A description of management and production levels of cross bred dairy cattle in Dar es Salaam and Morogoro urban and peri urban areas

Accepted 26th June, 2013

ABSTRACT

A study was carried out to describe management and production levels of crossbred dairy cattle in urban and peri urban areas of Dar es Salaam city and Morogoro town. A cross sectional study design using a random sample of 153 dairy farmers was used to collect data on management and production levels of dairy cattle. Cattle sheds were measured to establish stocking densities. Statistical analysis was done using SAS. One third of the farmers practised free grazing system. Poor quality forage and energy rich concentrate were the main feed resources. Farmers in Dar es Salaam and Morogoro covered 14.7±1.2 and 3.07±1.2 km/day (P<0.05) respectively in search of forages. Steaming up of dry cows was significantly (P<0.05) more common (22.8%) in Dar es Salaam than in Morogoro (14.2%). Natural service was the predominant (P<0.05) breeding method. Over half (52%) of cattle sheds had high stocking density (P<0.05) and each shed accommodated 1.37 animals per 6.7 m² standard space required per dairy cattle. Milk production in Dar es Salaam (10.4±0.7 litres/cow/day) and Morogoro (6.3±0.7 litres/cow/day) was statistically different (P<0.05). One third of the farmers planned to decrease their cattle herds due to shortage of feeds. Therefore, addressing some of these management aspects improve dairy cattle productivity.

Key words: Milk production, feed, cattle shed, free grazing, natural service, steamed up, stocking density.

INTRODUCTION

In Tanzania, dairying is one of the fast growing enterprises in the livestock sector contributing 30% of the livestock Gross Domestic Product (URT, 2012). Urban and peri-urban dairy farming has expanded considerably during the past decades as a result of inadequate milk marketing infrastructure, need for civil servants to supplement their income and the high price of raw milk in urban centers relative to the price in rural areas (Kurwijila, 2001). People from different socio-economic and cultural groups are involved in dairying as a source of income, food and employment (Ishagi et al., 2002; Mlozi, 2005). However, the situation in Dar es Salaam is different whereby dairy cattle are kept exclusively by medium and high income people in peri urban and low density settlement areas (Jacobi et al., 2000). Despite the enormous contribution of dairying in peri urban areas of Tanzania to Gross Domestic Product, the sub sector is constrained by factors such as genetic make-up of animals and management/environmental factors.

Poor milk marketing is very common in Tanzania and was given the highest rank among the constraints affecting milk production in Tanga town Tanzania (Swai et al., 2005). Informal milk marketing dominates the marketing of milk in Tanzania and according to MoAC/SUA/ILRI (1998), over
90% of the milk marketed informally is sold as raw milk. Informal milk marketing poses health risk to consumers of raw milk as it contains appreciable number of bacteria. Vivid example of health risks as a result of informal milk marketing was reported in Tanga town Tanzania whereby 83 and 56% of all milk handled and marketed in informal markets had higher Coliform counts than the recommended values of less than 50000 cfu/ml and were Brucella milk ring test positive respectively (Swai and Schoonman, 2011).

Water is a very important nutrient for the dairy cows in order to perform proper physiological functions of the body. Very unfortunately, clean and safe water is not readily available in urban and peri urban areas of Tanzania. For example, water supply service coverage in Dar es Salaam city is 68% and the situation is worse in other towns (URT, 2010). Shortage of water is critical especially during the dry season resulting into reduced milk production and health status of livestock (Guendel and Richards, 2002).

Environmental contamination with heavy metals from industries and improper disposal of animal wastes poses serious health threats to urban consumers of animal products and by-products. For instance, the levels of Lead (3.5 mg/kg) and Copper (3.6 mg/kg) contamination in the blood of cattle in Morogoro town Tanzania have been reported even though the levels have not reached an alarming point (Mlay and Mgumia, 2008). Improper waste disposal has been reported in urban areas of Mbeya, Morogoro and Dar es Salaam city and dumping of wastes was more common among elder household heads (22%) than among the young (9%) (Mlozi, 2005). More recently, Lupindu et al. (2012) in their study in Morogoro urban and peri urban areas revealed high risk of contracting zoonotic diseases as a result of improper handling of animal manure. Land is inadequate in most peri urban areas of Tanzania and still more of it is turned into living quarters. In view of this, Dar es Salaam and Dodoma cities have developed master plans showing agriculture as a land use, and Morogoro municipal has set aside land as green belt. Nonetheless, its implementation leaves a lot to be admired. Shortage of land, makes urban dairy producers to face difficulties in disposing animal wastes and has forced them to keep their cattle within their own residential compounds. Keeping animals close to people increases the chances of transferring zoonotic diseases such as brucellosis and tuberculosis. Zoonotic diseases are a serious concern in urban and peri urban areas of Tanzania. For instance a study conducted in Tanga town Tanzania by Cole et al. (2008) reported overall prevalence of brucellosis to be 5.5%. Likewise, scarcity of land in peri urban areas made most dairy farmers fail to establish pastures which in turn endangers the sustainability and the successful development of urban and peri urban dairy production systems (Kavana and Msangi, 2005).

Natural pasture species in the communally owned land have been the main source of feed for dairy cattle (Orodho, 2006), although smallholder dairy farmers do not have full control of it. Availability of forage in terms of quantity and quality, especially in the dry season, is a major concern for dairy production in Tanzania. During the dry season, the quality of the forage is very poor and leads to low milk production (Kavana and Msangi, 2005).

Studies on milk demand in Tanzania indicated higher levels of per capita milk consumption in urban centres (44 L/annum) than in rural areas (30 L/annum) and that consumption of milk is higher in lower age groups (8 years and below) than other age groups (MoAC/SUA/ILRI, 1998). Higher milk demand in urban centres provides an opportunity for the dairy sub sector to expand. Unfortunately, demand for milk and milk products is much higher than the actual milk production.

The above challenges have led to crossbred dairy cows in Tanzania to produce milk of about 1800 L/cow/annum below the potential yields of 2500 L/cow/annum (Msangi et al., 2005; Swai et al., 2005). Smallholder dairy farmers in rural areas of Tanzania manage their animals differently depending on the challenges they face and available resource bases they have. However, such management information is very limited in urban and peri-urban areas of Tanzania (Guendel and Richards, 2002). Knowledge on the current management and production levels of dairy cattle may assist in improving their production through formulation of policies and enforcement of urban by laws related to keeping of animals.

In order to improve dairy cattle productivity in urban and peri urban areas of Tanzania, it was ideal to collect important information on farmer's perception on the major challenges to high dairy cattle performance and characterise management practices in the study areas. Therefore, for comparative purposes, smallholder dairy farms in urban and peri urban areas of Dar es Salaam city and Morogoro town were randomly selected as an input to the on-going study on reproductive and productive performance of crossbred dairy cattle in urban and peri urban areas of Tanzania. The objective of this study was to describe the management and production levels of crossbred dairy cattle in Dar es Salaam city and Morogoro town.

**MATERIALS AND METHODS**

**Study areas and animals**

This study was carried out in urban and peri-urban areas of Dar es Salaam city and Morogoro town. The two study areas
are located within the same agro ecological zone two; having rainfall between 500-1000 mm (URT, 2007b). According to UN-Habitat (2009), Dar es Salaam city is the most urbanized region in Tanzania with 93.9% of its population being urban while Morogoro (27.0%) is the third region in the country to have large proportion of its urban population above the national figure (23%) of urbanization. Dar es Salaam is located at longitudes 37°10' to 39°30'E and latitudes 06°15' to 07°40'S. On the other hand, Morogoro region is located between latitude 5° 58' and 10° 0'S and longitude 35° 25' and 35° 30'E (URT, 2007b). Dar es Salaam city has three Municipalities namely Kinondoni, Ilala and Temeke but, only Kinondoni and Ilala were involved. All wards keeping cattle in Morogoro town were selected for the study.

In this study, an urban area is defined as part of town up to 10 km away from town centre and has high density of people, while peri urban area is part of town 10 km up to 30 km from town centre. This part of town has low density of people and houses and some basic social services such as piped water and electricity may be missing. Both urban and peri urban areas are within the jurisdiction of a Local Government Authority established and governed by the Local Government (Urban Authorities) Act (1982). According to urban authority by laws, keeping of animals in urban areas of Tanzania is allowed provided they are kept under zero grazing condition and not more than four heads (URT, 2007b). The choice of the two research sites was based on the fact that they have similar agro ecological zone, have fast growing human and cattle population.

Dairy cattle considered in this study were crossbreds between Bos taurus breeds (Friesian, Ayshire and Jersey) and zebu (Bos indicus). All lactating cows were hand milked two times a day. Dairy cattle were either zero grazed (stall fed) where forages are cut and carried to cattle to be fed under confirmation, semi zero and free grazed. Natural pasture formed the major source of feeds while concentrate was used to supplement lactating cows during milking time.

Study design and data collection

A cross sectional study design was conducted between April and August 2010 using a random sample of 71 and 82 smallholder dairy farmers from Dar es Salaam city and Morogoro town respectively. For the purpose of this study, a smallholder farm was defined as the one having 1<n<50 dairy cattle of all ages and sexes. However, for easy discussion, farmers were subdivided into three sub groups according to herd sizes namely: 1-10, 11-20 and 21-50 animals. Interviews with dairy cattle farmers using semi-structured questionnaires, focus group discussions with livestock stakeholders and personal observations using a check list were the main tools used to gather information on farmers’ demographic characteristics, types of farm labour, land size, livestock inventory/herd structure, dairy cattle feeding, milk production, processing and marketing, grazing systems and breeding methods. The hygienic condition of cattle sheds was visually observed and assessed as good/clean or poor/dirty. Cattle sheds measurements were taken by using a tape measure to get total cattle shed area in square metres. The stocking density was determined by computing the number of cows kept per cattle shade area.

Data analysis

Microsoft excel was used to store and draw graphs. Descriptive statistics of General Linear Model (GLM) of SAS version 9.1 (2002) was used to describe herd size and composition, milk yield, land size and amount of milk processed. Differences in sample size among continuous variables were taken care of by using GLM procedures (sum of squares type III). Separation of the least square means (LSMeans) were performed by using PDIFF procedure. Chi-square test (PROC FREQ) of SAS (2002) was used to analyse associations between possible combinations of categorical variables (demographic characteristics, types of farm labour, sources of capital) and values of p < 0.05 were considered as significant.

RESULTS

Demographic characteristics of dairy farmers

On overall, nearly half (n=85; 48.6%) of the dairy farmers were self employed while retired officers and government employees were 21.7 and 29.7% respectively. Employment status of the dairy farmers showed considerable variations ($\chi^2=17.30$, p=0.002) where by self employees (n=55; 31.5%) were many in Dar es Salaam city while retired officers (n= 26; 14.8%) and Government employees (n=34; 19.4%) were the majority in Morogoro town (Table 1).

Similar proportions of dairy farmers with college (n=69; 39%) and secondary education (n=67; 38.2%) were observed in the study areas. However, farmers who had primary education (n=39; 22.3%) were relatively few. Farmers had similar levels of education ($\chi^2=3.48$, p =0.175) even though Dar es Salaam had few (n=15; 8.6%) and more (n=39; 22.3%) farmers with primary and college education respectively (Table 1). Dairy farmers had various sources of funds/capital for establishing and running dairy enterprises and varied significantly ($\chi^2 =28.95$, p=0.001) between dairy farmers. However, the main and least
Table 1. Employment status and education levels of dairy farmers interviewed in Morogoro town and Dar es Salaam city.

<table>
<thead>
<tr>
<th>Variable</th>
<th>City</th>
<th>Retired officers (n)</th>
<th>Government employees (n)</th>
<th>Self employees (n)</th>
<th>Total (n)</th>
<th>Chi ($\chi^2$)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employment status</td>
<td>Morogoro</td>
<td>(26) 14.8</td>
<td>(34) 19.4</td>
<td>(30) 17.1</td>
<td>(90)</td>
<td>17.30</td>
<td>0.002</td>
</tr>
<tr>
<td></td>
<td>Dar es Salaam</td>
<td>(12) 6.9</td>
<td>(18) 10.3</td>
<td>(55) 31.</td>
<td>(85)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>(38) 21.7</td>
<td>(52) 29.7</td>
<td>(85) 48.6</td>
<td>(175)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education levels</td>
<td>Morogoro</td>
<td>(24) 13.7</td>
<td>(36) 20.6</td>
<td>(30) 17.1</td>
<td>(90)</td>
<td>3.48</td>
<td>0.175</td>
</tr>
<tr>
<td></td>
<td>Dar es Salaam</td>
<td>(15) 8.6</td>
<td>(31) 17.7</td>
<td>(39) 22.3</td>
<td>(85)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>(39) 22.3</td>
<td>(67) 38.3</td>
<td>(69) 39.4</td>
<td>(175)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figures in brackets (n) are number of respondents p=probability.

Figure 1. Percentage of the farmers who used different sources of capital for establishing dairy enterprises in Dar es Salaam and Morogoro towns.

Sources of capital were own capital (n=137; 78.2%) and in kind assistance (heifer in trust) (n=3; 1.7%) from Heifer Project International respectively (Figure 1). Dairy farmers who applied for loan were many (n=27; 15.4%) in Dar es Salaam and very few (n=5; 2.8%) in Morogoro town. Moreover, there was a significant relationship ($\chi^2=22.07$, p=0.001) between herd size and desire of the farmer to apply for loan, where by more dairy farmers (n=17, 9.7%) with small herd sizes (1-10) applied for loan than dairy farmers with herd sizes of 11-20 (n=8, 4.5%) and 21-50 (n=7, 4.0%) herd of cattle.

Feeds, feeding, breeding methods and sources of dairy farm labour

Dairy farmers depended mostly on natural pasture as feed source obtained from open spaces/communal grazing land. Forage vending is very common in urban areas where young boys cut forage from open areas/fallow land and sell it to dairy farmers. Most of the forage transactions were made along the highways.

The average land owned by dairy farmers was 3.2 ha and Dar es Salaam city respondents had significantly (P<0.001)
larger land size (5.0±0.6 ha) compared to 1.5±0.6 ha reported in Morogoro town. Unfortunately, very few dairy farmers in peri urban areas of Dar es Salaam (5.6%) and Morogoro (6.3%) allocated land for pasture production and/or grazing area. Generally, dairy farmers in the peri urban areas had 0.8 ha of land allocated for pasture production/grazing area. However, dairy farmers in Dar es Salaam peri urban areas had 0.8 ha of land allocated for pasture production/grazing area and/or grazing area. In contrast, dairy farmers in Morogoro peri urban areas set aside significantly (P<0.05) more land (1.6±0.3) for pasture production/grazing area than 0.1±0.3 ha of land set aside in Morogoro town.

Concentrate supplementation to dairy cattle varied significantly ($\chi^2=6.96$, p=0.008) between lactating and non-lactating (dry cows) in which energy rich concentrate was used to supplement dairy cows during milking sessions and few dairy farmers (n=65; 37.1%) did it to both lactating and dry cows. The act of supplementing dry cows during the last two months (60 days) of gestation period is termed as steaming up. The act of giving extra concentrate to dry cows in the last trimester was more common (n=40; 22.9%) in Dar es Salaam city than 14.2% of the respondents who practiced it in Morogoro town (Figure 2). Furthermore, steaming up of dry cows was more common (n=141; 80.5%) with small herd sizes (1-10 animals) than 6.8% found in large herds (21-50 animals).

Natural pasture was collected from various sources using different means of transport. Generally, dairy farmers in the study areas used mainly vehicles (n=83; 47.4%) and bicycles/heads (n=71; 40.5%) to collect forage from the sources to their respective dairy units. Nevertheless, few dairy farmers (n=21; 12%) freely grazed their cattle. Means used for collecting forage from the sources to dairy cattle units varied significantly ($\chi^2=20.86$, p=0.001) between the two study areas, in which many dairy farmers in Morogoro town (n=51; 29.1%) and Dar es Salaam city (n=58; 33.1%) used bicycles/their heads and vehicles (hired/own) respectively (Figure 3).

Number of cattle (herd size) significantly ($\chi^2=22.70$, p=0.001) influenced the choice of transport used to collect forage from the sources to the dairy units. Dairy farmers with small herds (1-10 animals) used mostly bicycle/head (n=67; 38.2%) whereas farmers with larger herds (21-50) had two alternatives, either grazing (n=5; 2.8%) or used vehicles (n=7; 4.0%) for collecting forage (Figure 4).

The average distance covered in search of forage was 8.7 km and differed significantly (P<.001) between the study areas. On average, farmers in Dar es Salaam city and Morogoro town covered 14.7±1.2 and 3.06±1.2 km respectively in search of forage. When a bicycle/head was used to collect forage, the number of trips made in a day for a herd size of 1-10 animals ranged from one to three. Zero grazing was predominantly ($\chi^2=10.66$, p=0.004) used in the
study areas (n=122; 69.7%) followed by semi zero grazing (n=42; 24.0%) while free grazing was practiced by a few (n=11; 6.3%) dairy farmers. Semi zero grazing (n=26; 14.9%) and free grazing (n=9; 5.2%) of dairy cattle were very prominent in Dar es Salaam city compared to Morogoro town (Table 2). In most cases, semi zero and free grazing systems were common in the peri urban areas where fallow land and open spaces are still available.

The methods used to breed dairy cattle varied significantly ($\chi^2=23.28$, $p=0.001$) where by the majority of the dairy farmers used natural service/bull (n=82; 46.9%) than artificial insemination service (n=40; 22.9%). On the other hand, the proportion of dairy farmers who used artificial insemination (n=10; 5.8%) in Morogoro town was less than 17.1% of dairy farmers who used the same service in Dar es Salaam city (Table 2). Likewise, few dairy farmers (n=23; 13.1%) who used a combination of both natural/bull and artificial insemination services were found in Morogoro town compared to 17.1% observed in Dar es Salaam city. The decision on the types of breeding methods a dairy farmer should use was not based on herd size and had no relationship ($\chi^2=7.94$, $p=0.093$) with levels of education.

On overall, dairy farmers depended largely ($\chi^2=18.55$, $p=0.029$) on hired labour (n=91; 52.0%) followed by a combination of hired and family labour (n=64; 36.5%) and few farmers (n=20; 11.4%) depended on family labour alone. A combination of hired and family labour (n=58; 33.1%) and hired labour (n=71; 40.5%) were more used in Dar es Salaam city and Morogoro town respectively to perform most of the work in the dairy units. The types of farm labour had a bearing on the herd size, where by small herd sizes (1-10 animals) were managed mostly by hired labour, but larger herd sizes (21-50 animals) were significantly ($\chi^2=11.77$, $p=0.019$) carried out by a combination of hired and family labour (Figure 5).

Cattle shed hygienic condition and conformity to standard design

Generally, cattle sheds were good at 86.2% but, there was no significant difference ($\chi^2=0.13$, $p=0.713$) in hygienic condition between the study areas. On overall, the majority of the cattle sheds had concrete floor (n=146; 83.4%) and very few (n=3; 1.8%) had earthen floor. However, the types of floor observed in Dar es Salaam city were similar ($\chi^2=1.60$, $p=0.448$) to the ones found in Morogoro town (Table 3). Herd size had significant ($\chi^2=7.73$, $p=0.020$) effect on hygienic condition of the cattle sheds where by small herd sizes (1-10 animals) which were mainly zero grazed were in poor hygienic condition than herd sizes of
Table 2. Percentage of dairy farmers using different grazing systems and breeding methods in Morogoro town and Dar es Salaam city.

<table>
<thead>
<tr>
<th>Variable</th>
<th>City</th>
<th>Zero grazing (n)</th>
<th>Semi zero grazing (n)</th>
<th>Free grazing (n)</th>
<th>Total (n)</th>
<th>Chi ($\chi^2$)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grazing systems</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Morogoro</td>
<td>(72)</td>
<td>(16)</td>
<td>(2)</td>
<td>(90)</td>
<td>10.66</td>
<td>0.004</td>
<td></td>
</tr>
<tr>
<td>Dar es Salaam</td>
<td>(50)</td>
<td>(26)</td>
<td>(9)</td>
<td>(85)</td>
<td>10.66</td>
<td>0.004</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>(122)</td>
<td>(42)</td>
<td>(11)</td>
<td>(175)</td>
<td>10.66</td>
<td>0.004</td>
<td></td>
</tr>
<tr>
<td>Breeding methods</td>
<td></td>
<td>Natural/bull</td>
<td>AI</td>
<td>Natural and AI</td>
<td>Total</td>
<td>23.28</td>
<td>0.001</td>
</tr>
<tr>
<td>Morogoro</td>
<td>(57)</td>
<td>(10)</td>
<td>(23)</td>
<td>(90)</td>
<td>23.28</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>Dar es Salaam</td>
<td>(25)</td>
<td>(30)</td>
<td>(30)</td>
<td>(85)</td>
<td>23.28</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>(82)</td>
<td>(40)</td>
<td>(53)</td>
<td>(175)</td>
<td>23.28</td>
<td>0.001</td>
<td></td>
</tr>
</tbody>
</table>

Figures in brackets (n) are number of respondents, AI=artificial insemination.

Figure 5. Percentage of the farmers who used different types of farm labour according to herd size in Dar es Salaam and Morogoro towns.

11-20 animals (semi grazed) and 21-50 animals (freely grazed).

Cattle shed design was similar ($\chi^2=0.01$, p=0.911) and did not conform to FAO (1998) standard design. On overall, the majority of cattle sheds (n=156; 89.1%) were constructed without using FAO (1998) standard design that has a provision for sleeping and walking/feeding spaces. Interestingly, both Dar es Salaam city (n=76; 43.4%) and Morogoro town (n=80; 45.7%) had larger and similar number of cattle sheds that did not conform to FAO (1998)
standard design.

Stocking density, herd size and structure

More than half (n=91; 52%) of cattle sheds had high stocking density and on average each shed accommodated 1.37 per 6.7 m² standard space required per dairy cattle. However, the stocking density (LSMean±SE) per cattle shed in Dar es Salaam city (1.48±0.09) and Morogoro towns (1.27±0.09) was not significantly (P>0.05) different. Also, cattle sheds used by zero grazed cattle (45) 34.6%, had high stocking density than semi zero grazed animals (16) 12.3% although the difference was not significantly (P>0.05) different.

The average herd size was 8.2 cattle per dairy unit. Dar es Salaam city had significantly (P< 0.001) larger herd size of 11.1±0.8 cattle per dairy unit compared to 5.5±0.8 cattle per dairy unit found in Morogoro town. The number of dry cows (4.2±0.3) and heifers (2.4±0.2) in Dar es Salaam city were significantly bigger (P<0.05) than 0.9±0.3 dry cows and 0.6±0.2 heifers found in dairy units of Morogoro town. However, the numbers of milking cows, calves and bulls were similar (P>0.05) in the two study areas. Stratification of smallholder dairy cattle herd indicates significantly ($\chi^2=19.92$, p=0.001) many (n=141; 80.5%) dairy farmers to have 1-10 cattle and few (n=12; 6.8%) had more than 21 to 50 animals. Dairy farmers who had more than 10 -50 dairy cattle were many (n=29; 16.0%) in Dar es Salaam city than in Morogoro town (3.4%).

Milk production, processing and marketing

The overall mean milk yield was 8.3 L/cow/day. The average milk yield in Dar es Salaam city (10.4±0.7 litres/cow/day) and Morogoro town (6.3±0.7 L/cow/day) were statistically different (P=0.001). Similarly, dairy households in Dar es Salaam city produced significantly (P<0.05) higher amount of milk (31.0±3.2 L/household/day) compared to 12.5±3.1 L/household/day produced Morogoro town. Among 153 farmers in the study areas only 8 (11.3%) dairy farmers in Dar es Salaam were involved in processing milk into dairy products and there was no dairy farmer in Morogoro town who was involved in adding value to milk. On average, each processor in Dar es Salaam city processed 16.0 L/day mainly into fermented milk (sour milk). Milk was informally sold directly to consumers or individual households. Variations in milk selling prices were noted where by a litre of milk in Dar es Salaam city and Morogoro town was sold at an average price of Tsh.686.61 and Tsh.1,050.0 respectively.

The average distance from dairy units to milk market places was 3.6 km. Dairy farmers in Dar es Salaam city covered significantly (P<0.05) longer distance (4.9±0.5 km) from respective dairy units to market places compared to 2.3±0.5 km covered in Morogoro town.

Future plans in dairying

Farmers were asked if they would like to increase, maintain or decrease their dairy herds and were required to give reasons for the answer. Dairy farmers had significantly ($\chi^2=10.04$, p=0.006) different preferences in which more (n=103; 58.8%) dairy farmers preferred to increase their cattle herd size than maintaining (n=21; 12.0%) or decreasing (n=51; 29.2%) cattle herd. On the other hand, more dairy farmers (n=28; 16.0%) in Morogoro town preferred to decrease herd size than Dar es Salaam city (Table 4).

Various reasons ($\chi^2=23.55$, p=0.001) forced dairy farmers to make decisions on either to increase, maintain or decrease their cattle herd. For instance, shortage of food and grazing land was the first (n=39; 58.2%) most important reason for planning to decrease cattle herds in the study areas. Other reasons were prohibitive urban by laws (n=15; 22.3%) that require each dairy farmer to have not more than 4 heads at a time and livestock theft (n=5; 7.4%). The problems of farm labour (n=5; 7.4%) and livestock theft (n=4; 5.9%) were the second and third reasons for wanting to decrease cattle herd in Morogoro town. Prohibitive urban by laws (n=15; 22.3%) was the second reason for planning to decrease cattle herd in Dar es Salaam city. Dairy farmers who were in favour of increasing herd size supported their argument by saying that dairying pays more than other agricultural enterprises (n=65, 62.5%), wanted to increase income (n=23, 22.1%) and it is a main source of income (n=16, 15.3%). The reasons given in favour of increasing herd size did not differ significantly ($\chi^2=0.82$, p=0.935) between the dairy farmers and farmer’s decision on future plan on dairying did not depend ($\chi^2=2.73$, p=0.603) on herd size.

DISCUSSION

Farmers’ demographic characteristics

Dairy farmers in the study areas used mostly their own funds/capital for establishing and running dairy cattle enterprises. This finding concurs with studies carried out by Kassa (2003) and Shiferaw et al. (2003) who reported 80.8 and 82.1% respectively of the urban and peri urban dairy farmers in Addis Ababa to have used their own funds to start dairy activities. In addition to this, Ayenew et al.
Table 3. Types of cattle shed floor and hygienic condition in Dar es Salaam city and Morogoro town.

<table>
<thead>
<tr>
<th>Variable</th>
<th>City</th>
<th>Stone paved</th>
<th>Concrete</th>
<th>Earthen</th>
<th>Total</th>
<th>Chi ($\chi^2$)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Types of cattle sheds floor</td>
<td>Morogoro</td>
<td>(16) 7.1</td>
<td>(72) 41.2</td>
<td>(2) 1.1</td>
<td>(90) 51.4</td>
<td>1.60</td>
<td>0.448</td>
</tr>
<tr>
<td></td>
<td>Dar es Salaam</td>
<td>(10) 5.7</td>
<td>(74) 42.2</td>
<td>(1) 0.7</td>
<td>(85) 48.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>(26) 14.8</td>
<td>(146) 83.4</td>
<td>(3) 1.8</td>
<td>(175) 100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hygienic condition of cattle sheds</td>
<td>Morogoro</td>
<td>(8) 6.1</td>
<td>(55) 42.3</td>
<td></td>
<td>(63) 48.4</td>
<td>0.13</td>
<td>0.713</td>
</tr>
<tr>
<td></td>
<td>Dar es Salaam</td>
<td>(10) 7.7</td>
<td>(57) 43.9</td>
<td></td>
<td>(67) 51.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>(18) 13.8</td>
<td>(112) 86.2</td>
<td></td>
<td>(130) 100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figures in brackets (n) are number of respondents.

Table 4. Percentage response of farmers on future plans in dairying in Dar es Salaam and Morogoro towns.

<table>
<thead>
<tr>
<th>Variable</th>
<th>City</th>
<th>Increase cattle herd</th>
<th>Maintain cattle herd</th>
<th>Decrease cattle herd</th>
<th>Total</th>
<th>Chi ($\chi^2$)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Future plan</td>
<td>Morogoro</td>
<td>(58) 33.1</td>
<td>(4) 2.3</td>
<td>(28) 16.0</td>
<td>(90) 51.4</td>
<td>10.04</td>
<td>0.006</td>
</tr>
<tr>
<td></td>
<td>Dar es Salaam</td>
<td>(45) 25.7</td>
<td>(17) 9.7</td>
<td>(23) 13.2</td>
<td>(85) 48.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>(103) 58.8</td>
<td>(21) 12.0</td>
<td>(51) 29.2</td>
<td>(175) 100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figures in brackets (n) are number of respondents.

(2009) reported a small proportion of farmers (16%) in urban dairy units of Bahir Dar city in Ethiopia who got credit services for dairy related activities. In view of these, Baltenweck and Staal (2000), pointed out that access to credit cannot be excluded as a reason for delaying adoption of dairy cows related innovations.

Feeds, feeding systems and sources of farm labour

In the study areas, dairy cattle were fed a variety of feed materials depending mostly on the availability. The feed resources include hay, green feeds, crop residues, concentrate and non-conventional feeds such as wandering jews (*Commelina benghalensis*). The quality of naturally occurring feeds in agro ecological zone two (study areas) was of moderate quality, having 6.8% CP and 55.6% of digestible organic matter (Kavana and Msangi, 2005). The available feed resources are unable to meet requirements of a dairy cow (12% CP) producing at least 10 L of milk per day (NRC, 1989). Moreover, dairy cattle under smallholder farmers in urban and peri urban areas of Tanzania who depend on forages from communal grazing areas, fallow lands and river banks, their animals are underfed. For instance, feeding regime practiced by smallholder dairy farmers in peri urban areas of Eastern Zone (study area) enabled exploitation of 83% of the animals’ potential for milk production (Kavana and Msangi, 2005). Energy rich concentrate was used to supplement mainly (62.8%) lactating dairy cows during milking sessions. According to Mtengeti et al. (2008), lack of protein supplement could be due to scarcity and/or high price. About one third of dairy farmers still practice a combination of semi zero and free grazing systems in communal grazing land. The communal lands are public owned lands that include riverbanks, dam edges, flood plains and fallow lands and these form the major source of dairy animals’ feed in urban and peri urban areas of
Tanzania. Semi zero and free grazing systems are very common practices in most peri urban areas of African cities (Gillah et al., 2012). In semi zero grazing system, animals are allowed to graze on open spaces for some hours and confined during the night where they are given supplementary feeds. The fact that semi zero and free grazing systems are dominant in peri urban areas is supported by Ngigi (2005) and Mustafa et al. (2011). Free grazing of livestock in Tanzanian towns is not allowed and contravenes the Municipal council by-laws which require all livestock to be kept under zero grazing system. Therefore, allowing free grazing of dairy cattle implies that possibly town council by-laws are not seriously enforced (Mlozi, 2005).

On overall, farm size allocated for agricultural activities in Dar es Salaam and Morogoro peri urban areas was 5.0±0.6 and 1.5±0.6 ha respectively. Contrary to this observation, Swai et al. (2005) reported large farm sizes (5 ha) in urban than 4.2 ha of land in peri urban dairy units of Tanga town in Tanzania. Availability of small land limits dairy farmers to expand their units and face difficulties in disposing animal wastes (Lupindu et al., 2012). The proportion of land allocated for pasture production/grazing area was smaller (6.3%) compared to land allocated to crop production (35.6%). A similar result was reported in Addis Ababa city (Ayenew et al., 2009). Availability of alternative sources of pasture, land scarcity, lack of pasture seeds and technical know-how on pasture establishment could be the possible reasons for not allocating land for pasture (Kavana and Msangi, 2005, Mtengeti et al., 2008).

High dependence on the use of bicycles/heads and vehicles (hired/own) for collecting forage was common in Morogoro town and Dar es Salaam city respectively. Similar results were reported by Prain et al. (2010) in Nakuru Kenya where urban dairy farmers transported their fodder using mostly (40%) bicycles. Contrary to this observation, more than half of the dairy farmers in the urban centre of Addis Ababa used donkeys to bring feeds to their farms (Shiferaw et al., 2003). It is worth to note that donkey transport is most important occupation and primary income source of urban household heads in Addis Ababa (Guendel and Richards, 2002). Looking at the results of the current study, you will find that Dar es Salaam dairy farmers covered significantly longer distance in search of forages (14.7±1.2 km) and have large average herd size (11.1±0.8), relative to Morogoro town, hence it was logical for them to use significantly (P<0.05) more vehicles (hired/own) to collect animal feeds. This situation may explain the high cost of milk production (188 Tsh per kg of milk) in Kibaha town (closer to Dar es Salaam city) relative to 171 Tsh per kg of milk (1 USD=1, 600 Tsh) calculated in Morogoro town (Kavana and Msangi, 2005). Generally, transport costs for smallholder farmers are too high to access feed resources and limit selling of manure to peri urban areas for crop production (Guendel and Richards, 2002). Management practices show that feeding of dry and early postpartum cows is not appropriate in urban and peri urban areas of Tanzania (Mellau et al., 2009), such that dairy farmers rarely steam up dry cows and haphazardly supplement lactating dairy cows. This observation is in agreement with other researchers in urban and peri urban areas of East African cities (Gillah et al., 2012).

A combination of hired and family labour (n=58; 33.1%) in Dar es Salaam city was used to perform most of the work in the dairy units. Contrary to this, their counterparts in Morogoro town used hired labour (n=71, 40.5% of farmers) to perform day to day activities of the dairy units. This is an indication that dairying in urban and peri urban areas of Tanzania creates employment opportunities to urban dwellers. Also, the current results suggest that large herd of cattle (21-50 animals) needs the attention of both hired labour and owner since such enterprises need close supervision. The use of hired labour in performing dairy activities is common in urban cities of East Africa (Gillah et al., 2012). This implies that dairy farming in urban and peri urban areas is a viable enterprise and owners of dairy cattle in those cities can afford to pay labour wages (Nugent, 2000; Mlozi, 2005; Orodho, 2006). Also, the involvement of hired labour in urban dairy units is probably linked to the fact that some dairy unit owners are government employees (29.7%) and others (48.5%) run small businesses. However, Salem et al. (2006) gave caution on the reliance of hired labour with less dairying skills and not motivated by pointing out that it may result in mismanagement practices of the dairy unit operations. Meanwhile, family labour is more pronounced in Bishoftu town Ethiopia (Megersa et al., 2011) and Kampala city (Ishagi et al., 2002) and accounted for 54 and 52% of the households keeping dairy cattle respectively. This shows that some urban dairy owners cannot afford to pay labour wages since they keep cattle on subsistence basis (Ishagi et al., 2002).

**Breeding/mating practices**

In this study, natural service (46.8%) was the predominant breeding method (P<0.05) when compared to artificial insemination service (22.8%). Similar results were reported in most urban and peri urban dairy units of East Africa (Gillah et al., 2012). Unreliable artificial insemination services, lower conception rates and high cost of the service scared most smallholder dairy farmers from using the service (Msangi et al., 2005). Contrary to this observation, 69.7% of urban smallholder dairy farmers of Dire Dawa town in Ethiopia used artificial insemination service.
Possible reasons for depending on artificial insemination service in some urban areas were lack of space to keep bulls and shortage of feed (Mureda and Zeleke, 2008).

**Herd size, stocking density and cattle shed hygiene and conformity**

The current average herd size (11.1±0.8) in Dar es Salaam city is larger than those reported in the previous studies in urban and peri urban areas of Tanzanian towns/cities (Gillah et al., 2012). For a long time, farmers in urban areas of Tanzania have not reduced their herd sizes despite the by-laws enacted in all urban centres concerning keeping livestock in towns. According to Urban Authorities by laws, Act of 1982 No. 8 section 80, it is forbidden to keep more than four head of cattle in urban areas of Tanzania. This implies that the Municipal Government officials are not enforcing the by-laws (Mlozi, 2005). However, in the current study, the need for more income made 62.5% of dairy farmers to contravene the urban by laws that required them to keep no more than four heads under confinement.

Over half (52%) of cattle sheds had high stocking density and accommodated 1.37 animals per 6.7 m² standard space required per dairy cattle (FAO, 1998). Similarly, high stocking densities in urban dairy units of Tanga Tanzania (Shirima and Msanga, 2004) and Nairobi, Kenya (Aleri et al., 2011) were reported where 2-3 cattle were housed in 4 m² and 74.6% of cattle sheds had small cubicle sizes respectively. Cows housed at a stocking density of 1.17 cows per stall had higher plasma cortisol levels (a stress hormone), had reduced milk yield and conception rates (Moore, 2010). Therefore, dairy farmers should be trained and sensitized to have cattle sheds that conform to standard design in order to avoid the negative effects of having smaller cattle shed per animal. A good cattle shed should have an area of 6.7m² for feeding, exercise and individual cubicles for resting (FAO, 1998).

The hygienic condition of the cattle sheds was not very good. Similar observations were made in several urban and peri urban dairy units of East Africa (Gillah et al., 2012). Shortage of water especially during the dry season and keeping a large number of animals per unit area (stocking density) were some of the factors which contributed to poor hygiene of cattle sheds. Shortage of water was a common problem in most urban and peri urban areas of Tanzania (URT, 2010).

Only few cattle sheds (10.9%) conformed to FAO (1998) cattle shed standard design that has a provision for sleeping and walking/feeding spaces. The observation is supported by other research findings in urban and peri urban dairy units of East Africa cities (Gillah et al., 2012).

Poor cattle shed design decreases the productivity of the dairy cows (Kassa, 2003) and predispose them to various body injuries and diseases (Aleri et al., 2011). The poorly designed cattle sheds implies that they were constructed without taking into consideration the space requirement per animal as stipulated in the Tanzania Animal welfare act (URT, 2008). The few cattle sheds that conformed to standard design were a result of donor funded dairy project (Heifer Project International) which required the dairy farmer to construct a standard cattle shed before starting the project. Generally, cattle sheds in smallholder dairy units are small structures made of cement blocks, burnt bricks or pieces of timber off cuts. They are normally covered by corrugated metal sheets or thatched with grasses. The floors are made of stones or concrete.

**Milk production, processing and marketing**

The current overall mean milk yield of 8.3 L/cow/day is within the range obtained from other earlier studies in urban and peri urban dairy units of East African cities (Gillah et al., 2012). Dar es Salaam dairy units produced significantly (P<0.001) more milk (10.4±0.7 L/cow/day) compared to 6.3±0.7 L/cow/day produced in dairy units of Morogoro town. The difference in milk production between the two study areas could possibly be explained by the fact that dairy farmers in Dar es salaam city used significantly (P<0.05) more artificial insemination (34.2%) and steamed up (22.8%) dry cows in the last trimester than dairy farmers in Morogoro town. Nevertheless, the average milk production in the two study areas (8.3 L/cow/day) is lower for dairy cows with genetic potential of producing at least 15 L of milk per day (Msanga and Kavana, 2002). Such low milk production could be due to poor nutritive value of feeds and improper feeding of lactating and dry cows which do not meet animals’ physiological requirements (Kavana and Msangi, 2005).

Very few (11.3%) dairy farmers were involved in milk processing and hence raw milk was the main output from dairy cattle and sold directly to consumers. One of the reasons contributing to low milk processing was a small amount of milk (21.5 L) produced per household/day relative to the demand for raw milk. This finding concurs with Shiferaw et al. (2003) who reported 61.8% of dairy farmers did not process milk because of low milk output to process into various dairy products. However, selling of raw milk may transmit many milk borne diseases to humans (Makita et al., 2010). Selling of raw milk to consumers is illegal in Tanzania. According to the Tanzania Dairy Industry Regulations, selling of raw milk is against cap 10 (1) (URT, 2007a) which states that no person shall sell milk or distribute to the public any milk for human
consumption unless such milk has been pasteurised, sterilised or subjected to such treatment to render it safe for human consumption. Furthermore, according to cap 4 (1) says that no person shall sell milk unless the milk has passed platform tests. Very unfortunately, the dairy inspectors in Tanzania who are charged with such duties and given powers in the performance of their functions as indicated in cap 10 (1) (a – e) are not performing their responsibilities.

Future plans in dairying

On overall, more than two thirds of the farmers in the study areas would like to increase their cattle herds because of its economic benefits associated with dairying. Similar observations were made in various studies in urban and peri urban dairy units (Limbu, 1999; Nugent, 2000; Orodho, 2006). To shade more light on this, Nugent (2000) in his study in Dar es Salaam city, estimated income obtained from keeping one or two dairy cattle to be $60/month, which is 30% greater than the average basic Tanzania government salary. Apart from its economic benefit, dairying in African cities generates employment, food and nutrition (Schiere, 2001; Kassa, 2003). Surprisingly, about one third of the dairy farmers planned to decrease their cattle herds even though the magnitude was similar between the two study areas. The current observations concur with Schiere (2001) who reported that dairy farmers in Hue city in Vietnam intended to stop keeping cattle because they were affected by market fluctuations, lack of capital, diseases and problems of manure disposal. Shortage of feeds and grazing land was the first most important reason for decreasing cattle herds in Dar es Salaam city (29.9%) and Morogoro (28.3%) towns. Moreover, dairy farmers in Dar es Salaam in significant number planned to decrease their cattle herds because of the prohibitive urban by laws. This is an indication that dairy farmers are becoming aware on the rules and regulations regarding dairying in urban and peri urban areas.

Conclusion

From the results of the current study it can be concluded that, dairying in Dar es Salaam city differs significantly to Morogoro town. The differences are on herd size, daily milk production (litres/cow/day), breeding methods (natural/Artificial Insemination), household milk production (litres/household/day), distance to milk market places and milk price. The notable good milk production (litres/cow/day) in Dar es Salaam city relative to Morogoro town could possibly due to the fact that dairy farmers in Dar es Salaam used significantly more artificial insemination service. Moreover, good price paid for a litre of milk (raw/fermented) in Dar es Salaam city gives an incentive to dairy farmers to intensify management in order to produce more milk.

Despite the high benefits obtained from dairying, some farmers are forced to decrease their cattle herds mainly due to shortage of feed/forage and prohibitive urban by-laws. The problem of feed shortage is aggregated by seasonal water availability in peri urban dairy units. This is an issue of serious concern and needs to be addressed in order to improve dairy production. Artificial insemination service is rarely used in urban and peri urban areas of Tanzania because of its unreliability and high cost. The concerned authority should have a critical look on it to ensure its availability, reliability and cost effectiveness. Cattle shed design and high stocking densities are other areas of concern as they are against animal rights stipulated in Animal Welfare Act (URT, 2008). It is therefore, high time to implement the law. Since market opportunities exist, there is a room for milk production improvement.

Acknowledgements

The authors would like to acknowledge the DANIDA peri urban livestock farming project for financial support to this research as part of the PhD study program of the first author. We also thank the dairy farmers and ward extension staff in Morogoro and Dar es Salaam urban and peri urban areas for co-operation and provision of valuable information for this study.

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Cite this article as:
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