre is presented in Figure 6. Information collected from the dairy research section of Bako Research Center showed that at least 109 cross-bred heifers were distributed to seven selected urban/semi-urban sites since the year 2000. The relatively big and some smallholder peri-urban farms have reported to acquire dairy heifers from local sources (Like other farmers owning cross bred animals), or from other distant areas like Addis Ababa and/or Debre Zeit.

Regarding the provision of artificial insemination (AI), semen for artificial insemination was reported to be obtained from the National Artificial Insemination Center located in Addis Ababa. Work for establishing new zonal semen production centre in Nekemte is currently underway through financial support obtained from Agricultural Growth Program of the Federal Ministry of Agriculture (MOA). Liquid N production and semen freezing for distribution to various districts is carried out by Nekemte Liquid Nitrogen Production and Distribution Centre. However, the majority of dairy farmers in both sites were observed to be more interested to use natural mating compared to AI, which indeed is induced by the widespread inefficiencies of the latter system.

Veterinary Services: Information gathered from the district trade office revealed the presence of a respective of, seven and three veterinary drug vendors operating at Nekemte and Bako. But the scope of these private veterinary service providers was limited only to veterinary drug vending. Discussions with key informants from district veterinary clinics at both locations revealed the following dairy cattle diseases to be important, among

others: mastitis, chronic bovine pleuro-pneumonia (mainly at Bako) and internal and external parasites. Reproductive health problems like repeat breeding and abortion were shown to be common. Veterinary services were observed to be provided by the public veterinary service providers though the services were rated inadequate in terms financial, material and knowledge resources.

Land: Land is the other important input in peri-urban milk production at both study sites. The study showed that a respective 33% and 21% of farmers at Nekemte and Bako do not own a separate land allocated for dairying and hence keep their animals in residential compounds. A respective 71% and 94% of farmers at Nekemte and Bako were observed to have a piece of land for growing improved forages. Similarly, a respective 25% and 75% of the farmers at Nekemte and Bako were observed to be engaged in crop-livestock mixed farming and thus own land for both operations (Figure 8). At each site, rented-in land for native hay production was owned by 4% of the respondents. Similarly, a respective 29% and 6% of the farmers at Nekemte and Bako, reported to own a piece of privately owned land allocated for production of local grass hay. For producers residing in the areas closer to the urban centers, urban land use for dairying has become an exceedingly contested issue and as a result they are facing pressure from the neighborhood dwellers and local authorities to shut off their farms on account of human and environmental health concerns.

Labour: Labour is also one of the key inputs in peri-urban dairying operations. Figure 9 depicts the different sources of labour for the various dairying activities at Nekemte. Milking was observed to be primarily done by women (50%), followed by hired labour (42%) and women and children (33%). Similarly, milk processing was observed to largely be the activity of women (83%), followed by hired labour (13%). Dairy barn cleaning is mainly carried out by hired labour (54%), followed by women and children (33%).

The sources of labour for major dairy activities in Bako area are given in Figure 10. It was indicated by 88% of the respondents that milking is done by women, followed by hired labour (12%). Similarly, milk processing was reported to be practiced mainly by women (92%) and hired labour (8%). Considerable labour contribution for barn cleaning was reported to come from children (42%),

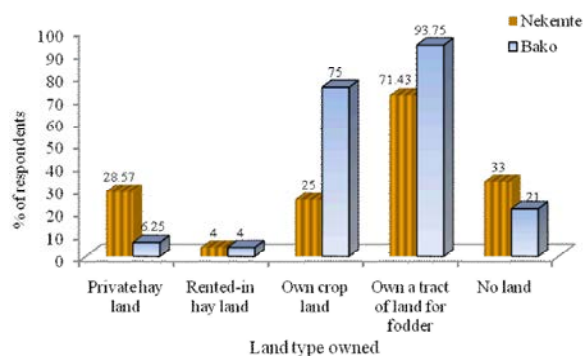


Fig. 8: Land ownership by the type of land possessed at Nekemte and Bako (% of respondents; n=24 at each site)

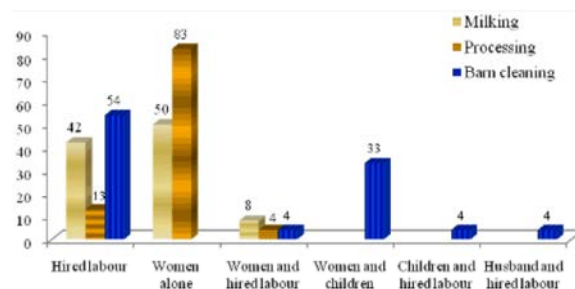


Fig. 9: Source of labour for undertaking different dairy related activities at Nekemte (% of respondents; n=24)

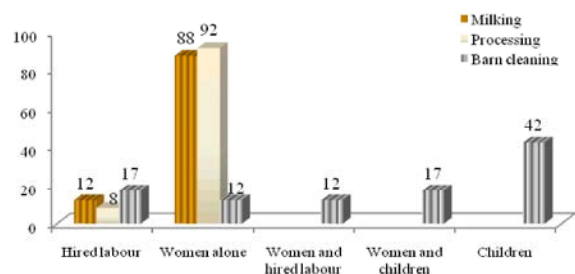


Fig. 10: Source of labour for main dairying activities at Bako (% of respondents; n = 24)

followed by hired labour (17%) and women and children (17%). Equally, 12% of the respondents indicated that both women and children are involved in barn cleaning, while 12% reported cleaning to largely be undertaken by women alone.

Production: Peri-urban dairy farming households are the main operators at this stage of the value chain (Figure 1). Based on the number of animals and status of farmstead structures and facilities available on farm, the peri-urban

Table 3: Household dairy cow ownership by breed type (mean $\pm$ SD; number/household) and daily milk yield per animal (mean $\pm$ SD; in liters) at Bako and Nekemte

Variable		Bako	Nekemte
Cow ownership	Local	1.83 $\pm$ 1.731	0.63 $\pm$ 1.17
	Cross	2.67 $\pm$ 1.88	7.29 $\pm$ 8.12
	Overall	1.23 $\pm$ 1.57	7.29 $\pm$ 8.12
Milk yield	Local	1.79 $\pm$ 1.17	1.78 $\pm$ 0.44
	Cross	6.54 $\pm$ 2.32	9.79 $\pm$ 2.04
	Overall	4.44 $\pm$ 3.04	7.61 $\pm$ 4.02

dairy farms visited were classified into two sub-systems. These are: small-scale and medium sized peri-urban dairy farms. Both sub-systems are available in Nekemte area, but the former predominates at Bako. About 13% of the farms visited at Nekemte are medium-sized farms, while about 88% are small-scale ones.

Table 3 shows dairy cow ownership pattern and daily milk yield of the dairy cattle genotypes under Nekemte and Bako peri-urban conditions. Accordingly, the mean number of local dairy cows owned/household was high at Bako (1.83 $\pm$ 1.71) compared to Nekemte (0.63 $\pm$ 1.17). Conversely, the number of crossbred cattle per household is 2.67 $\pm$ 1.88 for Bako and 7.29 $\pm$ 8.12 for Nekemte. Pooled over the two breeds, the mean number of cows owned/household is high at Nekemte (7.29 $\pm$ 8.12). Daily milk yield is comparable at both sites for the local breeds, while for crossbred cattle yield values for Nekemte exceeded that of Bako by 49.69 %. In the same way, overall milk yield animal⁻¹ day⁻¹ was observed to be higher at Nekemte (7.61 $\pm$ 4.02).

Marketing (Distribution): Fluid milk and processed milk products obtained from traditional processing are the main items traded at both sites. At Nekemte, milk is primarily produced for market purpose and the larger share is channeled through informal market outlets (Figure 8a). All respondents at Nekemte indicated that only little fraction of milk produced is retained for family consumption. Only about 4% of the respondents have reported to allocate the entire milk produced for household use (Figure 8a), while about 13% have indicated to channel their milk through neighborhood consumers. A practice of vertical integration is also evolving in that 17% of the respondents have indicated to channel their milk through own catering service outlets like cafeterias, restaurants or hotels.

Around 4% of the interviewed households have reported to channel milk through own catering and neighborhood customers, while 50% indicated to channel through neighborhood and other customers involved in

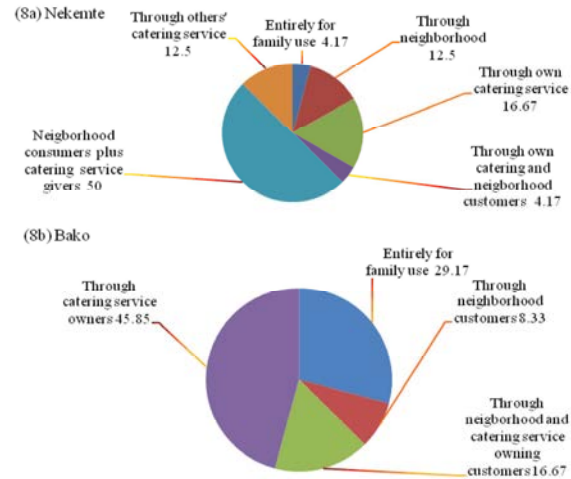


Fig. 8: Milk sale outlets for Nekemte (8a) and Bako (8b) peri-urban areas

provision of catering services. At Bako, 29% of the respondents reported to use the entire milk produced for family consumption, while the majority sale to cafeterias, restaurants or hotels (46%). Milk sale to neighborhood customers and neighborhood plus catering service providers, altogether contributes to 25% at Bako. It was evident that pooled across the sites, the larger proportion of the respondents (67%) channel their milk to neighborhood and catering service providers, followed by 33%, who reported to produce milk for home consumption only. Milk price was observed to not vary widely within each site; price per litre was reported to be 15 Ethiopian Birr at Nekemte and 12 Ethiopian Birr at Bako by entirely all the respondents interviewed.

Processing: The survey showed that no formal milk collection and processing activities prevail at both study locations. Milk processing here thus refers to the act of traditionally converting milk into milk products at home or by catering service providers to derive other milk products. Accordingly, milk is processed into regularly consumed products like plain hot milk, a mix of coffee and milk (*macchiato*), fermented whole milk, butter, traditional ghee, buttermilk and cottage cheese. Dairy farmers and catering service providers are the main actors who process milk into these milk derivatives. At household level, milk processing activities are carried out using traditional processing methods and inputs.

Consumption: At the study sites, milk and milk products are consumed by family members and urban and itinerant consumers. At household level, children are prioritized in

consumption allocation followed by household head and infirm members of the family. Since butter, butter milk and cottage cheese are served with other food items; they are not prioritized among household members. At Nekemte, clarified butter (Traditional ghee), buttermilk and cheese are normally seasoned with different traditional spices and are served with pancake (*injera*), round thick bread locally called '*chumbo*' and a traditional food called '*anchote*'.

Value Chain Enabling Environment: Regional policies essentially crafted to fit regional development priorities within an overall national policy framework have significant roles to play in enabling the performance of a given commodity value chain. Specific policy reforms such as privatization, commercialization, cooperative promotion and gender and poverty focused initiatives and improved allocation of public resources for development of infrastructures are believed to create an enabling environment that would enhance efficiency of value chains. In the present study context, overall regional policy directions enabling dairy value chain development are formulated by the regional council; budget for livestock research and development is allocated by the same; and the same body provides overall political leadership to ensure effective implementation of regionally planned (Feed and dairy) development initiatives in a manner aligned with national development priorities. Regional Bureaus of Investment and Trade and Industry are responsible for investment permits and licensing of private service providers related to feed and dairy development. Regional/district level Bureaus of Finance and Economic Development regulate budget use by public organizations that support sectoral and subsectoral development initiatives; and coordinate activities of NGOs. It was observed that Bureau of Health currently has no significant role in relation to dairy value chain development. But, its future involvement is expected to be crucial in addressing public health concerns related to intensive peri-urban dairy development initiatives.

The Federal Government of Ethiopia has recently instituted independent Livestock Development Department led by a State Ministry within the MOA that caters for livestock development. There are three directorates under this department; (1) Animal Production and Feed Resource Development Directorate, focusing on dissemination of inputs for livestock production and feed resources, (2) Animal Health Directorate, focusing on health and quarantine service provision and regulatory services, (3) Pastoralist Directorate, mandated for the

pastoral areas and dealing with animal health and production issues in the pastoral areas of the country. A new positive move also is the institutionalization of Veterinary Drugs and Animal Feed Administration and Regulatory Authority. This authority focuses on policy issues related to regulatory issues associated with drugs and feed quality and their production processes. The overall regional policy guidance for district level feed and dairy (Livestock) value chain development is provided by district level Livestock Production and Health Agency. Field level evidences generally revealed that coalition between the various policy and support actors is not strong and their efforts are not well aligned, generally resulting in poor complementarity and inefficient use of available development resources made available through both government and NGO sectors.

DISCUSSION

This section is organized under the following sub-sections: dairy household attributes, production input supply issues as mapped in snapshots of milk and feed value chains; and production, marketing, processing and consumption segments of fluid milk value chain.

Household Characteristics: The present study showed that the larger proportion of dairy farmers were male headed and this can partly be explained by the relatively better access of male heads to dairy knowledge sources and other inputs required for peri-urban dairy production. The mean age of household heads pooled across the two sites (47.2 years; $n=48$) was comparable to that of 47.6 ± 1.7 ($n=60$) reported by Zewdie [18], 47.35 ($n=180$) reported by Addis *et al.* [19] and 46.02 ± 0.75 ($n=280$) reported by Biruk *et al.* [21] from similar case studies conducted elsewhere. The larger proportion of household heads were well educated and this is also expected to positively contribute to the success of peri-urban dairying activities, as high levels of education is linked to the ability of accessing, processing and utilizing knowledge of any sort related to dairying [20, 21].

Pooled across the two study sites, only 8% of the households have reported to exclusively depend on dairying for their livelihood and it can be implied that peri-urban dairy farming in the present study sites is thus used as a source of supplementary income for the greater part of the respondents than as a main source of livelihood. In the same way, urban and peri-urban (Dairy) farming activities were reported to be deliberate efforts to provide alternative sources of food and income [22]. This form of

enterprise was also reported to offer considerable employment opportunities to a large proportion of the urban and peri-urban dwellers. In relation to dairying, Mugisa *et al.* [23], for example reported market-oriented peri-urban dairying to serve as a source of income mainly for women farmers.

Input Supply: The study revealed that there was no formal and well structured peri-urban dairy feed supply system at both sites, which concurs with observations reported from related works in other production systems elsewhere in Ethiopia [24]. It was further observed that after integrated peri-urban dairy improvement interventions were initiated by the original value chain development drivers (Research centers and zonal and district level agricultural extension service providers in the present case), other actors such as small scale oil processors, grain millers, opportunistic hay producers, crop residue suppliers and traditional brewers were encouraged to informally co-work with the dairy farmers as feed ingredient suppliers, leading to evolution of informal feed supply actors. Assessment of the perception of the actors involved revealed that the high feed demand induced by the coming in of the intervention turned out to be an opportunity for them for channeling their feed ingredients. From the stand point of value chain innovation, this local informal network is a vital evolution of partnership that has to be nurtured through pertinent innovation support interventions for continuous communication and learning so that the system will go on evolving into self generating local coalition supporting peri-urban dairy feed supply.

Improved forage production and their contribution to on farm dairy feed base was observed to be generally low; biomass output from improved forage plots maintained by farmers was observed to be limited to modest fresh mass cut and carried during or following wet months of the year. No reasonable effort for expanding land area under improved forages and their on-farm use were observed. A partial proof to this is that at both locations, land area under elite forage species was 0.1 units lower than what each farmer innovating with complementary peri-urban feed and dairy breed interventions is anticipated to have, that is 0.5 hectares. In essence, farmers who claimed to produce improved forages were observed to just maintain old and exhausted forage plots as a symbol of their commitment to the terms agreed up on at the time of receipt of the dairy heifers. A general inclination of slighting improved forages and relying more on poor quality roughages and bought-in concentrate ingredients is common. This tendency is arising despite high demand

for and price of milk, an observation incoherent with the widespread view of many thinkers and value chain experts claiming adoption of improved forages to be more enhanced when integrated with market oriented innovation activities [9, 11, 25].

On the other hand, the renting-in of hay land, though practiced by limited number of farmers, is an important innovative practice in feed production. But it is important that farmers practicing hay production on such land or on own hay land targeting peri-urban dairy farmers regularly be given technical support on appropriate pasture management and quality hay production methods as hay quality problems are pervasive across farms.

With reference to breeding and veterinary services, the existing situation was also found to be daunting as was also true elsewhere [26]. While provision of well organized breeding services by way of natural mating or AI is critical for maintaining appropriate blood level, this is not aptly happening in the present study sites. Similar situations have also been reported from a range of earlier studies [27, 28]. Generally, controlled breeding was not practiced and the whole operation was not well organized, suggesting the need for putting appropriate remedial actions in place to circumvent the consequences of uncontrolled breeding. But evidences show that there was no visible remedial measures being taken at grass root levels. As a result, the AI service delivery system was observed to be generally ineffective, characterized by high intensity of repeat breeding, the situation that forced the majority of farmers to incline more to use of natural mating [28].

The dairy cattle diseases and reproductive health problems observed in the present assessment concurs with observations reported earlier by other authors [29, 30]. The widely expressed perception of respondents on the inefficiency of the prevailing veterinary extension service delivery systems at the two sites concurs with reports of other researchers who also described the system as “non-participatory” in nature, operating with experts of “low capacity” and as operating under critical “shortage of...budgets and facilities”, among other features [31]. The presence of few private veterinary drug suppliers, though limited to veterinary drug vending, is a promising trend. However, it is important that necessary technical and regulatory support services be given to these nascent actors so that the system would further evolve into pluralistic, interactive and accountable system. This latter position is also consistent with what has continually been highlighted by many researchers. Azage *et al.* [32], based on information from a large body

of related work, for example, concluded by highlighting that "...the role of the private sector has to be promoted and supported in different forms to ensure proper input supply system".

This study also revealed that shortage of land, particularly for farmers residing closer to urban centers has become a critical issue. The larger proportion of farmers were observed to keep their animals in residential compound and consequently endure pressure from neighboring residents and local administrators to shut off their farms on account of perceived human and environmental health worries. Indeed, this situation is a common phenomenon across urban and peri-urban areas of the country, resulting in substantial decline in the number of dairy cattle managed under these systems. At some point, it is thus vital to seriously think as to how this issue can be settled so that the livelihood of farmers will not be threatened, as despite its limitations this system of dairying serves as a social safety net for the many poor people, mainly women and retired people [23, 33, 35 - 38].

The study also indicated that women are highly involved in on farm dairying activities, milking and milk processing. Additional time and labour burden of women induced by the introduction of cross-bred cows was therefore evident. This is a vital issue as on farm technological innovations increasing the drudgery of women were often noted to have slow rate of adoption than those where work is more uniformly distributed. This situation was even reported to be true under situations where the intervention was reported to improve the welfare of the household as measured by the total income earned [39]. In the same way, Mullins [40] and Price Waterhouse [41] reported women to provide most of the labour required on-farm, yet experiencing limited control over income earned from dairying business. It is thus vital that in the future research on gender differentiated impacts of the current and other similar interventions be assessed as differences in gender divisions of labour and control over incomes are conceivably common across varying production systems in Ethiopia.

Milk Production: The mean daily milk yield of local cows recorded in this study (1.79 lts day⁻¹ for Bako; and 1.78 lts day⁻¹ for Nekemte) was comparable to that reported earlier (1.7 lts) under on-farm conditions [42], but slightly lower than values (2.4 lts day⁻¹) reported under on station management system [43]. The on farm daily milk yield of F1 crossbreds for Bako site was comparable to on-farm yield levels (6.52 lts day⁻¹) reported by Gizaw *et al.* [28].

Similarly, milk yield of crossbreds at Nekemte (9.79 lts day⁻¹) was closer to those values reported by Gizaw *et al.* [28] and Yosef *et al.* [44], which were 9.40 and 9.79 lts day⁻¹, respectively and falls within the ranges of 9-12 lts day⁻¹ reported by Moges and Baars (45). These differences could be due to variations in husbandry systems and extent of exotic blood level of the population studied, among other factors. Taken as a whole, the higher mean milk yield observed at Nekemte site can be attributed to the higher number of cross-bred cows at this site and differences in environmental conditions between the sites.

Marketing, Processing and Consumption Stages:

The absence of formal milk marketing system in the present study sites was in agreement with reports from other parts of Ethiopia. For instance, around 95% of the milk marketed at national level was reported to be channelled through informal market outlets [46], a system typified by direct delivery of fresh milk to immediate neighborhood customers, or catering service providers. Similarly, Muriuki and Thorpe [47] reported that the share of milk sold through formal market in Ethiopia (5%) is much lower than values for Kenya (15%). Relatively large proportion of milk produced at Bako (29% of the respondents) is entirely consumed at home, which can be associated with the low entrepreneurial character of the farmers at this site. This situation can also be linked to the fact that the larger proportion of farmers at Bako (75%; see Table 1) was engaged in crop-livestock production and none of them considered income derived from dairying as a sole source of livelihood. Another likely reason can be the price factor, in that milk price at Bako was relatively low compared to that of Nekemte, which might have depressed the inclination of selling milk at the former location.

Additional interesting situation encountered at Nekemte was that of the inclination of farmers to start own catering services and processing own produce into other milk derivatives. This was viewed to be beneficial for the reason that it reduces market transaction costs that some farmers across the two sites mentioned to face. Though the problem was not overtly talked about as critical during this field study, an important issue at marketing, processing and consumption stages of the value chain and that indeed has to be given due emphasis is that of milk quality and safety and sanitary and phytosanitary standards. This calls for improvement of the capacity of public regulatory actors operating at the two case study areas.

Value Chain Constraints and Suggestions for the Way Ahead :

The present study generally revealed that in both sites, various dairy value chain constraints prevail; productivity of dairy animals was generally poor, induced by both technical and non technical constraints. The peri-urban dairy subsector was also observed to face various institutional and policy related constraints that are also responsible for the inefficiency embedding in various segments along the value chain. The relative rank of value chain constraints hindering system productivity were observed not to evidently vary across study sites. In the following subsections, important peri-urban dairy value chain constraints that deserve considerable attention are outlined under five key themes: animal feeds, breeding and health; provision of support services; product marketing; safety of dairy farming practices and products; and environmental pollution concerns. Strategic directions to alleviate these constraints and make peri-urban dairy development venture more attractive are also pinpointed for further public action.

Feed Resources, Breeding and Veterinary Services:

Technical constraints observed to be responsible for low herd productivity generally revolve around three issues: quantitative and qualitative inadequacy of feed, limited milk production potential of the cattle genotypes in the system and poor management and herd health. Among the key inputs, feed shortage was considered by many respondents to be the major constraint to improved production and productivity. Seasonality and high feed cost was indicated to be one of the most critical challenges. Potential feed interventions like improved fodder species, where land is available, improvement of poor quality roughages through various treatment options and supplementation strategies can be exploited. But policy incentives and institutional arrangements encouraging their adoption and sustainable utilization are generally lacking.

The current work also showed that peri-urban dairy farmers in the case study areas keep both local and cross bred cattle. The low milk yield of local cattle, which was roughly 2 lts day⁻¹, based on data generated in this study was found to be an important constraint of the system. Their adaptive ability to the prevailing harsh environment is often not accompanied by high performance traits and neither have these breeds been selected for high milk production. However, there is still a potential for increased production through improved management and selection of superior animals within the local breed, among others. At present, this issue is being addressed

through introducing crossbreds, with on farm milk yields (Based on the present study) being much lower than the expected potential. Peri-urban dairy producers with financial capacity and management skill need to continue using these crossbreds to increase their farm productivity. However, in the long term, a combination of selection and cross-breeding with exotic blood levels is more appropriate, the decision on the level of exotic blood being decided based on the skill base of producers. Regarding disease, the most important dairy cattle diseases observed to affect the performance of urban and peri urban dairy herds in the present study include reproductive disorders, mastitis and pneumonia, among others. Field level evidences indicated that mastitis is highly prevalent across the two sites, resulting in significant economic losses, suggesting the need to put remedial actions in place.

Provision of Support Services: The success of peri-urban dairy value chain depends on the quality and timely provision of support services like feed inputs and breeding and veterinary services and infrastructural and credit services. Based on field level information, the following constraints associated with provision of support services were outlined: shortage of qualified veterinary service providers; inadequate networking among extension and support service providers; poorly organized and inefficient animal breeding services; lack of access to credit; increasing cost of inputs and sale of poor quality inputs by dishonest actors. As support services are essential for ensuring efficient functioning of a value chain, constraints related to services provision need to be alleviated through strengthening existing support infrastructures and disease surveillance activities and capacitating key players in the subsector.

Product Marketing: Marketing of peri-urban dairy products were faced by many constraints in the case study areas. The following are some of the constraints pinpointed in the course of the present study: absence of peri-urban dairy producers' and marketing cooperatives; lack of adequate market information; lack of cold storage facilities; repeated interruption of electric power; marketing of adulterated dairy products, among others. To address the inefficiencies associated with the current marketing arrangements, promoting the formation of dairy producers' and marketing cooperatives, establishment and improvement of market information exchange systems; and development of mechanisms for coordinated enforcement of product and market standards by

stakeholders and promotion of product diversification to meet market needs and enforcement of regulations to harmonize informal marketing have to be considered.

Safety of Farming Practices and Products: Public health is linked to safety of products that humans consume. Exposure of dairy producers and consumers to risks associated with waste disposal and diseases is a matter of concern. The production practices and products may not be safe for human consumption. Safety of practices and products along the value chain were observed to be constrained by the following factors: unsafe use of veterinary drugs and vaccines, reliance on off-farm fodder and commercial feeds whose source and safety are not guaranteed; inadequate awareness by producers, traders and consumers on best practices in the production processes and product quality; inadequate enforcement of existing laws on feed, food and drug safety measures, among others.

To ensure safety of practices and products, the following measures need to be taken: promote and build capacity on good livestock production practices and enhance quality control in feed formulation and safe use of feeds and drugs; develop mechanisms for coordinated enforcement of product safety, traceability and standards; establish mechanisms to ensure regular and effective inspection and control on the use of veterinary drugs; strengthen surveillance to ensure that feeds are obtained from credible sources; advocacy and sensitization of consumers to make informed choice about food safety

Environmental Pollution: Increasing urbanization and the consequent rise in demand for food by the urban mass is apparently leading to expansion of peri-urban dairy activities in the study sites, with attendant environmental pollution. The rising concern of environmental pollution was observed to be associated with the following: unhygienic disposal of manure and other peri-urban dairy farm wastes; improper disposal of animals' wastes leading to pollution of land and downstream water sources; noise and air pollution from dairying activities, among others.

For mitigating the potential adverse effects on the environment of peri-urban dairy farming activities, the following interventions can be considered: mobilizing the peri-urban dairy stakeholders to deal with dangers and risks associated with dairying induced pollution; enhance coordinated enforcement of existing laws on bio-safety; build capacity of concerned lead institutions and, improve partnership and networking for dealing with

environmental pollution issues; explore opportunities and promote investments in farm waste management through public-private sector players; and improve public awareness on good peri-urban farming practices through increased extension and advocacy by implementing agencies.

CONCLUSION

In this study, fluid milk value chains at two peri-urban areas were analyzed in western Oromia, Ethiopia. The majority of the farms were male headed; and peri-urban dairying is aimed at generating additional income for households. The main milk value chain segments identified were: input supply, production, marketing (Distribution), processing and consumption. Key inputs/services used in peri-urban dairying activities are: feed, heifers' supply/breeding services, veterinary drugs, land and labour. Inadequate supply and high price of dairy feeds, inefficient breeding and veterinary service delivery systems and shortage of land was observed to be critical constraints. Lack of land was found to be grave, forcing farmers to keep their animals in residential compounds. Women are highly involved in diverse dairy related activities, mainly milking and milk processing.

Both local and cross-bred animals are kept, with both genotypes exhibiting inferior daily milk yield performance. Generally, no formal milk marketing and processing system prevailed at both areas; the milk produced is generally channelled through informal routes. The subsector was also observed to face various technical, institutional and policy related constraints that are responsible for the inefficiency embedding in the value chains. Key peri-urban dairy value chain constraints that deserve considerable attention were finally identified: shortage of animal feeds, inefficient breeding and veterinary services; inadequate value chain support services; weak product marketing systems; safety of dairy farming practices and products are not assured; and environmental pollution threats induced by farm waste disposal problems. Strategic directions to alleviate these constraints and make peri-urban dairy development venture more attractive are also pinpointed for further development interventions.

ACKNOWLEDGEMENTS

The authors are grateful to the Addis Ababa University and the Ethiopian Institute of Agricultural Research for financial support to implement the field work.

The technical assistants of the Animal Production Research Division of Bako Agricultural Research Centre; and livestock extension officers at the two study districts are highly acknowledged for their support in the selection and identification of dairy farmers and sharing their motor bikes during the field work. Farmers and other key informants are acknowledged for sharing their knowledge with us.

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