DOCUMENTATION OF LOCAL MANAGEMENT SYSTEMS FOR THE MILKING HERD, REPLACEMENT HEIFERS AND CALVES OF SOME LARGE AND SMALL DAIRY CATTLE FARMS USING ON-FARM ANALYSIS

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ABSTRACT

On-farm analysis was conducted to compare management systems for the milking herd, heifer replacements and calves in five large and four small dairy cattle farms in the provinces of Batangas, Laguna and Quezon in the Philippines. Farm capacity in terms of number of dairy cows, land area, number of workers and farm's daily milk production was higher in large dairy cattle farms (20 or more cows) than small farms (less than 20 cows). However, the differences in daily milk yield per cow, number of cows per hectare and per worker suggest the limitations and opportunities to improve basic farm management in order to improve efficiency of production in large and small dairy farms. Breed of cattle, milking collection system and milking practices were different between large and small farms. There were also differences in reproductive management practices, calving management, housing and feeding systems and herd health program and disease problems. The milking herd, replacement heifers and calves in large farms had generally better body condition and animal cleanliness scores than those in small farms. This study suggests that on-farm analysis should be used regularly by local dairy farmers, consultants, students and extension agents to generate specific recommendations for individual large and small dairy cattle (and buffalo) farms. Economics of production should be considered in the future to compare farm profitability among dairy cooperatives, individual private farms, commercial farms and institutional farms.

Keywords: dairy cattle farms, management systems, on-farm analysis

INTRODUCTION

The per capita consumption of milk in the Philippines in 2009 was 16.57 kg and supplied largely by imported milk. Domestic milk production from cattle, buffaloes and goats in the same year was 13.8 million liters only, representing less than one percent of the total annual national consumption of 1,753 million liters of milk and milk products. The imported dairy products mostly from New Zealand,

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U.S.A., and Australia, consisted of milk and cream, butter, cheese and curd and cost about US$ 652.45 million (Bureau of Agricultural Statistics, 2010).

Through the support from the National Dairy Authority (NDA), the dairy cattle inventory has grown to 15,073 head in 2009 but only representing 0.47% of the total cattle inventory. Milk production from cattle was 7.9 million liters from 12,094 milking cows, or an average of 2,035 liters of milk produced per cow per year. The remainder of local milk production was produced by buffaloes and goats. Cow's milk was produced mainly by dairy cooperatives (63.0%), followed by individual private farms (19.3%), commercial farms (12.11%) and institutional farms (5.6%).

In 2009, the International Farm Comparison Network (IFCN) composed of dairy researchers from more than 80 countries reported that dairy farms with a large herd size had a very low share in the number of dairy farms worldwide but had less than 10% of the world's cows and about one fifth of the total milk production. However, with greater cost increases in high costs systems (*i.e*. large farms), it becomes more attractive to source milk from small farms particularly for developing countries. Small scale farming has the potential to compete at world milk market prices if they address issues related to milk quality, market access and non-tariff trade barriers (Hemme *et al*., 2003; Garcia *et al*., 2003).

While basic farm management is important to achieve efficiency and profitability of dairy production, there is meager information on actual practices adopted by local milk producers in the Philippines. Using on-farm analysis as a tool to contribute to decision-making and actions taken by dairy farmers to expand production and control costs (Roth and Hyde 2000), this study compares management systems for the milking herd, replacement heifers and calves in large and small dairy cattle farms. The benchmark information generated in this study may also be used in the development of separate course curricula and training modules for large and small dairy cattle farmers.

MATERIALS AND METHODS

On-farm analysis is a practical tool for decision making in dairy farms, particularly useful to extension agents, individual dairy farmers, variety of business, government and educational professionals (Roth and Hyde, 2000). While the format and analysis may change to make the analysis more consistent with farmers' and analysts' needs, the basic data usually consist of production and financial information for all farmers – management, labor, farm unit size (buildings and equipment capacities). On-farm analysis may also be used to describe diversity in the way milk is produced – in terms of farm size, milk yield per cow and per year, feed costs and quality, milking technology and the linkage into the dairy chain and, therefore, cost of production (Hemme, 2003).

Survey questionnaires were, thus, developed, pre-tested and used in actual on-farm analysis of selected dairy cattle farms in the provinces of Batangas (Lipa City and Sto. Tomas), Laguna (Calauan and Los Baños) and Quezon (Tiaong) from May to August 2009.

Data gathered from 5 large (20 cows or more) and 4 small (less than 20 cows)

dairy cattle farms included farm capacity and performance, other production and reproduction parameters, available breeds of cattle, reproductive management practices and problems, feeding system, forage and concentrates, milking collection system and milking practices, calving management practices, health programs and disease problems, housing system concerns and body condition and animal cleanliness scores.

All data were compared between large and small dairy cattle farms using descriptive statistics (simple mean, standard deviation, and range) for quantitative parameters and frequency table analysis (percent incidence and distribution among dairy cattle farms) for various farm management practices.

RESULTS AND DISCUSSION

Comparison of farm capacity and performance

Farm capacity in terms of the number of dairy cows, land area, number of workers and farm's daily milk production was higher in large farms (with 20 or more cows) than small farms (less than 20 cows) because large farms have the financial capital to acquire and raise more animals in larger tracts of land.

Table 1, however, shows that daily milk production per cow was higher in large

Table 1. Cow inventory, production records, land use, and labor utilization in dairy cattle farms.

Parameter	Size of operation				All farms (N=9)	
	Large farms (N=5)		Small farms (N=4)			
	Ave.± SD	Range	Ave.± SD	Range	Ave.± SD	Range
Cow inventory						
No. of milking cows	85.0±0.6	24-191	5.2±2.0	2-7	50.0±60.1	2-191
No. of dry cows	43.4±19.2	16-76	4.8±4.9	0-13	26.0±24.2	0-76
Production records						
Farm's daily milk prod. (kg)	891.9±645.2	200-2000	19.5±10.3	6-100	513.5±641.0	6-2000
Milk yield (kg) per cow/day	10.2±0.7	8-10	6.6±4.7	3-15	8.6±3.7	3-15
Land use						
Total land area, ha	58.2±62.8	5-158	2.8±2.7	0.5-6	32.5±50.2	0.5-158
No. of milking cows/ ha	1.46 cows/ha		1.86 cows/ha		1.54 cows/ha	
Labor utilization						
Total workers	16.4±6.8	5-23	2.8±2.7	1-6	10.0±5.4	1-23
No. of milking cows/worker	5.2 cows/worker		2.3 cows/worker		5.0 cows/worker	

farms (10.2 kg/day) than small farms (6.6. kg/day). More milking cows were raised per hectare in small farms (1.86 cows/ha) than in large farms (1.46 cows/ha). Furthermore, farm workers in large farms took care of more cows (5.2 cows per worker) than in small farms (2.3 cows per worker). Bench mark information on other production and reproduction parameters were also recorded but were available in large farms only (see Table 2).

Table 2. Other production and reproduction parameters recorded in large farms only.

Other production and reproduction parameters	Ave.± S.D.	Range
Lactation length*, days	197.0±93.0	194-200
Dry period*, days	79.7±38.9	45-134
Calving interval*, months	14.0± 1.7	11-15
Age at first calving**, months	27.6± 2.2	25-30
Mature cow weight**, kg	394.7±34.5	350-434
Age of cow**, years	3.7±0.8	2.5-4.5

* Based on data from 2 farms only; ** Based on data from 5 farms.

While large farms tend to produce more milk per cow than their smaller counterparts (Roth and Hyde, 2000), small farms have the potential to be more efficient than large farms. Basic farm management must be improved in order to reduce costs of production and, therefore, increase farm profitability. In the future, milk per worker equivalent may be used in the on-farm analysis to determine whether labor is being utilized efficiently. Larger farms need more labor than small farms. Workers on larger farms are able to specialize in a particular job, such as milking or feeding. In smaller farms, fewer people are responsible for a wide variety of tasks to operate the farm smoothly.

Available breeds of cattle

Purebred cattle such as Gir and Jersey and three-way crosses (*i.e.* Holstein Friesian x Brahman x Sahiwal) were raised in large farms only. Two-way crosses were available in both large and small farms, mostly through the National Dairy Authority (NDA). While there was no common preference for a particular breed, the Holstein Friesian x Sahiwal cross was commonly used among large farms (60%) and among small farms (75%). The Holstein Friesian x Jersey cross was also available in 2 out of 5 large farms and 1 out of 4 small farms. Other two-way crosses (i.e. Holstein x Brahman cross in a small farm and Holstein x Gir cross in a large farm), were also noted.

Reproductive management practices and problems

Artificial insemination (AI) was practiced in all dairy cattle farms. Table 3 shows that heat (estrus) in large and small farms was detected mostly by visual

Table 3. Methods of heat detection and pregnancy check, and reproductive problems in large and small dairy cattle farms.

Parameters	Frequency (percent)		
	Large farms (N=5)	Small farms (N=4)	All farms (N=9)
Methods of heat detection			
1. Visual observation only	4/5 (80%)	4/4(100%)	8/9 (89%)
2. Combination of visual observation, fetal test sexing, and Kamar method	1/5 (20%)	0/4 (0%)	1/9 (11%)
Methods of pregnancy check			
1. Visual observation only	4/5 (80%)	4/4(100%)	8/9 (89%)
2. Both visual 1 and rectal palpation	1/5 (20%)	0/4 (0%)	1/9 (11%)
Reproductive problems			
Abortion	3/5 (60%)	1/4 (25%)	4/9 (44%)
Dystocia	2/5 (40%)	3/4 (75%)	5/9 (56%)
Cystic ovaries	2/5 (40%)	0/4 (0%)	2/9 (44%)
Metritis	2/5 (40%)	0/4 (0%)	2/9 (44%)
Retained placenta	2/5 (40%)	1/4 (25%)	3/9 (33%)

observation. Pregnancy check was also conducted mainly by visual observation while rectal palpation to check for pregnancy was done in only one large farm. The most common reproductive problem was abortion (60% among large farms) and dystocia (75% among small farms). Cystic ovaries, metritis and retained placenta were also reported in large farms.

Feeding system, forage and concentrates

Mixed roughage and concentrates were provided in all dairy cattle farms, except for one small farm which gave roughages only (Table 4). Water was given *ad libitum* in all farms, except for one small farm.

Table 4 also shows that eight species of grasses and seven legumes were grown for forage and fodder in the local dairy farms. The most commonly grown grass species was Star grass (*Cynodon nlemfuensis*) in 60% of large farms and Napier grass (*Pennisetum purpureum*) in 56% of small farms. The most commonly grown legume was Mani-mani (*Arachis pintoi*) in 40% of large farms and Rensonii (*Desmodium cinerum*) in 50% of small farms. Cassava (*Manihot esculenta*) was also grown in one of the large farms. Data on pasture yield per hectare should also be determined and considered in the on-farm analysis.

Commercial feed concentrates were in given in all farms, except for one small farm. Brewer's spent grains were available in 40% of the large farms only. Molasses and vitamins ADE were also available in all farms, except for two small farms. Mineral salt blocks were provided in all farms. One large farm gave additional minerals in the form of hoof stability premix and sodium bicarbonate.

Table 4. Feeding system, forage crops and concentrates fed to dairy cattle.

	Frequency (percent)		
	Large farms (N=5)	Small farms (N=4)	All farms (N=9)
Feeding system			
1. All roughage	0/5 (0%)	1/4 (25%)	1/9 (11%)
2. Mixed roughage and concentrates	5/5 (100%)	3/4 (75%)	8/9 (89%)
Forage crops fed to dairy cattle			
Grasses:			
- Guinea grass (*Panicum maximum*)	2/5 (40%)	1/4 (25%)	3/9 (33%)
- Humidicola (*Brachiaria humidicola*)	0/5 (0%)	1/4 (25%)	1/9 (11%)
- Napier grass (*Pennisetum purpureum*)	2/5 (40%)	3/4 (75%)	5/9 (56%)
- Para grass (*Brachiaria mutica*)	1/5 (20%)	0/4 (0%)	1/9 (11%)
- Signal grass (*Brachiaria decumbens*)	0/5 (0%)	1/4 (25%)	1/9 (11%)
- Sorghum (Sorghum vulgare)	1/5 (20%)	0/4 (0%)	1/9 (11%)
- Star grass (*Cynodon nlemfuensis*)	3/5 (60%)	0/4 (0%)	3/9 (33%)
- Ruzi grass (*Brachiaria ruziziensis*)	1/5 (20%)	0/4 (0%)	1/9 (11%)
- Setaria (*Setaria sphacelata*)	0/5 (0%)	1/4 (25%)	1/9 (11%)
Legumes:			
- Centrosema (*Centrosema macrocarpum*)	1/5 (20%)	0/4 (0%)	1/9 (11%)
- Ipil-ipil (*Leucaena leococephala*)	0/5 (0%)	1/4 (25%)	1/9 (11%)
- Kakwate (*Gliricidia sepium*)	1/5 (20%)	1/4 (25%)	2/9 (22%)
- Rensonii (*Desmodium cinerum*)	1/5 20%)	2/4 (50%)	3/9 (33%)
- Malunggay (*Moringa oleifera*	1/5 (20%)	0/4 (0%)	1/9 (11%)
- Mani-mani (*Arachis pintoi*)	2/5 (40%)	0/4 (0%)	2/9 (22%)
Concentrates			
Commercial feed concentrates	5/5(100%)	3/4 (75%)	8/9 (89%)
Brewer's spent grains	2/5 (40%)	0/4 (0%)	2/9 (22%)
Molasses	5/5(100%)	2/4 (50%)	7/9 (78%)
Supplements			
Vitamins ADE	5/5(100%)	2/4 (50%)	7/9 (78%)
Mineral salt block	5/5(100%)	4/4 (100%)	9/9(100%)

Milking system and milking practices

In large farms, cows were milked twice a day using milking machines in a milking parlor (pooled milk). However, one large farm still used milking machines that collect milk in individual cans. The milking procedure in all large farms included washing, drying with the use of towels and disinfection by teat dips after milking. Sanitizer was used in 80% of the large farms while teat dips before milking was

practiced in 3 out of 5 large farms only. As a standard practice, cows were dried off two months before calving, although two farms reported that cows were dried off based on daily milk yield.

In contrast, small dairy cattle farms used milking machines that collect milk in individual cans. Three small farms practiced twice a day milking, while one farm milked their cows once a day. The milking procedure in small farms also included washing, drying with the use of towels and disinfection by teat dips after milking. Sanitizer was, however, used in 2 out of 4 small farms only and teat dip was not used before milking. Three out of 4 small farms dried off their cows two months before calving while one small farm dried its cows based on daily milk yield. One small farm did not have a drying off program.

Calving management practices

Calving was unassisted in all dairy cattle farms, although navel dip was applied to all newly born calves. Milk and vitamins ADE were also given to all calves.

Calves in large farms were fed colostrums artificially through a bottle (4 out of 5 farms) or esophageal tube (1 out of 5 farms). Weaning age was mostly within 24 hours after birth (4 out of 5 farms). Milk replacer and vitamin E/Selenium were also available in 3 out of 5 large farms. Calves in large farms were generally weaned from milk at 60 to 90 days old. One large farm reported that calves were weaned from milk based on their live weight.

In contrast, calves in small farms were fed colostrum through a bottle (2 out of 4 farms), bucket (1 out of 4 farms) or esophageal tube (1 out of 4 farms). Weaning age was mostly soon after birth (3 out of 4 farms). Milk replacer and vitamin E/ Selenium were available in 2 out of 4 small farms. Calves in two small farms were weaned from milk at 60 to 90 days old. However, two small farms reported weaning their calves from milk at a younger age.

Health programs and disease problems

Health programs were different for large and small dairy cattle farms (Table 5). Cows in large farms were commonly vaccinated for foot and mouth disease and hemorrhagic septicemia in 3 out of 5 farms. Vaccination for clostridial disease, *Escherichia coli* and leptospirosis was practiced in at least one large farm. In contrast, vaccination against hemorrhagic septicemia was done in 2 out of 4 small farms while vaccination against foot and mouth disease was given in one small farm only.

Deworming to control internal parasites was conducted in all dairy cattle farms. However, tick removal was practiced in 3 large farms and 3 small farms.

All dairy cattle farms except for one small farm had a mastitis control program. The California Mastitis Treatment (CMT) was practiced in two large farms only. Intramammary antibiotics were also used to control mastitis in 3 large farms and 2 small farms.

Disease problems of milking cows, replacement heifers and calves were also different between large and small dairy cattle farms. The most common disease problems for milking cows were foot rot disease and pneumonia in 2 out of 5 large farms and milk fever in 1 out of 4 small farms. On the other hand, the most common

Table 5. Health programs and disease problems in large and small dairy cattle farms .

Parameters	Frequency (percent)		
	Large farms (N=5)	Small farms (N=4)	All farms (N=9)
Health programs:			
Vaccination against			
- Clostridial disease	1/5 (20%)	0/4 (0%)	1/9 (11%)
- *Escherichia coli*	1/5 (20%)	0/4 (0%)	1/9 (11%)
- Foot and mouth disease	3/5 (60%)	1/4 (25%)	4/9 (44%)
- Hemorrhagic septicemia	3/5 (60%)	2/4 (50%)	5/9 (56%)
- Leptospirosis	1/5 (20%)	0/4 (0%)	1/9 (11%)
Parasite control			
1. Deworming only	2/5 (40%)	1/4 (25%)	3/9 (33%)
2. Both 1 and tick removal	3/5 (60%)	3/4 (75%)	6/9 (67%)
Mastitis control			
1. Intramammary antibiotics	3/5 (75%)	2/4 (50%)	5/9 (56%)
2. Combination of 1 and California Mastitis Treatment	2/5 (40%)	0/4 (0%)	2/9 (22%)
3. No mastitis control program	0/5 (0%)	2/4 (50%)	2/9 (22%)
Disease problems:			
Milking cows			
- Foot rot disease	2/5 (40%)	0/4 (0%)	2/9 (22%)
- Hardware disease	1/5 (20%)	0/4 (0%)	1/9 (11%)
- Milk fever	0/5 (0%)	1/4 (25%)	1/9 (11%)
- Pneumonia	2/5 (40%)	0/4 (0%)	2/9 (22%)
Replacement heifers and calves			
- Circulatory failure	1/5 (20%)	0/4 (0%)	1/9 (11%)
- Diarrhea	3/5 (60%)	2/4 (50%)	5/9 (56%)
- Heat stroke	1/5 (20%)	0/4 (0%)	1/9 (11%)
- Pneumonia	3/5 (60%)	2/4 (50%)	5/9 (56%)
- Traumatic shock	1/5 (20%)	0/4 (0%)	1/9 (11%)

disease problems for replacement heifers and calves were pneumonia and diarrhea in 3 out of 5 large farms and 2 out of 4 small farms.

Housing system concerns

Table 6 shows that the housing system for calves in large dairy cattle farms was by group pens (3 out of 5 farms) or individual calf hatches (2 out of 5 farms). In contrast, calves in small farms were mostly raised in individual calf hatches (2 out of 4 farms), group pens (1 out of 4 farms) or tethering (1 out of 4 farms).

Table 6. Housing system for calves, floor/bedding material, lighting and ventilation conditions and waste disposal and cleaning systems in large and small dairy cattle farms.

Parameters	Frequency (percent)		
	Large farms (N=5)	Small farms (N=4)	All farms (N=9)
Housing system for calves			
1. Individual calf hatches	2/5 (40%)	2/4 (50%)	4/9 (44%)
2. Group pens	3/5 (60%)	1/4 (25%)	4/9 (44%)
3. Tethering	0/5 (0%)	1/4 (25%)	1/9 (11%)
Floor type for the milking herd			
1. Cemented floor	2/5 (40%)	1/4 (25%)	3/9 (33%)
2. Ground soil	3/5 (60%)	3/4 (75%)	6/9 (66%)
Floor/bedding material for calves			
1. Elevated floor			
- With rice straw	1/5 (20%)	0/4 (0%)	1/9 (11%)
- Without bedding	1/5 (20%)	0/4 (0%)	1/9 (11%)
2. Cemented floor only	0/5 (0%)	1/4 (25%)	1/9 (44%)
3. Ground soil only	1/5 (20%)	2/4 (50%)	3/9 (33%)
4. Ground soil with rice hull	2/5 (40%)	1/4 (25%)	3/9 (33%)
Lighting conditions for cows, heifers and calves			
1. Received enough light	2/5 (40%)	2/4 (50%)	4/9 (44%)
2. Received much light	3/5 (60%)	2/4 (50%)	5/9 (56%)
Ventilation conditions for cows, heifers and calves			
1. Open (well-ventilated)	4/5 (80%)	4/4 (100%)	8/9 (89%)
2. With electric fan	1/5 (20%)	0/4 (0%)	1/9 (11%)
Waste disposal and cleaning systems			
1. Dry cleaning*	0/5 (0%)	1/4 (25%)	1/9 (11%)
2. Wet cleaning*	2/5 (40%)	2/4 (50%)	4/9 (44%)
3. No waste disposal system**	3/5 (20%)	1/4 (25%)	4/9 (44%)

*Semi-confinement housing; **Pasture-based.

Floors for the milking herd were mostly ground soil in large farms (3 out of 5 farms) and small farms (3 out of 4 farms). Cemented floor for the milking are was provided in 2 large farms and in 1 small farm. On the other hand, calves in large farms were commonly raised in elevated floors (2 out of 5 farms) or ground soil (3 out of 5 farms). One large farm provided rice straw on its elevated floors while another large farm provided rice hull on top of the ground soil. In contrast, calves in small farms were raised on ground soil (3 out of 4 farms) while one small farm provided cemented floor to its calves. One small farm also provided rice hull on top of the ground soil.

The lighting conditions in large farms were commonly rated as receiving much sunlight (3 out of 5 farms) and receiving enough sunlight (2 out of 5 farms). Two (2)

out of 4 small farms were evaluated to have received enough sunlight and the other two had much sunlight.

All dairy cattle farms were open and well-ventilated, except for one large farm that provided electric fans to enhance air circulation inside the farm building.

Semi-confinement housing that allowed wet cleaning (using water spray) and proper waste disposal was provided in 2 out of 5 large farms. Three large farms were pasture-based and do not have a waste disposal system. In contrast, only 1 out of 4 small farms had no waste disposal system. Two small farms practiced wet cleaning while one small farm performed dry cleaning (using shovel or floor scraper).

Body condition and animal cleanliness scores

In general, slightly higher body condition scores were given for replacement heifers and calves than milking cows. Higher body condition scores were also noted for dairy animals in large farms than those in small farms (Table 7). The body condition scores may be used to assess the nutritional status of the dairy herd and assist in reproductive and health management in dairy farms (Bondoc *et al*., 2003).

Table 7 also shows that dairy animals in large farms seemed to be cleaner than in small farms. Calves appeared to be slightly cleaner than replacement heifers and milking cows in large farms. On the other hand, milking cows were slightly cleaner than replacement heifers and calves in small farms. The cleanliness scores are a reflection of the housing system and animal care given to them towards a healthy comfortable environment for better milk production.

Table 7. Body condition* and animal cleanliness scores* in large and small dairy cattle farms.

Parameter	Size of Operation				All farms	
	Large farms		Small farms			
	Ave.± SD	Range	Ave.± SD	Range	Ave.± SD	Range
Body condition scores**						
Milking cows	3.4±0.8	2-4	2.0±0.7	2-4	2.8±0.8	2-4
Replacement heifers	3.6±0.5	3-4	2.5 0.7	2-3	3.0±0.8	2-4
Calves	3.5±0.5	3-4	2.2±0.5	2-4	3.0±0.8	2-4
Animal cleanliness scores***						
Milking cows	2.4±1.0	1-4	3.5±0.9	3-5	2.9±1.1	1-5
Replacement heifers	2.2±0.4	2-3	3.5±0.7	3-4	3.0±0.8	2-4
Calves	2.0±0.7	1 3	3.5±0.6	3-4	3.0±0.6	1-4

*Based on 45 milking cows (5 cows/farm in 9 farms), 30 replacement heifers (5 heifers/farm in 4 large farms; 5 heifers/farm in 2 small farms), and 35 calves (5 calves/farm for large farms; 2-3 calves/farm in 4 small farms).

**Body condition scores: 1= thin, 2= slightly thin, 3=good, 4=slightly fat, 5=fat.

***Animal cleanliness scores: 1= clean, 5=dirty.

CONCLUSION

Farm capacity in terms of the number of dairy cows, land area, number of workers and farm's daily milk production were higher in large dairy cattle farms (with 20 or more cows) than small farms (less than 20 cows). However, differences in daily milk yield per cow, number of cows per hectare and per worker suggest the limitations and opportunities to improve basic farm management to improve efficiency of production in large and small dairy cattle. These can be attributed to differences in available breeds of cattle, reproductive management practices, feeding system, milking practices, calving management practices, health program and disease problems and housing system. The milking herd, replacement heifers and calves in large farms had generally better body condition and animal cleanliness scores than those in small farms.

In the future, on-farm analysis should include financial data (*i.e.* economics of production) to compare farm profitability among dairy cooperatives, individual private farms, commercial farms and institutional farms. Individual milk records must also be available in all farms in order to identify the high and low producing animals based on production level, lactation stage, and days in milk. Other parameters (*i.e.* average lactation length, dry period, calving interval, age at first calving and mature weight and age of the cows) must be recorded in small farms.

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