Full Length Research Paper

Assessment of on-farm milk handling practices in Mbarara District Southwestern Uganda

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Milk quality has been markedly linked to milk handling practices. In this paper we report on existing milk handling practices in Mbarara district, western Uganda assessed through a cross-sectional survey. A total of 347 dairy farmer households were randomly selected. Results indicated that the main types of milking containers used were plastic (74.6%). The main source of water used during milking was from springs (39.5%). A high proportion (51.9%) of the milking persons did not use any sanitizer when washing hands prior to milking. 58.5% of the farmers washed the udder prior to milking and 22.2% had clean milking area. Only 22.5% of the farmers tested the milk for mastitis and 79.3% of the farmers did not carry out post-milking treatment. Majority (70.3%) of the farmers preserved unsold milk, mainly by boiling. The study also showed a significant positive association between training in milk handling and cleanness of the milking area and milking containers (Somers' d = 0.492 and 0.500, p = 0.00 and 0.00, respectively). We concluded that training dairy farmers in proper milk handling practices could improve milk quality and possibly alleviate milk post-harvest losses that occur as a result of poor handling.

Key words: Dairy farming, milk handling, post-harvest losses, south-western, Uganda.

INTRODUCTION

In Uganda the contribution of agriculture to national food self-sufficiency and food security cannot be over emphasized (World Bank, 2010). Agriculture accounts for over 40% of gross domestic product (GDP) and more than 90% export earnings. The livestock sub-sector contributes 17 to 19% of the agricultural GDP and 7 to 9% of the national GDP. Of livestock GDP, the dairy industry is estimated to contribute 40 to 50%. (Kasirye, 2003). Furthermore dairy farming provides triple benefits of nutritive food, supplementary income and productive labour to over 2.5 million farm households thus playing a

significant role in combating food insecurity and poverty alleviation in Uganda (Staal & Kaguongo, 2003; Balikowa, 2011; Narugunde, 2013). However, this sector suffers devastating effects of post-harvest losses of spillage and spoilage as result of poor handling practices. For instance, in recent studies by Food and Agriculture Organization (FAO), economic losses in the dairy sector in Eastern Africa are estimated at $ 90 million per year. Causes of losses in the milk value chain take route in every transaction from production to consumption (Garcia et al. 2008; Kasirye, 2003). In Uganda 27% of the milk produced is wasted with 10% lost to spoilage during transportation, 11% at handling and marketing, while 6% is lost at farm level, translating into significant loss to the farmer (FAO, 1996). Worse still, raw milk being a bulky product coupled with its short storage life is very difficult

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to transport. Therefore milk must be consumed immediately unless it is processed for preservation and/or converted to other products (Matthewman, 1993).

The Ugandan government through Dairy Development Authority (DDA) has provided enormous efforts in areas of infrastructure development for milk transport, bulking and processing, marketing and market promotion, supply of inputs as well as provision of advisory and business development services particularly in animal health, breeding, farmer training and financial services (Balikowa, 2011). In the face of the current campaigns and reforms in Uganda's dairy sector, the condition of the current on-farm milk handling practices has not been empirically explored. FAO (2005) points out that a good dairy farming practice is an important practical tool used world-wide in supporting farmers to produce and market safe, quality milk and milk products to satisfy the expectations of the food industry and consumers. Thus there is urgent need to address the knowledge gap that exists on the current milk handling practices. The study therefore aimed at identifying and documenting the current on-farm milking and milk handling practices in Mbarara district South-western Uganda. This will act as an informative basis for exploring ways of reducing farm level post-harvest milk losses, improving productivity, competitiveness, entrepreneurship and growth of small and medium enterprises (SMEs).

MATERIALS AND METHODS

Study Area

The study was carried out in Mbarara district located in south-western Uganda about 330km from Kampala (Figure 1). Mbarara municipality is the largest urban centre in western Uganda making it the main business hub of the western region, connecting the different business entities to the capital city Kampala and the rest of Uganda as a whole. The district boarders with the following areas: Ibanda and Kiruhura districts to the North, Kiruhura and Isingiro districts to the East, Isingiro and Ntungamo districts to the South, Shema district to the West. Its population is estimated at 418,200 people (UBOS 2009). Balikowa (2011) points out that South-western milk shed accounts for over 30 % of the total milk production nationally and constitutes the major source of marketable milk in the country. According to the 2008 livestock census report, Mbarara area produces over 100,000 litres of milk per day, contributing significantly to the national milk production. This made Mbarara district an Ideal study area.

Data collection

Data on milk handling practices were collected by way of direct analytical observation and dairy farmer interviews from a random sample among dairy farmers.

Study population and Determination of Sample size

According to the 2008 national livestock census report about 3579 farm households in Mbarara district practice dairy farming. Using this farm household population, the sample size was determined using Krejcie & Morgan (1970) formula.

$$n = \frac{\chi^2 \times N \times p \times (1-p)}{(ME^2 \times (N-1)) + (\chi^2 \times p \times (1-p))}$$

Where: n = sample size, χ^2 = chi-square for the specified confidence level at 1 degree of freedom, N = population size, p = population proportion, ME = Margin of error

At 5% level of significance the calculated sample size for dairy farmer household was 347. The farmer households that participated in the study were randomly selected using lists provided by DDA.

Field questionnaire

Data were mainly collected by use of a short semi-structured questionnaire which was carefully developed and pre-tested to ensure validity and reliability before use. The questionnaire was used to collect information on dairy production characteristics, education level ofhousehold head, major sources of household income, herd size, animal health background, general challenges, participation in trainings, available feed resources, labour activities and challenges in milk marketing and registration with cooperative societies. For respondents that were literate, the questionnaire was self-administered, while for the illiterate, it was filled with the help of field assistants.

Field observation

Farms identified in the target population were visited during milking time in the morning and evening. During the visits, information on farm structures and their physical characteristics, milking and milk storage practices, milking equipment, milk production, hygiene of milking personnel and farm premises and characteristics of the cows including the type of breed, were obtained by direct observation. Cleanliness of the milking area and milking containers was assessed using a scale modified from Ellis et al. (2006). For instance milking areas at each farm site were observed and scores were assigned on a 1 to 4 scale (score 1 = clean, no dirt; score 4 = very dirty, heavily soiled with mud, urine and/or dung). As regards to cleanliness of milk containers scores were assigned on a scale of 1 to 5 (score 1 = very clean, no dirt; score 5 = very dirty, heavily soiled with mud/dirt). A GPS was used
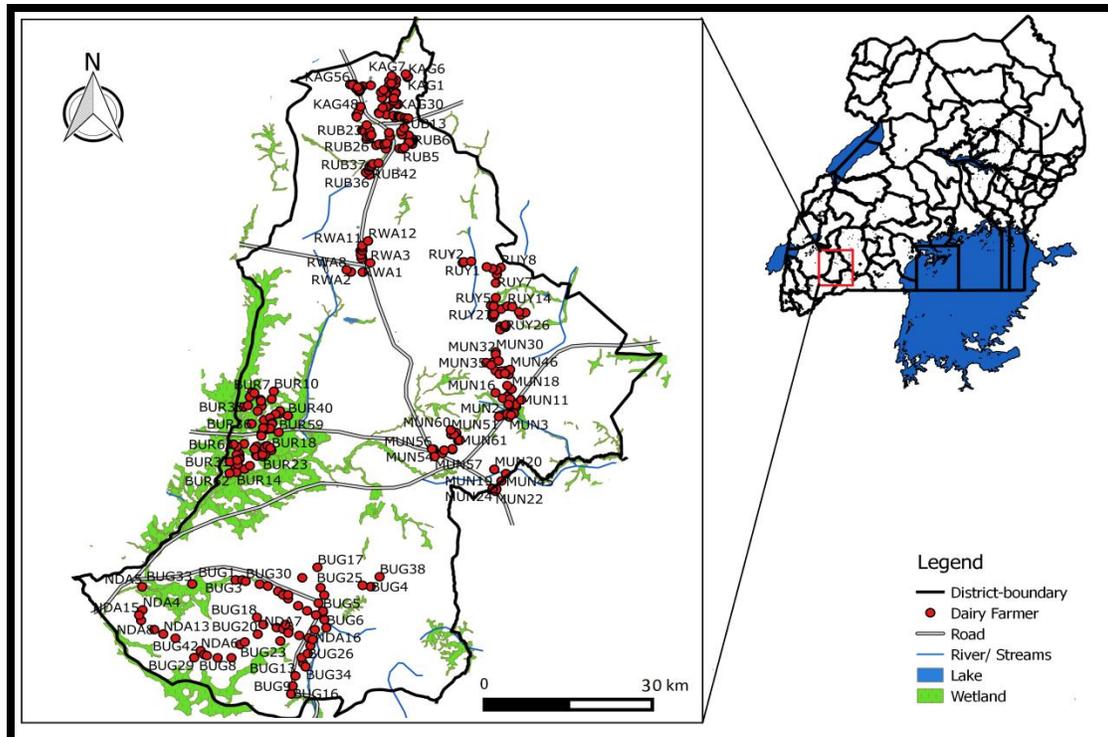
Figure 1. Map of Uganda. Extended is the map of Mbarara district showing the dairy farm households that participated in the study**.**

to note the location of the dairy farm households and the coordinates were used to generate the map of the study area (Figure 1) with the aid of QGIS (2014).

Data analysis

Data collected on milk handling practices during and after milking at farm household level were pooled, analyzed and presented in form of tables, charts and graphs. Furthermore, Somer's d was used as an asymetric measure to test for any assoiation between selected variables; this was archived using IBM Statistical Package for Social Science (SPSS) version 20 (2011).

RESULTS

Socio-economic characteristics

As indicated in Table 1, most respondents were male (74.9%) and the rest female. The majority (54.5%) of farm heads were above 46 years old and a considerable number (89%) of farmers were educated at least up to primary level. Furthermore mixed farming was a major occupation for most of the farmers (87.3%). The farmers supplemented cattle keeping with crop farming. Crops grown included bananas, maize, beans and coffee.

### Dairy production systems

A large percentage of the farmers (56.2%) had cross bred cattle and the rest had either exotic or local breeds (Figure 2). As indicated in Figure 3, the main grazing system practiced by farmers was paddocking (49.3%), while semi-zero grazing was the least practiced form of grazing (4.6%). 93.9% of the farmers fed their cattle on natural fodder while the rest fed the animals on hay/fortified fodder. In addition, only 35.4% of the farmers supplemented the cattle's diet with concentrates mainly comprising of residues from local beer brewing and maize germ.

Milk handling

According to Figure 4, the main source of water used during the milking process was from springs (39.5%), and a high percentage (51.9%) of the milking persons did not use any sanitizer when washing hands prior to milking. Only 58.5% of the farmers washed the udder prior to milking. However majority (43.5%) of those that washed the udder used cold water instead of warm water. Of the farmers that washed the udder 55.3% did not use any sanitizer when cleaning the udder. A high proportion of farmers (77.5%) did not test the milk for mastitis. Of those who tested the milk for mastitis (22.5%), the majority (20.5%)

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Table 1. Social economic characteristics of dairy farm households (n=347).

Variable	Percentage (%)
Sex	
Male	25.1
Female	74.9
Formal Education Level	
Uneducated	11.0
Primary	38.3
Secondary	20.2
Tertiary	30.5
Age of farm managers	
18-25	1.2
26-35	9.2
36-45	34.9
>46	54.8
Main occupation	
Livestock Farming	6.9
Mixed Farming	87.3
Salaried Employment	5.8
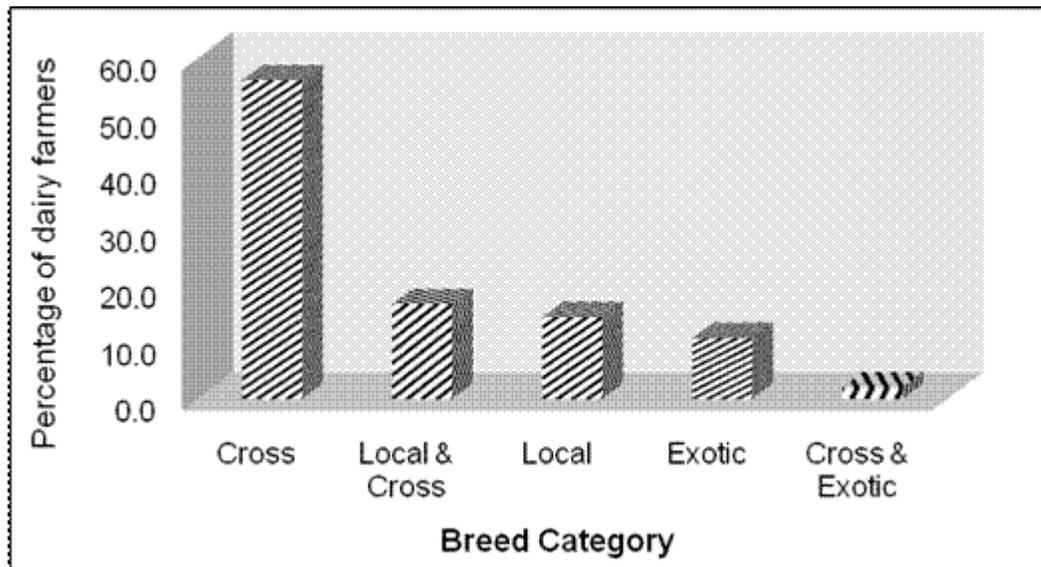
Figure 2. Percentage proportion of breed categories owned by farm households in Mbarara district.

used the strip cup method while the rest (2.0%) used the Californian mastitis test method. The milk that tested mastitis positive was often given to dogs or poured away. Most of the farmers (97.7%) carried out fore-stripping prior to milking. The main form of fore-stripping was calf suckling (89.3%), only 8.4% did it by hand. In addition, only 42.4% of the farmers dried the cow teats before milking. A very small proportion of the farmers (20.7%) carried out post-milking treatment of the udder. Nevertheless, 83.0% of the farmers had milking shades while the rest milked the animals in an open place. Regarding cleanliness of the milking area, only 22.2% had clean milking area and 18.2% milked from very dirty areas (Figure 5). The main type of milking containers
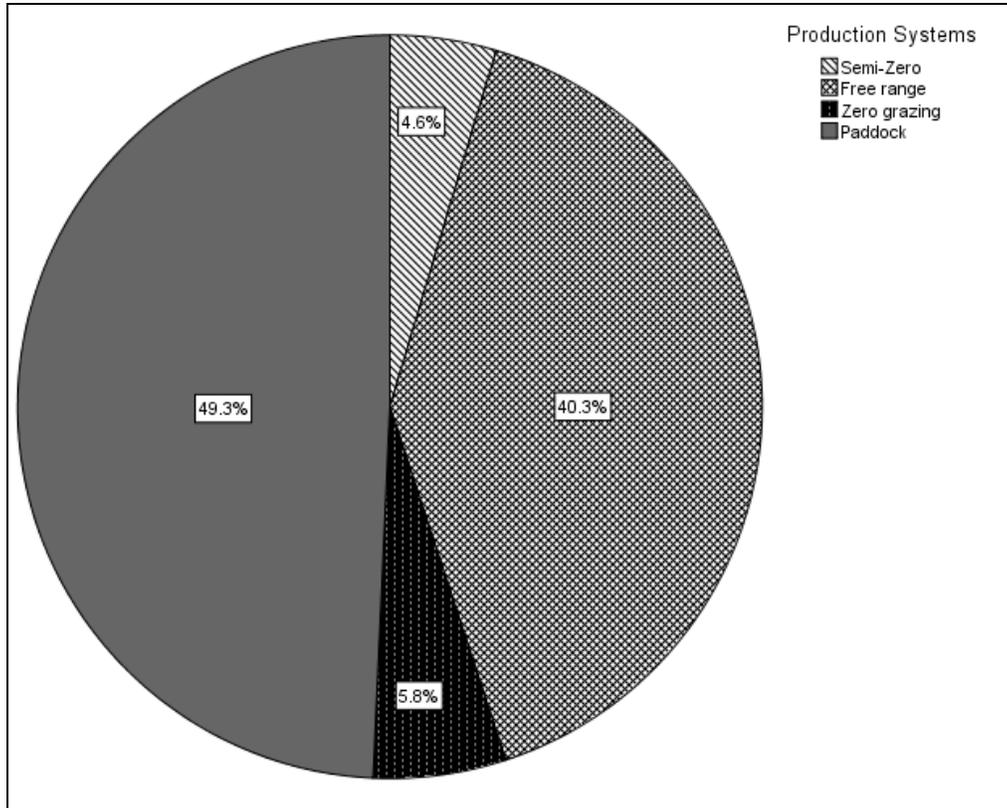
Figure 3. Different production systems practiced by dairy farmer households in Mbarara district.
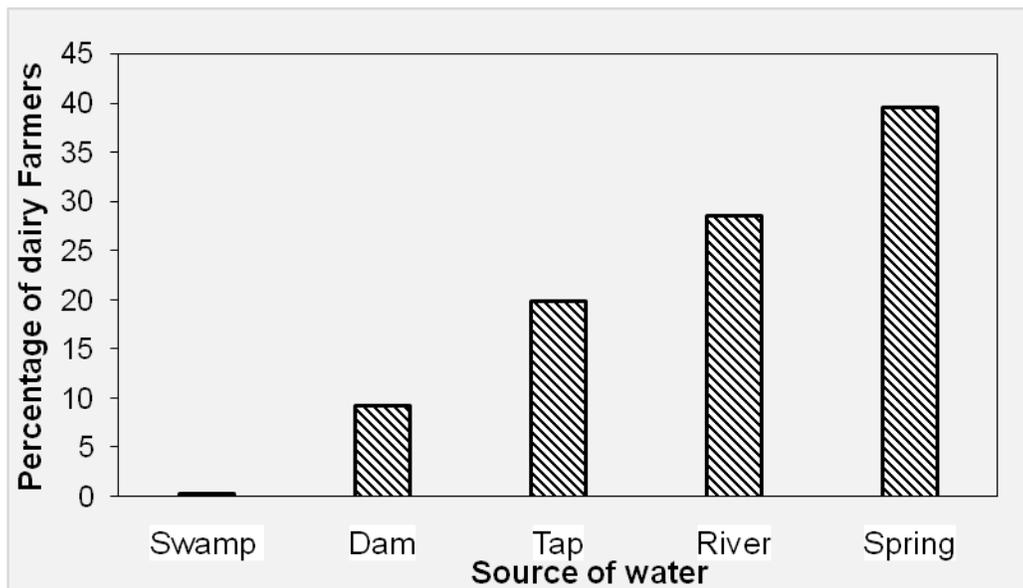

Figure 4. Sources of water used by the farm households in Mbarara district.

used was plastic (74.6%) while aluminium and stainless steel were used by only 11.5 and 13.8% of the farmers respectively. 55.0% of farmers had very clean milking containers while 4.0%, 20.5%,15.0% and 5.5% had clean, moderately clean, dirty and very dirty milking containers respectively. Milk bulking containers used by

farmers were mainly aluminium (49.3%) and plastic (45.2%) while the rest were made of stainless steel. Regarding cleanliness of bulking containers 58.5% of the farmers had very clean containers while 10.1%, 16.1%, 11.5% and 3.7% had clean, moderately clean, dirty and very dirty bulking containers respectively.

Farmers endeavoured to reduce milk spoilage by cooling and boiling. Only 28.2% of the farmers were found to have cooling systems. Majority of the farmers (70.3%) preserved unsold milk, mainly by boiling while the rest did not boil the milk. Farmers also donated milk to reduce wastage. 36.6% of the farmers donated milk monthly and of these 14.1% donated milk to relatives, 7.8% donated milk to church organisations, 9.2% donated milk to neighbours and 5.5% donated milk to friends. Only 34.0% of the farmers were registered and sold their milk to dairy co-operative societies while the rest sold the milk through informal channels such as neighbours, middlemen and schools. The main form of milk transportation from the farm to the buyers was by bicycle (54.6%). Other forms of transportation were on foot (32.0%), motorbike (11.4%) and the least used form of milk transportation was by car (2.0%).

In bid to add value and increase the shelf life of the milk only 28.2% of the farmers processed the milk to products such as butter and ghee.

Training on milk handling

In order to improve milk handling practices, farmers must or should receive formal training in milk handling. However only 42.4% of farmers reported to have received formal training on best milk handling practices. Somers' d test of association indicated a significant positive association between training in milk handling and cleanliness of the milking area and milking containers (Somers' d = 0.492 and 0.500, p = 0.00 and 0.00, respectively).

DISCUSSION

Results in Table 1 indicate that there were more males involved in dairy farming compared to females.These findings are in line with Wayua et al. (2012). However, they deviate from Atuhaire et al. (2014) who reported that in Jinja district there were more females involved in dairy farming than males on account of the Heifer Project International that targeted women for economic empowerment. Most farm household heads were above the age of 46 as also noted by Njarui et al. (2012) who documented a low contribution of youth in dairy farming. Perhaps this low youth participation may be attributed in part to inability to access capital since dairy farming is quite an expensive venture. Secondly, due the fact that most youth are still in school and thirdly, most youths in Uganda prefer to seek for white collar jobs in urban areas.   Results indicated a moderate education level attained by dairy farmers with at least half of them attaining secondary education. This may be attributed to the introduction of universal access to education. The paramount role of education in dairy farming cannot be overemphasised. High education levels have been associated with improved utilisation of available resources and adoption of new technologies required to improve milk production and handling practices (Alam et al., 2009).

It was observed that most farmers practiced mixed farming, possibly due to low milk prices and availability of market, as well as failure to access milk collection centres. A high proportion of farmers had cross bred cattle most probably because cross breeding is associated with a positive contribution to milk production by genetic improvement and environmental adaptation (Wang et al., 1992). Paddocking was observed to be the most common system of grazing in Mbarara district (Figure3) possibly as a way of parasite control and pasture management.. This may also be explained by the fact that cross-breeds unlike the pure local breeds are unable to trek long distances hence making paddocking the ideal form of grazing (Roschinsky et al., 2012). A considerably low proportion of farmers supplemented the cattle's diet with concentrates. Dairy concentrates are considered expensive and furthermore, very few farmers are aware of the use of dairy concentrates. Main source of water used during milking was from springs because it is the most available source of water as also reported elswhere by Njarui et al. (2014). A significantly high percentage of the milking persons do not use any sanitizer when washing hands prior to milking and when cleaning the udder. This may compromise the quality of milk produced under such condition. Most farmers claimed that sanitizers are expensive especially when one has many milking animals and they need skilled persons to use. Also the process of cleaning would be laborious and time consuming. Previous studies by Aleri et al. (2012) and Schooman and Swai (2011) also agree to this finding. Contrary to Gemechu et al. (2014), majority of the farmers allowed the calf suckle prior to milking, a practice which stimulates milk let down. A high proportion of farmers did not carry out mastitis test on the udder quarters before milking because most of them cannot afford the mastitis test kits and reagents, which they claimed were very costly. A very small proportion of the farmers carried out post-milking treatment of the udder. Most probably because they cannot afford the chemicals required for post-milking treatment of the teats (teat dipping). According to Saran (1995) teat disinfection aids in reducing contagious mastitis infections caused by *Staphylococci* and *Streptococcus* species. Evidence from previous studies has shown that, when practised continuously, teat disinfection after milking reduces new udder infections due to these organisms by 50% or more (Fox et al., 1991; Brightling et. al., 1998; Ruegg, 2004). A considerably high number of farmers milked the animals under unhygienic conditions; the milking areas were often covered in mud and dung, not to mention using soiled milk-
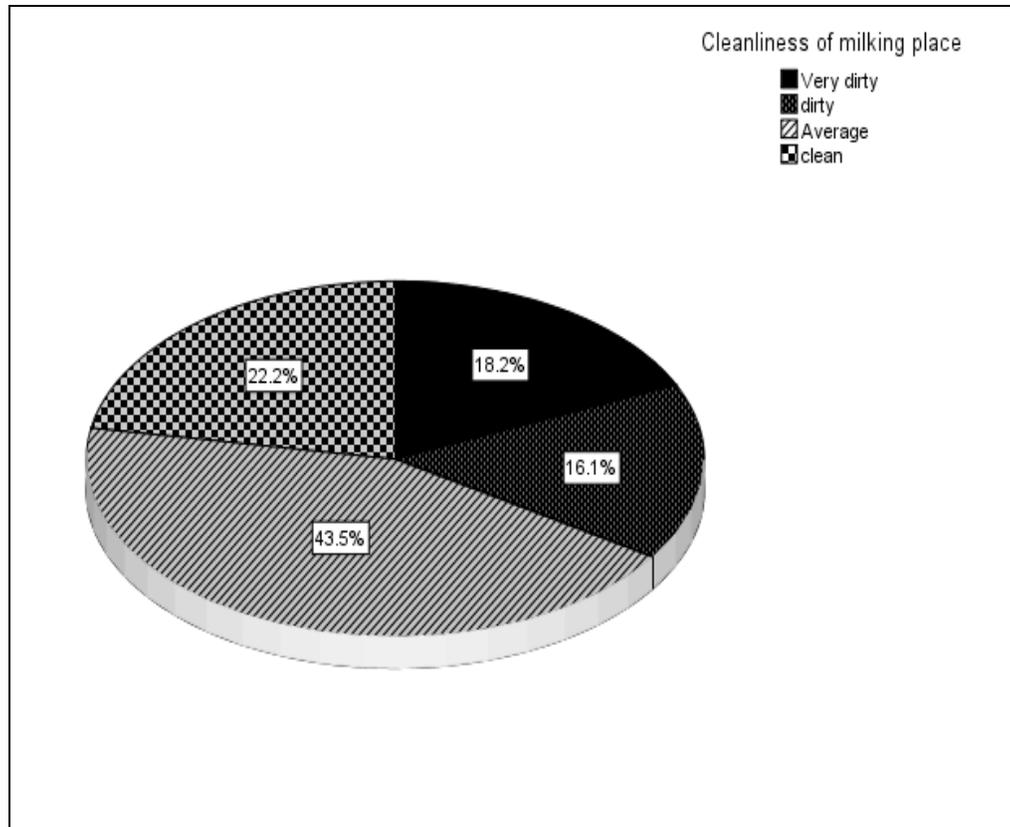
Figure 5. Cleanliness of milking place at the Dairy farms in Mbarara district.

ing containers, which could lead to milk contamination. As noted by Bonfoh et al. (2006) and Ghazi et al. (2010) cleanliness of the milking area and containers play a vital role in determining the quality of milk. Plastics that are not food grade were the commonly used form of milking containers. This may be due to the fact that these are cheap compared to stainless steel and aluminium containers as also reported in the findings by Wayua et al. (2012). However, as a result of efforts from the dairy co-operative societies and the DDA, most farmers are adopting the use of aluminium cans during milk bulking. Plastics used have a design that makes cleaning them very difficult. The milk residues retained in the grooves on the plastics support the growth of spoilage microorganisms (Bonfoh et al., 2006). A very low proportion of the farmers had cooling systems. This may be due to the fact that these equipment are unaffordable, too costly to run and maintain most dairy farm households. A similar situation regarding lack of electricity in rural areas has been singled out as a major setback for milk cooling (e.g Tijjani & Yetişemiyen, 2015) and this is exacerbated further by unstable power supply as often experienced in Mbarara district. Registration with the dairy cooperative societies was also low due to the fact that the societies often dictate on the price at which

the farmer should sell his/her milk and the payments are not made on time. This leads to farmers selling their milk through informal channels where they can get prompt payments. Better still, price per litre of milk in the latter may be higher than the cooperative society. The cooperative societies do not therefore provide competitive advantage in terms of milk price. Additionally, the strict rules and regulations set by the cooperative societies such as use of aluminium cans for milk bulking has caused withdrawal of some farmers from dairy cooperative societies because they cannot afford these cans.

The main form of milk transportation from the farm to the buyers was by bicycle. This is because it is a cheaper means of long distance transport for the farmers than the motorbike and car that require fuel, which is not affordable by most farmers. This is in line with the findings by Gillah et al (2015). Nevertheless a significantly high proportion of farmers have never received formal training on best milk handling practices.

This poses a challenge in producing and maintaining good quality milk since most farmers are unaware of potential sources of milk contamination during and after milking.

CONCLUSION

This study has indicated that on-farm milk handling in Mbarara district is characterised by both traditional and modern milk handling practices. The majority of the farmers still use plastic containers contrary to the recommended stainless steel or aluminium containers. Milk quality is further compromised by uncleanliness of the milking area and containers in addition to the source of water (open springs) used during the milking process. Poor sanitary practices such as improper cleaning of the animal udder, not using sanitizer when washing hands and calf suckling before milking predisposes the milk to potential sources of microbial contamination. This increases susceptibility of milk to spoilage and puts consumers at the risk of acquiring food borne diseases. However, the study also revealed that training farmers in proper milk handling practices improves the overall milk handling process. The study therefore recommends compulsory basic formal training of dairy farmers in milk handling practices in order to improve milk quality and possibly alleviate milk post-harvest losses that may occur at farm level.

ACKNOWLEDGMENT

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