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Trends in Hand Milking and Machine Milking in Kenya

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Abstract: Dairying in Kenya is characterized by small scale and labour intensive operations such as hand milking. The aims of this research were to determine trends in milking by hand by milking machines and technology needed for dairying. The research used an interview schedule and convenience sampling method in Naivasha, Nakuru, Eldoret, Kitale, Nyandarua and Nairobi Regions. A total of 74 farmers milking by hand, 8 farmers using milking machines, 50 experts in Kenyan dairy sector, 5 dairy processors and 9 dairy equipment dealers were surveyed. The results indicated that the breeds reared were either pure or crosses of Friesian (56%), Aryshire (30%), Jersey (7) and others 7%. The breeds reared by farmers milking by hand and machine were not significantly different. About 9.7% had adopted milking machines and skilled hand milking personnel were 13%. The duration of milking by hand was mostly (62%) above recommended time (7 min). Majority of farmers (95) and 96% of experts recommended adoption of milking machines for high milk quality, improved production and health of animal throughout lactation periods. The reasons farmers were not using milking machines were the cost and few herd. Farmers who milked by hand and supplied milk to dairy processors were 42% of this, 37% had their milk rejected for failure to meet quality standards. Each of sampled dairy processors received 60-70% of milk processing capacity per day. Adoption of milking machines has been prevented by high initial and operation costs, lack of designs applicable for farms with <20 cows, sensitization and diversified marketing. The ones using milking machines are challenged with inadequate water and electricity.

Key words: Hand milking, machine milking, challenges, technology needs, sensitization, diversified marketing

INTRODUCTION

Kenya produces over 3 billion litres of milk per year, 70% of which is from dairy cattle. Total milking herd is approximately 27.7 millions of animals (Muriuki, 2011). Milk production is mainly from cattle, camels and goats. Smallholder farmers dominate dairy production (80%), with limited land and small dairy herds (Majiwa *et al*., 2012). Milking is one of the major and final operations that determine profitability of a dairy farm. However, farmers are faced with several challenges that include low productivity, poor hygiene and hand milking routines. Hand milking exposes dairy animals to injury, dangers of disease transmission and incomplete emptying of the udder which complicate the health of the cow as well as subsequent milk yield (Dzidic, 2004; Millogo, 2010). Hand milking is slow, very tiresome and unhygienic. It is difficult for milkers to milk each cow within seven minutes. These challenges can be mitigated by investing in machine milking. The cost of farm machinery is high and/or not suitable for small scale farms which have minimized mechanization, hindering maximum yield.

The models of milking machines imported into Kenyan market; majority of small scale farmers cannot afford to buy and use. They require high initial capital and huge investment in electricity supply. Secondly, the design specifications for milking machines may be based on requirements of dairy industry of countries of origin which would vary with Kenyan dairy industry requirements. Factors such as type/breed of dairy cattle reared, milk production per cow and average number of dairy cattle per farmer influence design specifications.

The research was conducted in some Kenya's dairy hub (Naivasha, Nakuru, Eldoret, Kitale, Nyandarua and Nairobi) that established local dairy trends. The aims were: to assess current usage and demand of milking machines, determine type and average number of cattle reared per farmer, challenges faced by farmers milking by hand and by a machine and obtain measures required to be undertaken to improve Kenyan dairy sector.

MATERIALS AND METHODS

Research methods: A stratification was done into six regions; Naivasha, Nakuru, Eldoret, Kitale, Nyandarua and Nairobi. Figure 1 shows a section of Kenya map where the survey was done. A further classification of

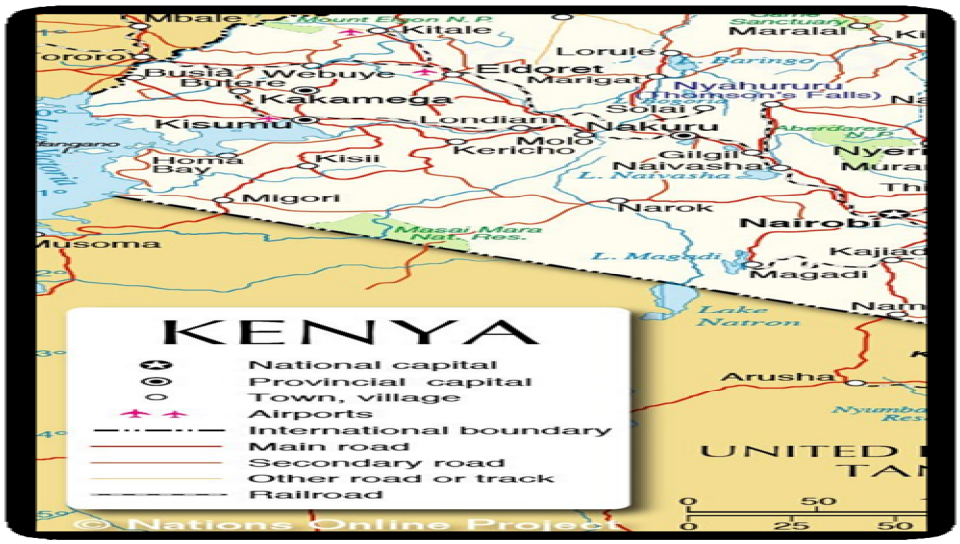

Fig. 1: Section of Kenya map where the survey was done

respondents was done into farms milking by hand, farms using milking machines, experts, dairy processors and dairy equipment/machines dealers. Fifteen samples of farms doing hand milking were chosen from each region except Nairobi. Due to low adoption of machine milking, uniform sample size per region was unattainable. Four farms machine milking were surveyed in Nakuru and two in Naivasha. In Nyandarua, Eldoret and Kitale one sample was surveyed in each region.

Experts were drawn from dairy training institutes, dairy processing industries/equipment dealers, research and development institutes. The minimum qualification was a bachelors degree and in a position of a lecturer, supervisor or researcher in dairy sector. They were interviewed at their respective places of work. Six dairy equipment/machine dealers were from Nairobi and three from Nakuru. The dealers would not be found in other regions. Two dairy processors were sampled in Nakuru and Nyandarua, one was from Naivasha. No processor was assessed in Eldoret, Nairobi and Kitale.

A convenience sampling method was used to reach respondents. The survey was done from January-March 2015. It involved observation on milk production systems, interviewing and filling questionnaires that had been pretested. The data was analyzed using SPSS Version 22 and Excel 2007 Microsoft programme. The analysis was mostly descriptive.

RESULTS AND DISCUSSION

A total of one hundred and forty 6 samples were obtained, 74 were farms milking by hand, 50 experts, 8 farms using milking machines, 9 dairy equipment/machines dealers and the remaining 5 were dairy processing plants.

Table 1: Dairy cows owned by farmers milking by hand

Variables	Dairy cows	Frequency	Percentages	Total (%)
This category can use	50-60	10	13.50	27
bucket milking machines	40-49	4	5.40	
	25-39	6	8.20	
This category may find it	15-24	10	13.50	73
uneconomical to use	10-14	10	13.50	
current designs of	5-9	16	21.60	
any milking machines	1-4	18	24.30	
Total	74	100		

Trends in milk production and management: The study showed that majority (54%) of farmers milking by hand had a dairy herd of 1-10 cows (mean of 6). About 27% had a herd of 25-58 cows. Table 1 shows number of cows owned by farmers milking by hand. The breeds were either pure or crosses of Friesian (56%), followed by Aryshire (30%), Jersey (7%) others were 7%. Friesian cows dominated small holder farms in Western Kenya (Wanjala and Njehia, 2014) which agrees with this research. Majority of milking people were Semi killed 58%, unskilled 29 and skilled 13% (had training). About 60.5% of farms hired milking people. Unfortunately, most milking personnel highlighted that they were not happy with milking routine work. This was noted as the rate of hiring was temporary and frequent worker's exit. About 39.5% farms used family members as milkers. If different people milk, clear milking routine instructions and training are necessary for quality milk production (Ruegg, *et al*., 2005).

The farms using milking machines were 9.7%, the ones who used herringborn (parlour system) milking machines had a herd of 400-800 (37.5%) and 100-400 (50%). About 12.5% had herd of around 25-40 cows and had adopted bucket milking machines. Table 2 shows total herd owned and milked by farmers using milking

Table 2: Total dairy cows and milked cows for farmers using milking machines

Total dairy cows	Milked cows	Percentage milked
162	48	30
325	140	43
320	144	45
150	58	39
40	25	63
450	220	49
473	320	68
800	600	75

Table 3: Factors that have prevented farmers from using milking machines

Factors preventing the use of milking machines	Percentage of farmers
It is costly to buy, install and operate	53.3
Have few cows	20.2
Have no access to electricity	11.1
Have no knowledge of the importance of using milking machines	4.4
Low milk yields	4.4
Lack of appropriate farm structures	4.4
Not aware that milking machines exist	2.2

Researcher's calculation

machines. In about 62.5% of farms machine milking, milking herds were below 50% of the total herd. The mean of milked herd to total herd was 51%, a higher rate than one indicated by Kenya dairy board 32.3% survey by Anonymous (2013). The means of Kenya dairy board was based on farmers milking by hand and those using milking machines (all dairy farmers) which might have pulled the mean down. The mean of this study (51%) is based on farmers using milking machines. This indicates that embracing technology in farms increases productivity. The breeds reared by farmers using milking machine were Friesian which accounted to 56, Aryshire 32, Jersey at 7 and other breeds were 5%. The difference in breeds reared by hand milking and machine milking farmers were not significantly different.

The time spent in milking each cow is very important in ensuring that maximum milk yield is attained throughout the lactation periods. The time of milking each cow by hand is a function of milk yield per cow and skill of a milking person. The 7 min is the recommended maximum. However, 62% of farmers milking by hand exceeded this time with a number of them going up to twenty minutes. It was encouraging to note that some farmers had information that they should milk within seven minutes. The duration of milking by a machine is a function of milk yield of a cow and pulsation rate of a machine. All farmers who used milking machines were within the recommended time (7 min), most of them 63% attained 5 min and below. Day to day milk variation of machine milked cows is 6-8% while a hand milked and restrictedly suckled cow is high, 18-21% (Millogo, 2010). There is 5.5% increase in milk yield in standardized milking procedure compared to a variable milking procedure (Ruegg *et al.*, 2005). The procedure may, among other factors be influenced by level of motivation or stress of a milking person which varies from day to day and caused by many factors surrounding a person unlike a milking machine.

Hand milking farmers who supplied milk to processing plants were 42% while 47.3% sold direct to consumers such as hotels, institutions, shops and neighbors. A 10.7% did not sell their milk. Those who supplied milk to a processing plant, 37% indicated that the milk would often be rejected for failure to meet quality standards. Quality assurance managers highlighted that the rate of rejection was high to milk from hand milking farmers and to that supplied by brokers. These was attributed to milking procedures and dirty milking parlors that are muddy during rainy season which increases contamination between milking person and milk. Broker's urge of making more money, skim or neutralize milk which causes rejection. Farmers shy from supplying milk to processing plants due to low prices offered by the plants. Another reason was fear of rejection and therefore, sell direct to consumers who are not able to analyze its quality before use.

Milk is contaminated immediately after milking with bacteria and the level of contamination becomes harmful when milk reaches a consumer (Millogo, 2010). Many small scale farmers in Romania were hand milking, had no milk storage tanks to store milk at right temperatures and used dirty milking parlours (Popescu, 2015), depicting unhygiene conditions where milk is produced. Their milk was often rejected by milk processors for failure to meet European Union Standards which agrees with findings of this study. Consumers must be careful in consuming milk that is direct from farmers or has not been processed.

Challenges and opportunities in milk production: A 95% of farmers milking by hand indicated that they would like to use milking machines, while 2.5% said that they do not want a machine and the remaining 2.5% were undecided. Farmers highlighted various challenges (Table 3) that have prevented them from using milking machines.

The farms that were hand milking and connected to electricity from national grid were 55, 32.4% were connected to three phase while 22.6% had single phase. The ones not connected to electricity accounted to 45%. This agrees with factors in Table 3, that major reason why farmers are not using milking machines is not access to electricity but the cost involved and herd size. Table 1 indicates that about 27% of farms have 25-58 dairy cows and some were connected to electricity but were hand milking yet there are milking machines in the market for such a capacity. This has to do with the cost involved and lack of awareness of existence and importance of using milking machines.

The use of milking machines in Kenya dates back to 1970s. KALRO Naivasha (Dairy Research Institute) was the oldest in the samples with over 40 years of operation. Herringbone (8 aside) milking machine was installed in the institute in 1970s and was still in operation. Other farms had improved from bucket type of milking machines to Herringbone due to need of quality and zero contact of human beings with milk. About 50% of farms had used milking machines for more than 10 years an indication of reliability. Majority, 63% highlighted that they faced challenges in using milking machines that included blackouts or low voltages, parts breakages, low pressures and resistance of the cow when introduced to a machine for the first time.

The farms using milking machines that were connected to electricity from national grid and had a standby generator were 62.5%. While 37.5% depended only on electricity from national grid and reverted to hand milking in case there was no electricity. The abrupt revert from machine milking to hand milking creates variation (Johnson, 2000). It would be good if all farmers would have power back up. A dairy farm can generate its own electricity that can be derived from biogas and/or solar. Unfortunately, most farms had not ventured into these technologies for their dairy production.

Cleaning a parlor (herring borne) milking machine requires an approximate of 600-1200 L of water after every milking. In some of milking parlours, it was evident that the cleaning process was not followed as per requirements of manufacturer. Some measuring cylinders had stained due to poor cleaning. Some farmers used different detergents from ones recommended and were inaccessible to enough water. A bucket type of milking machine requires an approximate of 20-30 L of water for cleaning. Hand milking requires about 5-8 L of water. It might require farms to have more access to water and electricity if they adopt milking machines. These are some of operation costs that hinder farms from using milking machines.

Views from experts in Kenyan dairy sector concerning milk production: The experts interviewed were animal scientists, veterinary doctors, engineers, dairy technologist and/or farm managers. They gave their views as indicated here.

A 96.3% of respondents recommended farmers to use milking machines by giving the following reasons, efficient milking with complete emptying of udder within seven minutes, high milk quality and low chances of mastitis. Does not require skilled hand milking personnel, accuracy in recording and monitoring milk yields per cow, consistency, reduce theft of milk and reduce milk rejection at selling points. The other, 3.7% failed to recommend the use of milking machines citing that it is expensive to buy, install and operate, some animals are stressed up and teats block or die.

The expert's opinion on efficient milking with complete emptying of udder within the required time (7 min) agrees with the findings of the researchers survey with farmers using milking machines, most of them attained five minutes and below. High quality milk from farmers using milking machine is true as their milk was not rejected by milk processors. Milk from hand milking farmers was often rejected. There is high somatic cell count which influence milk quality in smallholder dairy farms milking by hand (Lam, 2011). The high somatic cell count is as a result of poor udder health. Careless milking hygiene causes subclinical mastitis at cow and herd levels. There is high chances of controlling mastitis by machine milking than hand milking (Mein, 2012) which agrees with expert's opinion. Milking machine is unlikely to cause mastitis and harm on a farm if it is installed, operated, maintained, tested and functions according to standards (Laven, 2016). Herring borne milking machine is designed with a measuring cylinder which records milk yield per cow. The system pumps milk to a milk cooling storage tank that can be locked minimizing milk theft.

The experts were asked about the measures that have been put in place to encourage farmers to use milking machines. About 22.3% indicated that there have been exhibitions and demonstrations by machine dealers and extension officers during farm fields and shows. In addition, commercial banks advance loans for purchase of milking machines. Majority of experts 77.7% felt that no measures had been put in place to encourage farmers to use milking machines. About 4.4% of farmers milking by hand indicated that they do not know the importance of using milking machines, 2.2% were not aware that milking machines exists. This calls for more sensitization on existence and importance of using milking machines.

When asked about the measures to be undertake to improve dairy production, the experts recommended that a public organization to work with farmers to design and develop milking machines affordable and applicable to small scale farmers. Supply and reliability of water and electricity should be increased. Adequate water intake increases milk yield (Lam, 2011), increasing water to farms should be a major undertaking. The government should lower prices or partner with donors in promoting the use of milking machines. In addition, the experts suggested a proper civic education in advantages of mechanization and reduction in the cost of farm machinery and spare parts. County governments were urged to invest in milk cooling plants in dairy hubs.

Milk marketing was noted by experts as one of the challenges facing dairy sector. They felt that an improvement is required in marketing channels, infrastructures, milk pricing and guidelines to reduce exploitation by middlemen. Development of improved marketing systems is a gateway to increased production (Massen, 2007). Animal production attributes such as introduction of high yield and quality genetics, training on pasture and fodder production technologies were recommended. Better ways of feeding, breeding, health and policies that encourage animal production and processing were emphasized as well. Promotion of research to solve local problems was additionally suggested by experts.

Dairy processing industries and equipment/machine dealers: The milk processing industries surveyed received about 60-70% of their milking processing capacity per day. The volumes rejected were 6,000 -7,000 litres per day. Milk was received from brokers, individual farmers or processor's own cooling plants. On delivery, milk was checked for fat and protein percentages, acidity, density, total pathogenic germs and somatic cell counts. The standard fat is 3.5%, number of pathogenic germs is a maximum of 100,000 per mL of milk and total somatic count is a maximum of 400,000 per mL of milk. The parameters reflect where milk was produced and the degree of disinfection used (Popescu, 2015). The parameters determined the rejection or acceptance of milk. Industries are supposed to run throughout to conserve energy. Due to in ability to receive 100% of their capacity per day, short shut down happens which are costly to the industry. The extra energy cost incurred has a high probability of transfer to a consumer. Some farmers were not supplying milk to dairy industries because of low prices offered by industries. Proper milk pricing motivates farmers to improve production. This requires industries to review prices or inputs they give to farmers in order to encourage farmers to supply milk to them.

Kenya imports milking machines majorly from Sweden, Turkey and China. The classes of these machines are bucket, trolley (single or double) and Parlors (Herringborn). Stock turnovers of milking machines were low. Out of nine dairy equipment dealers surveyed, only three had stocked milking machines. The dealers were concentrated in Nairobi, the capital city, forcing farmers to travel long distances for purchase of machines/equipment and spare parts.

CONCLUSION

Milk production is dominated by smallholder farmers, about 73% own <25 dairy cows and around 46% own <10 cows. The adoption of milking machines is in farms with a milking herd of 25-600 and total herd of 40-800 cows. Majority (95%) of farmers milking by hand and 96% of experts would like or suggested adoption of milking machines for high milk quality, improved production and health of animal throughout lactation periods. Lack of adoption of milking machines by majority of farmers has been prevented by high initial and operation costs, lack of design applicable for farmers milking l>20 cows. Lack of sensitization and diversified marketing has also hindered adoption of milking machines. The ones using milking machines are faced with a lack of enough water and electricity.

Farmers milking by hand are usually unable to get regular/skilled milking people, their milk fail to meet European Union or local standards and lack guidelines on milk selling prices. To improve dairy production, expert's feels that the government needs to promote mechanization, improve animal genetics, health, feeds, research, marketing and processing of dairy products.

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