

Full Length Research Paper

Survey on different factors influencing small-scale milking practices in a peri-urban area

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Managerial and financial abilities are amongst factors that contribute to profitability and survivability of small-scale farmers. Some rural and peri-urban areas have not adapted up to date milking techniques and hand milking is still the preferred method, especially for families that own one to six cows. Efficient milking techniques and impeccable hygiene standards are essential and the aim of the study was to determine the nature and extent of managerial, personal and milking practices of small-scale farmers in a typical South African peri-urban area. The questionnaire survey also provided a means of determining the level of understanding of the respondents in terms of milk handling, milking practice, animal health, as well as what kind of structures were used and the respondents' knowledge with regard to personal and general hygiene. It was found that the respondents were not accustomed to the clinical and sub-clinical signs of mastitis and were reluctant to associate their cattle with any illness. The general hygiene knowledge of the respondents was good and all respondents were aware that the cattle's health status can affect milk quality. The lack of proper herd management contributed to very low milk yield, unhealthy cows and a generally undesirable milking infrastructure.

Key words: Milk practices, small-scale farmers, milk quality, hygiene, dairy management, dairy farming.

INTRODUCTION

Environmental health in developing countries such as South Africa is mainly seen as a diverse science which plays an important role in the health and welfare of the people. The Department of Health in South Africa attempts to ensure a safe environment not only for the more privileged but also for the poor, through the provision of basic health services and hygiene practices. Due to the racial segregation policies of the past, the previously disadvantaged communities have suffered much in terms of lack of environmental health information and services. One of the cultural traditions that remained with the previously disadvantaged communities, however,

is the keeping of animals such as goats, pigs, sheep and cattle near their houses. These animals are kept as a sign of wealth and as subsistence farming for the family to provide in their daily needs. Milk compared to meat is one of the primary food products in these households and here raw milk is preferred over pasteurized milk (Walton, 1956).

When the amalgamation of rural and urban areas took place, the South African Health Regulations (R236 of 1973) did not change and amongst others, the regulations prohibited the keeping of any farm animal in a residential area. The owners of these animals were not taken into consideration and it therefore became a major problem in such communities to accommodate the animals. In a survey by the Animal Nutrition and Animal Products Institute, Irene, it was indicated that the sector of smallholder dairy farmers in the peri-urban areas were

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however on the increase (Banga, 2001). Nayagets (2005), reports that small-scale farmers are diversely populated as they are from low, middle and top class families with 75% of these farmers mainly from poor backgrounds. There are about 525 million farmers worldwide and Africa host 8% of this total and within this percentage, 33 million (80%) represent farmers from Africa who contribute to the production of Africa in general. Nayagets (2005) further reports that 90% of the total agricultural production is mainly from Africa. Moreover, 40% of small-scale farmers depend on farming activities in South Africa for their daily living (Machette et al., 2004).

Generally, milk quality starts with proper management and the animal's health status which additionally has a definite impact on the quality of milk. However it was found that the quality of milk derived from the subsistence farming was seriously neglected (McNitt, 1993; Jansen, 2003; Srairi et al., 2009). The bacterial population of freshly drawn milk from a healthy cow is largely derived from the environment within which the cow is kept as well as the equipment through which the milk passes and the container in which it is stored. There are thus numerous factors which could influence the quality of milk as a whole, the most common being handling, temperature, storage and packaging practices. Management of the herd and milking shed can contribute to healthy milk with a low bacterial count; and Coetzee (2000) confirms this by reporting that management is the most important aspect of the milking procedure and when knowledgeable management is in place, bacteriological counts as low as 5 000 to 6 000 bacteria per millilitre are realistic.

In addition, to the above, efficient milking techniques are essential, especially when milking is done by hand. McNitt (1993) mentions that in South Africa the average number of cows hand-milked per man per hour was five and a decade ago, statistics from the major milk producing countries indicated an annual decline in the number and size of sheds where hand-milking was practised (World Health Organization, 1996). The labour productivity in such hand-milking herds is low, with a few cows per person involved. The duration of milking each cow is long with a relatively slow milk extraction rate compared to machine-milking. This contributes to lower average lactation yields in hand-milked herds. Nevertheless, for small-scale farmers, especially in rural and peri-urban areas, hand-milking is the method of choice, because maintenance and cleaning is minimal with little or no capital investment on equipment.

Good hygiene standards are required during milking and as a result clean milking cloths and hooded milking buckets are necessary to prevent dust, dirt and udder hairs from falling into the milk. The udders and tails of cows need regular clipping before milking begins. Moreover, the foremilk should be drawn and examined and all visible dirt should be removed from the udder and

teats, thorough washing and drying off with disposable towels must be done. Milking should commence with clean, dry hands, using the full hand in preference to just a finger and thumb, which could lead to misshapen udders and teat injuries. It is best to milk the rear quarters first as they contain the higher proportion of milk. Whether you are utilising hand or machine for milking, the cow should be adequately prepared for all the milk to be removed from the udder; the milk should then be cooled within 3 hours or transported to a cooling facility (Bodman and Rice, 2002; Schreiner and Ruegg, 2002).

Personal characteristics, personal interests as well as practices including one-sided technical choices normally form part of good management practices and motivate the producers to change hygiene practices to result in better yield (Barkema et al., 1998; Chassagne et al., 2005). As a result, due to lack of studies on milking practices and personal hygiene as well as plans to develop the small-scale farmers into recognised business farmers, particularly in this typical peri-urban area, it became the aim of this study to determine the nature and extent of management, personal hygiene and milking practices of these small-scale farmers in this typical peri-urban area of South Africa.

MATERIALS AND METHODS

Outlining of the study area

The area populated by previously disadvantaged people that formed part of the study is situated about 55 km from an urban city. The socio-economic structures vary from formal to informal structures and although there are a few flush toilets connected to septic tanks, the greater part of the population make use of the bucket system, and in some areas latrine facilities are non-existent. Every stand has its own water supply, except where new structures are erected. The main power sources are electricity, wood, paraffin; candles and/or gaslight are usually used as the main light source. In the community are four schools, a police station, municipal offices and a primary health care clinic.

Cattle holding pens are mostly situated at the four corners of the residential area, with a minimum number of cattle in the residential area which are kept close to the owners' house. These cattle are normally housed in medium-sized holding pens at night. Most of the holding pens are built from wooden and/or steel poles with wire fencing attached to the poles (Figure 1). Neighbouring holding pens are joined, and open into a gathering holding pen where all the cattle are gathered before they go out for grazing. Grazing takes place on municipal land or any vacant area surrounding the residential area. One person is normally responsible for supervision of the cattle and is paid an amount by each small-scale farmer per month for his/her duties.

Sampling protocol

A geographical cluster of fifty-seven (n=57) small-scale farmers were identified in this typical peri-urban area in South Africa of which 89.5% participated in the study. All the selected farmers kept cows and housed them in, close to their own homes. The questionnaires used in the descriptive study were compiled in



Figure 1. Structures (A-D) of typical holding pens where cattle are gathered and kept before grazing.

English and translated into the local native language. Information was gathered pertaining to the demographic background, infrastructure, and condition of cattle, milking techniques and hygiene knowledge and practice of milkers (Barnouin et al., 2004).

Statistical analysis

The questionnaires were encoded after the completion of all questionnaires and a coding table was developed into which the

respective codes were captured. All statistical calculations were done using Microsoft Excel 2007 software.

RESULTS AND DISCUSSION

A total of 54 questionnaires were completed (94.7% response rate) for the present study and Table 1 summarizes the information that served as a background

Table 1. Demographic, cattle and infra-structure information of the small-scale farmers living in a informal settlement in the selected peri-urban area.

Demographic	0	1	2-3	3-5	5-7	More than 7	
Number of children in household	7.5	3.8	39.6	24.5	20.8	3.8	
Number of adults in household	0	1	2	3-4	More than 4		
	1.9	11.3	41.5	30.2	15.1		
Cattle owned and milked	1	2	3-4	5-6	more		
How many cattle do you own (n = 52)*	1.9	21.2	30.8	9.6	36.5		
How many cows are currently milked (n = 52)*	44.2	32.7	15.4	1.9	5.8		
Infra-structure	Once	Twice	Three times	More			
How many times a day do you milk your cattle	69.8	30.2	0	0			
	At home	In the field	On an enclosed area in the field	Under a specific tree	At a self-constructed milkshed	At a nearby registered milkshed	Other
Where do you milk your cattle	7.5	13.2	62.3	0	15.1	1.9	0
Do you sell milk to other families	yes	No					
	39.6	60.4					
Has a veterinarian or technician ever treated your cattle.	13.2	86.8					
^a Have your cattle been ill recently (n = 53)* ^a	21.2	78.8					
	Coughing	Diarrhoea	Scars/bleeding/swelling or any visible disorder of the udder	Loss of appetite	Prostration	Other	
^b If "Yes" what symptoms did the animal show (n=9)*	0	11.1	0	55.6	22.2	11.1	
	Do not treat them at all	Treat them myself	Go to senwes for medication and advice	The local veterinarian	Other		
If your cattle are ill, where do you take them? (n = 37)*	0	29.7	46	24.3	0		

*Frequency (n) value only indicated in cases where the full amount of respondents did not answer the question. ^a and ^b are related questions.

to the residential profiles of the households and infrastructure evaluated in the study. The households were smaller than expected with the majority of families having 2-3 children and 2-4 adults per household (any person older than 19 years of age was regarded an adult) (Table 1).

It was noted that 75% of small-scale farmers in the present study only obtained education background at primary level (data not shown). Moreover, the infrastructure and way of life of this community was related to their habits and the accessibility of resources such as water, which often precluded their implementation of proper milking practices (Matthewman, 1993).

At the time of data collection 36.5% of the respondents owned more than 6 animals while 1.9 and 21.2% indicated that they owned one or two animals respectively. The average number of cattle owned by the small-scale farmers in this peri-urban area was 6 cattle per household with an estimated total of 342 animals (data not shown). During the milking process it became obvious that farmers only milk the required amount of milk needed by the families. The farmers use the calves to suckle from their mothers to stimulate lactation and directly commenced with hand milking without washing the teat and udder. This practice has obvious hygiene implications to their respective families especially to the immuno-compromised individuals and young children. Table 1 further indicates that 39.6% of respondents sell milk to other families, which is a high percentage when considering that there is no or little control over these supplies.

Steenkamp (1999) notes that milk production increased by 20% when milking three times a day compared to only twice a day, it was found that 69.8% of all small-scale farmers were only milking once a day and 30.2% twice a day (Table 1). The average quantity of milk retrieved by farmers in the study area (from 1 - 5 L per session) is much lower than would be expected from typical healthy cows in full lactation (*circa* 96 L per household taking the average number of 6 cows per respondent into account as well as the fact that a healthy cow should produce ± 16 litres of milk per session) (Rasby, 2006). This low milk production in relation to the number of cows milked is likely to be the result of farmers not milking the animals to full capacity. It is clear that the cows are poorly managed in terms of lactation periods, and are often kept as a valued asset and not as a milk producer. There is also poor and improper milking management, ineffective milking practices and ineffective or deficient cattle care. Lack of domestic infrastructure such as running water, electricity and refrigerators undoubtedly contribute to the predicament of the farmers in terms of milk production and preservation. Barnouin et al. (2004), reports that good managerial and breeding practices can improve and control clinical and sub-clinical udder infections, a

practice which can affect most of the cattle positively in the present study.

62.3% of small-scale farmers milk in an enclosed area in the field (Table 1), whereas 15.1% milk in self-constructed milk sheds, 13.2% in the open field and 7.5% cows got milked at home. Figure 1 shows that no physical structures exists other than the holding pen structure of wire, wood and steel poles. None of the holding pen structures had a cement floor and thus the milking area could not be properly cleaned or sanitized. Hammer and Babel (1957) conclude that the contamination from external sources is considerably reduced when the cows and floor are cleaned, the manure removed on a daily basis, utensils sterilized and the udders and teats of the cow washed. The authors thus suggest that the milking environment has a marked effect on the quality of milk produced.

The health conditions and treatment of cattle are also presented in Table 1 and this aspect is of primary importance because the health of the cattle has a direct effect on the quality of milk produced (Hillerton, 1996; Blowey and Edmondson, 2000; Tybor and Gilson, 2002). 86.8% of respondents indicated that none of their cattle had ever been treated by a veterinary surgeon, whilst 78.8% of the respondents indicated that their cattle had recently been ill. 55.6% of the respondents indicated that a loss of appetite was the most apparent sign of illness (Table 1). Loss of appetite is one of the most common indicators of poor health and the presence of illness. McNitt (1993) and Kirk (1993) point out that apart from loss of appetite; a further common sign of mastitis infection is an elevated body temperature and depression. It is further suggested that all milk-producing cows should be routinely examined for the presence of disease.

Results in Table 1 further shows that a notable percentage (46%) of respondents consulted a local agricultural retailer for medication and advice whilst the remainder of respondents treated the cattle either themselves (29.7%) or take the cattle to a local veterinarian (24.3%). The importance of animal health is of primary concern when one considers the number of animals owned by the small-scale farmers, keeping in mind that some of the illnesses could be contagious and could affect the entire animal population as well as the quality of milk derived from these animals. Sato et al. (2005), reports that animals that do not receive any antibiotic treatment as it seem to be the case in this study, will end up with higher culling and disease rate. However, this kind of cattle keeping without treatment can be associated with organic dairy production, a procedure reported to produce safe and wholesome food as well as keeping the environment safe (Sato et al., 2005).

In Table 2 the milking techniques that were used by the small-scale farmers during milking practice are described.

Table 2. Milking techniques utilised by farmers in a peri-urban area.

	Only you	One	I have one helper	I have many helpers			
How many people milk your cows	47.1	11.3	20.8	0			
	Father	Mother	Grand-parants	One of the sons	One of the daughters	Friend or neighbour	Other
Who is responsible for milking the cows	35.8	1.9	0	24.5	0	3.8	1.9
	Yes	No	Sometimes				
When you milk a cow do you chain the back legs together	81.1	18.9	0				
Do you wash the udder of the cow before you start to milk	86.8	13.2	0				
Does soil from the udder or faecal material/urine enter the milk when you are milking (n = 51)*	17	74.5	7.9				
Do you start milking directly after the cow has given birth	32	68	0				
Do you milk a cow that appears ill (n = 52)*	3.8	96.2	0				
Do you continue milking a cow that has mastitis (n = 44)*	9.1	90.9	0				
Do you milk a mastitis cow separately (n = 36)*	80	20	0				

* Frequency (n) value only indicated in cases where the full amount of respondents did not answer the question.

47.1% of the respondents indicated that their helpers were restricted to not more than two people. The father was found to be primarily responsible for milking (35.8%) whereas in 24.5% of the cases it was one of the sons. This aspect is important because the more handlers there are, the more difficult it becomes to educate farmers and to control the milking practice applied. Table 2 furthermore indicates that 81.1% of the respondents tied the back legs of the cow together during milking as shown in Figure 2. 86.8% of the respondents indicated that they wash the udder of the cow before they start milking and 74.5% indicated that no dirt from the udder, faecal material or urine enters the milk while they are milking, 17.6% indicated that dirt does enter the

milk and 7.9% indicated that it sometimes enters the milk during milking. This suggests that the respondents are aware that contamination from external sources can occur, but due to neglect or limited vision during the early morning hours when milking takes place, it is accepted as normal practice.

Table 2 further shows that 32% of the respondents start milking the cow directly after it has given birth. This practice is highly undesirable, as the natural bacterial count in milk after giving birth is much higher than normal. The colostrum is very rich in vitamins and minerals and has a naturally higher bacterial count. It is known that the cow should be separated from those being milked for a period of fourteen days

prior to calving and five days thereafter. 96.2% of respondents indicated that they do not milk a cow that appears ill, while 90.9% indicated that they do not continue milking a cow that has mastitis. When questioned as to whether the cattle were milked separately when they suffer from mastitis, 80% of the respondents indicated that they do separate them. This practice is ideal and care should be taken, by thorough hand-washing to reduce bacterial transmission to healthy cows nearby. Schreiner and Ruegg (2002), reports that mastitis continues to be the most frequent costly disease that leads to production losses of dairy farm and one of the ways to reduce exposure to potential udder pathogens is via docking, a method seldom used by small-scale farmers in the



Figure 2. An employed milker utilising a tail of the cow to wipe his hands before and after milking.

present study.

Table 3 outlines the level of hygiene knowledge and related milking practice of the small-scale farmers in this study. In terms of personal hygiene, 90.6% of the survey indicated that respondents do not visit a toilet facility prior to milking their cattle. Most respondents (54.7%) indicated that they wash their hands before and after milking. When milk is carried to the household, 96.2% of the respondents indicated that they cover the container in which the milk is transported. 94.3% state that they pour their milk from the milking bucket into another container to be used in the household. This practice increases the handling of the milk product and the hygiene of the second container could contribute to microbial contamination. Of the 94.3% respondents who transfer their milk from the milking bucket to another container, 82.3% used a plastic bucket with a lid, 15.7% a plastic or a glass bottle and 2% a plastic bucket without a lid for storage.

Table 3 furthermore indicate that 98.1% of the respondents do not add milk to the previous day's milk. The time period between milking and consumption is relatively short and the survey indicated that most of the first milk was consumed shortly after 10h00. 20% of respondents indicated that they consumed the milk

directly upon arrival at home. The remaining milk is consumed after 13h00 (51%) and during the evenings (20.4%). Many of the respondents consume milk that has become sour (38.6%) and thick (36.4%). None of the respondents indicated that they consume milk that contains clots, visible signs of dirt/foreign objects, notable signs of fermentation or contamination in or on the milk, or signs of blood (Table 3).

The respondents indicated that during the summer 69.8% keep their milk in a refrigerator while 11.4% indicated that they keep it at room temperature in the kitchen. 9.4% of the respondents indicated that they keep their milk on the floor or in a nearby tree during the summer months to keep cool. In winter, 47.2% prefer to keep their milk in a fridge, 37.7% in or on top of a kitchen cupboard, 9.4% on the floor and 3.8% in a tree near the house (Table 3).

The respondents' knowledge of hygiene was surprisingly high as the entire population knew that personal and general hygiene is important whereas 60.4% of the respondents knew the meaning of the term "hygiene" and 100% reasoned that if the cattle were ill the milk would be of poor quality. 64.7% of those taking part in the survey were of the opinion that bacteria are present in milk. A total of 52.8% of the respondents indicated that

Table 3. Hygiene knowledge and milking practices of per-urban area small-scale farmers.

	Yes	No						
Do you know what the term "hygiene" means.	60.4	39.6						
Do you visit the toilet before milking your cattle	9.4	90.6						
	After milking	Before milking	During milking	Before and after	Not every day	Never		
When do you wash your hands	0	37.7	1.9	54.7	1.9	0		
	Yes	No	Sometimes	Never				
Do you cover the container when you are carrying the milk home	96.2	1.9	0	1.9				
^a Do you pour the milk from the milking bucket into another container for the household	94.3	5.7						
	Plastic or glass bottle with lid	Plastic of glass bottle without lid	Plastic bucket with lid	Plastic bucket without lid	Other			
^b If yes, into what do you pour it (n=55)*	15.7	0	82.3	2	0			
	Yes	No	Sometimes					
Do you pour the fresh milk with the previous day's left-over milk	1.9	98.1	0					
	Directly	After 5-10 min.	After 15-30 min.	Before 10 am.	After 10 am.	After 1 pm.	At night	Other
How long after you have milked, do you consume the milk for the first time.	20	4	10	18	34	12	2	0
How long after you have milked, do you consume the last of the milk (n=53)	0	0	4.1	4.1	6.1	51	20.4	14.3
	It has become sour	It has become thick	It contains clots	Visible signs of dirt or foreign objects in milk	Visible signs of fermentation or mould growth in or on the milk	There is blood in the milk	other	

Table 3. Contd.

	38.6	36.4	0	0	0	0	0
Do you sometimes consume milk that appears as follows							
	In the tree near the house	In a fridge	In or on top of a kitchen cupboard	Near a stove	On the floor	Other	
Where do you keep your milk during summer	9.4	69.8	11.4	0	9.4	0	
Where do you keep your milk during winter	3.8	47.2	37.7	0	9.4	0	
	Yes	No	Sometimes				
Is personal and general hygiene important when you are milking the cow	100	0	0				
Do you think there are germs in milk (n=55)	64.7	31.4	3.9				
Do you think you can become ill from milk	52.8	45.3	1.9				
Do you think the milk will be bad when your cattle are ill	100	0	0				
Do you milk the cattle yourself when you are ill (n=54)	5.7	94.3	0				

* Frequency (n) value only indicated in casas where the full amount of respondents did not answer the question. ^a and ^b are related questions.

one could become ill from milk whilst 45.3% indicated that one could not become ill from milk. In conclusion, the respondents were not familiar with the clinical and sub-clinical signs of mastitis and they were reluctant to associate their cattle with any illness. Figure 3 shows two photographs of sores and infection in the herds, which confirms suspicions that there are undetected illnesses and infections present in the herds. The period between milking and consumption of milk was found to be relatively short and this is ideal as the multiplication of microbial growth can be prevented by reducing growth time. The practice of milking a cow directly after it has given birth

would also have a direct influence on the bacterial counts of the milk. Although the majority of respondents reported that they keep their milk in a refrigerator during the summer season while about half prefer to keep it in a refrigerator during winter, this does not agree with the actual infrastructure available in the households (in reality, only $\pm 30\%$ of households own a refrigerator). It is thus likely that the respondents gave the answers that they thought were expected of them, especially in cases that directly touched on their socio-economic status.

The general hygiene knowledge of the respondents was notable, as shown by the large

numbers of respondents who covered the milk with a lid. This practice is obviously advisable, and the respondents were, without exception, aware that personal hygiene is important. All of the respondents reasoned that if the cattle were ill the milk quality would be poor and the majority understood the meaning of the term hygiene. Apart from the ointment Vaseline (Elida Ponds (Pty) Ltd.), the majority of farmers do not take water or soap for hand cleansing with them.

However, the lack of proper management of the herd and milking infrastructure appears to be a major contributor to the ineffectiveness of milking and poor hygiene of the milk. For example, the



Figure 3. Animals with signs of illness belonging to the small-scale farmers in the informal settlement peri-urban area.

amount of milk retrieved by farmers is much lower than the optimal amount of milk that could be retrieved from 6 cows (the average per household in the area). The dairy animals are kept in primary holding pen structures, which

do not protect them from environmental conditions, and water is not abundant. The respondents had to travel at least one kilometre to attend to milking and the likelihood that their hands would be re-contaminated should be

kept in mind. Figure 2 shows a milk handler who wiped his hands with the tail of a cow in the absence of water and soap for proper hand-washing. This practice is totally unacceptable and is likely to contribute to the microbial contamination of the milk and even to the likelihood of the cow to develop mastitis. Animal hides are well known sources of coliform, other faecal-related as well as spore-forming bacteria.

Based on the present study, it is recommended that the farmers themselves be educated on correct care for their animals and on what is expected from a milk handler with regard to milking practice and milk quality; education sessions be formulated to include all aspects considered in the questionnaire; sponsorships be sought with regard to products such as mastitis test kits, in order to improve the knowledge and practice of the milk handlers; the local municipal health official/health inspector obtain a register for maintaining control over the farmers as well as to ensure a healthy product, although due to lack of manpower this would be an ideal situation; all municipalities be encouraged to obtain information regarding these small-scale farmers and to compile registers for these farmers who produce milk, regardless whether or not it is only for their own personal use; and the placement of cattle in a central area or areas outside residential areas be undertaken by each local council to establish control over roaming animals, registered milking cattle and milk handler/informal small-scale farmers. It should furthermore be kept in mind that the aim is not to abolish the practice or to eradicate the keeping of cattle by small-scale farmers but to educate the communities and handlers in order to obtain a good, wholesome and safe product for human consumption under controlled conditions in the peri-urban area.

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