Economic opportunity survey of small-scale dairy farms at Keren Sub Zone of Eritrea

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Abstract

An investigation was conducted to study the economic opportunities on small-scale dairy farms (SCD) to assess production and financial management and record-keeping system and to identify areas of economic opportunity on SCD at Keren Sub Zone. There were 57 market-oriented SCD in regions categorized into 4 classes, namely herd size 1-5 (A), 6-10 (B), 11-15 (C), and more than 16 (D), respectively. Through stratified random sampling, 30 SCD were selected for the economic opportunity survey, including 13, 11, 4, and 2 samples from A, B, C, and D, categories, respectively. Three-level standard questionnaire software was utilized for surveying. The primary data were used to calculate production and management indices individually for each SCD followed by statistical analysis using standard methods. It is recommended that the awareness of the farmers on scientific practices of dairy cattle needs enhancement. Dairy producers should have a continuous assessment of the profitability of their farms and develop their pastures. The area of economic opportunity needs identifying intervention to get a profit. The balanced ration should be formulated for each class of animals. Full records of the farm activities including detailed information on individual animals should be maintained on the farm.

Keywords: Economic opportunity, Eritrea, Financial management, Recordkeeping, Small scale dairy farms, Survey.

Introduction

Eritrea is located, between $12^0 42'$- $18^0 2'$ N and $36^0 30'$- $44^0 20'$ E, in the horn of Africa covering an area of 124,324 km^2. The altitude ranges from the highest mountain (3,010 m above sea level) to depression (100 m below sea level). The coastal plain consists of a semi-arid desert. The population of the country is estimated to be about 3.7 million, and 73% derive its livelihood from Agriculture (MoA 2014) accounting for about 37 percent of national GDP, and livestock products for about 5% (MOA 2011). The climate is influenced by its topography, resulting in diversified agroecological zones. Conditions range from hot and arid in the coastal plains to cool in the highlands. The problem of inadequate total rainfall over most of the country is compounded by the high variability of both total rainfall and its distribution. Mostly, the rains are bimodal starting with short rains (Apr to May), followed

by a dry period before the main rains (mid-Jun to mid-Sep).

Commercial dairy farming in Eritrea was started by Italian settlers in the 20th century, when, it was under Italian colonization. The growing demand for milk, especially in urban centers, stimulated Italian settlers in the highlands to develop modern dairy farms using high merit dairy breeds. These farms were intensively managed and recognized as main milk suppliers to the urban population. The commercial dairy sub-sector reached its peak in the 1970s (AED 2011).

However, with the escalation of the war, with the Ethiopian military, from 1975 to 1991 the farmers lost their animals resulting abandonment of dairy farming. In Nov 1992, the association re-started supplying milk to the milk processing plant. There was a tremendous

increase in the number of dairy cows in the last ten years (AED 2011).

Livestock farming is now an integral part of agriculture without which not a single agricultural activity can be performed. Cattle are the most important species, especially for dairy farming. In highland regions, cattle are reared for draught, milk, and meat production, whereas in lowland regions, for milk and meat only. Livestock plays a vital role in financial systems, both at the household and national levels. The livestock population in the country is 2.3 million cattle, 2.5 million sheep, 5.5 million goats, and 373,952 camels (MoA 2013).

At present, dairy farms are developing in the country, but most of them are unorganized. Like in other countries, there is a large gap between producers' incentives and consumers' motives. Possibilities for dairy quality upgrading remain fairly limited (Ruben et al 2017).

Farmers especially on the small-scale dairy farms (SCD) in the country had a lack of awareness to identify the actual problems in different areas of the dairy farm. The training provided by the government was not sufficient. The shortage of capital to run SCD was another challenge. It was thus very much needful to discover the factors and activities which are most profitable on the dairy farm so that the owners can be encouraged to make important and fruitful managerial decisions (Enseminger 1991). Keeping all the above facts in view, the present investigation was conducted to study the economic opportunity in SCDs to assess production and financial management and record-keeping system and to identify areas of economic opportunity in SCD at Keren Sub Zone.

Materials and methods

The study was conducted in Sub Zone Keren (Anseba Region). The Sub Zone is situated in North West in Asmara at an elevation of 1390 m above sea level and 15.78 latitude and 38.45 longitudes. The average annual temperature of this area is 24°C, wind velocity 14 km/h northeast, and humidity 46 percent. There were169 market-oriented SCD all before 2015, but due to the relocation of dairy farms from the

city and the severe drought of 2015-16 total farms are reduced to 57 now.

Under the intensive dairy farming system in the study area, the dairy farms were categorized into 4 classes, namely having herd sizes 1-5 (A), 6-10 (B), 11-15 (C), and more than 16 (D), respectively. Through stratified random sampling, 30 dairy farms were selected for the economic opportunity survey, including 13, 11, 4, and 2 samples from A, B, C, and D, categories of dairy farms, respectively.

To conduct the survey, three-level standard questionnaire software (Nourdland et al 2007) was utilized. The responses to the items on questionnaires were used to establish a database consisting of four sections; total milk production, expenses of cattle health care and feeds, inventory of herd cull and death, and milk and calf production per cow.

On-farm visits were conducted to collect all the required information through questionnaires and direct observations, including on-farm conditions, inventory, and review of records. The survey was conducted by examining all the cattle on the farm during inventory assessment and inspecting feedstuffs. The farmers were interviewed to obtain detailed and accurate data.

The primary data collected has been used to calculate production and management indices individually for each dairy farm through Microsoft Office Excel 2016 (UQ Library 2016), followed by ranking and comparing dairy farms using standard statistical methods and techniques (Snedecor and Cochran 1994). The latest version of SPSS software was used for this purpose (SPSS 2016).

Results and discussion

The number of all classes of cattle at SCD under study, except growing bulls/steers and suckling male calves (Table 1) was high in D and low in the A category. Present findings confirmed the results of Ensiminger (1993) concluding that the opportunity of getting replacement heifers increased as the herd size increased. Lactating cows as a percentage of total cows was an indirect measure of both the reproductive performances of the herd and the length of the lactations (Nordlund et al 2007), and both

parameters remained similar among the four categories.

Table 1: Composition and Land and labour utilization

Parameters	A	B	C	D	P-value
(I) Composition of SCD					
Lactating cow	1.46±0.18	2.55±0.21	3.25±0.85	7.00±3.00	**0.00**
Dry cow	0.77±0.26	1.73±0.3	2.50±0.87	1.00±1.00	0.21
% Lactating cows to total cows	0.73±0.08	0.63±0.05	0.58±0.17	0.85±0.15	0.18
% Lactating cows to total cattle	0.37±0.03	0.31±0.02	0.30±0.07	0.35±0.15	0.13
Total mature cows	2.23±0.28	4.27±0.33	5.75±0.85	8.00±2.00	**0.00**
Pregnant heifers	0.08±0.08	0.09±0.09	0.25±0.25	1.50±1.50	**0.01**
Growing heifers	0.54±0.18	2.09±0.31	3.50±0.65	4.50±0.50	**0.00**
Suckling heifer calves	0.54±0.18	0.82±0.26	0.75±0.48	2.50±0.50	**0.01**
Total replacement heifer	1.15±0.25	3.00±0.30	4.50±0.29	8.50±0.50	**0.00**
Mature bulls/steers	0.00±0.00	0.18±0.12	0.50±0.29	1.50±0.50	**0.00**
Growing bulls/steers	0.23±0.12	0.36±0.15	1.25±0.75	0.50±0.50	0.10
Suckling male calves	0.46±0.18	0.55±0.21	0.25±0.25	1.00±0.00	0.60
Total male cattle	0.69±0.21	1.09±0.16	2.00±0.58	3.00±1.00	**0.01**
(II) Land and labor utilization					
Family labour	2.00±0.23	1.82±0.35	1.25±0.48	2.00±0.00	0.60
Hired Labour	0.00±0.00	0.73±0.36	1.75±0.75	0.50±0.50	0.12
Total land (ha)	0.70±0.10	1.22±0.28	1.13±0.31	0.75±0.25	0.34
Pasture (ha)	0.00±0.00	0.11±0.06	0.69±0.45	0.25±0.00	**0.03**

Insignificant family labor engagement or labor hired in four categories of SCD could be due to the family size and non-availability of hiring labor (Table 1). Almost similar total landholdings could be due to the government policy to allot standard unit area of total land to the farmers. The pasture land was highest in the category of SCD in comparison to others which could be because of Government policy and the personal interest of the farmers. Herrero et al (2014) have also explored that socioeconomic scenario is mainly the reason for the organization of a small dairy farm.

The number of milking, milk used for family and other purposes and fed to calves, milk price, and milk sold to produced ratio has remained non-significant in four categories of SCD (Table 2). The standard milking frequency in low-producing cows was twice a day and as such, it remained the same in all the categories under study. The milk used for the family purpose was depending on the family size. The milk used for other purposes was affecting the net profit of dairy farms so it was always discouraged. However, an increasing trend was observed regarding milk fed to the calves with

the increased holding of the dairy farms because of variation in the number of suckling calves. As far as the milk price is concerned, it was controlled by the local market. The milk produced, sold, and total income from milk was significant and presented an increasing trend with the increase in holding of a dairy farm and confirmed the findings of Nakanwagi and Hyuha (2015). The milk sold-to-produced ratio at the dairy farms under category D was 0.08 which confirmed the findings of Bayemi et al (2007), however, in four categories of SCD under study, the results remained non-significant.

Selling of animals can be one of the production management practices in dairy cattle either to cover part of the expenditure on feed and the case of feed shortage, and health care expenses or to cull the non-productive and low producer cows associated with culling (Table 2). There were no significant differences in the number of lactating, dry, and mature cows, pregnant and suckling heifer calves, totally replacing heifers, mature bulls/steers, growing bulls/steers, and total male cattle sold in the last 12 months among four categories. This was due to the

reason that the farmers were willing to maintain their stock in their dairy farms. However, there was a significant difference in suckling male calves and growing heifers sold in the last year. Keeping male calves on the dairy farm was not profitable for a dairy farm and as such those were sold. On the other hand, pregnant heifers had high market demand and value due to their longer productive life, so it was beneficial for the farmers to sell them to gain additional profits. Mattewman (1993) suggested that good herd management at a dairy farm required the exclusion of unproductive animals from the herd and replacement with improved stock. Male calves were not economical to keep on the dairy farm and farmers should remove them from the stock as soon as possible. Farmers should prefer to keep only female calves as future replacements. Present findings also confirmed the above suggestions.

Table 2: Deposition of milk produced and Animals sold

Parameters	A	B	C	D	P-value
(I) Deposition of milk produced					
No. Milking per day	2.00±0.00	2.00±0.00	2.00±0.00	2.00±0.00	0.08
Milk for family use (l/d)	2.54±0.43	3.18±0.38	3.25±0.85	4.50±0.50	0.34
Milk for other use (l)	0.15±0.10	1.18±0.57	1.00±0.58	1.50±1.50	0.23
Fed to Calves (l/d)	2.77±0.68	3.45±0.76	3.50±2.25	6.50±1.50	0.07
Total milk produced (l/d)	13.46±1.72	26.55±3.55	31.00±9.72	76.50±33.50	**0.00**
Milk sold (l/d)	8.00±1.10	18.73±3.06	23.25±7.34	64.00±34.00	**0.00**
Total Milk income	324.54±45.24	658.1±89.4	820.5±238.57	1967.5±892.5	**0.00**
Milk price/ l	22.85±1.91	24.73±0.38	27.00±1.08	25.50±0.50	0.72
Milk sold/produced	0.57±0.06	0.69±0.05	0.75±0.03	0.80±0.10	0.35
(II) Animals sold					
Lactating cows	0.00±0.00	0.18±0.12	0.25±0.25	0.00±0.00	0.35
Dry cows	0.00±0.00	0.09±0.09	0.00±0.00	0.00±0.00	0.65
Mature cows	0.00±0.00	0.27±0.14	0.25±0.25	0.00±0.00	0.22
Pregnant heifers	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	-
Growing heifers	0.00±0.00	0.00±0.00	0.50±0.50	0.50±0.50	**0.05**
Suckling heifer calves	0.00±0.00	0.09±0.09	0.00±0.00	0.00±0.00	0.65
Total replace heifers	0.00±0.00	0.09±0.09	0.50±0.50	0.50±0.50	0.13
Mature bulls/steers	0.08±0.08	0.00±0.00	0.00±0.00	0.00±0.00	0.75
Growing bulls/steers	0.23±0.17	0.09±0.09	0.00±0.00	0.00±0.00	0.74
Suckling male calves	0.00±0.00	0.00±0.00	0.00±0.00	0.50±0.50	**0.00**
Total male cattle	0.31±0.17	0.09±0.09	0.00±0.00	0.50±0.50	0.47

The veterinary and medical costs in four categories of SCD non-significantly differed, but the total health care costs significantly differed (Table 3). Wang et al (2017) reported that disease prevention did not have a significant influence on a dairy farm income. Forage and concentrate fed per cow, forage and concentrate unit price, and total forage and concentrate prices cost per cow were recorded as almost the same among the four categories. Feed cost as a percent of milk income was again recorded to be identical. If feed cost in terms of percentage of income from milk sale was high on a farm, there might be problems of low production per cow or high feed costs relative to other local smallholders (Nordlund et al 2007).

Death loss in any animal production enterprise is one of the major economic losses in terms of the animal itself and the production obtained from it (Table 3). The findings in this regard demonstrated that there was no significant difference in loss because of death between the four categories under study. Zero mortality rates were observed in mature bulls/steers and suckling male calves. Nordlund et al (2007) reported that if calf mortality rates on individual farms were higher than the goals, an investigation of risk factors would include evaluation of calving assistance practices,

colostrum management, and calf-hood disease risks for diarrhea and pneumonia. In the present study, the mortality rate was observed to be lower which might be due to good colostrum management and low calf-hood disease risks for diarrhea and pneumonia.

Table 3: Major Expenditure and Death losses

Parameters	A	B	C	D	P-value
(I) Major Expenditure					
Veterinary cost (NKF/year)	242.30±14.80	342.70±54.20	254.00±19.30	300.00±50.00	0.11
Medical cost (NKF/year)	145.77±14.90	147.73±16.67	145.00±26.30	200.00±20.00	0.19
Total health care costs (Nkf/year)	560.40±47.80	806.80±89.00	760.00±72.20	910.00±80.00	**0.05**
Forage fed/cow (kg/day)	13.23±0.59	13.64±0.53	24.50±11.90	15.50±0.50	0.46
Forage unit price (NKF)	4.38±0.56	5.14±0.53	5.50±0.65	3.75±0.75	0.66
Total forage cost/cow/day in NKF	57.35±6.84	69.36±7.57	151.50±89.62	57.75±9.75	0.30
Concentrate fed/cow (kg)	4.43±0.52	5.42±0.79	4.63±0.83	6.25±0.25	0.30
Concentrate unit price (NKF)	12.19±0.67	13.61±0.59	11.88±0.89	14.17±1.50	0.08
Total concentrates cost/cow (NKF)	58.77±7.29	79.33±11.42	63.38±11.85	102.75±8.75	0.10
Total feeding cost NKF	116.11±8.75	148.69±14.1	214.88±83.79	160.50±1.00	0.48
Feed cost as % of milk income	0.51±0.06	0.58±0.05	0.58±0.02	0.60±0.00	0.56
(II) Death losses					
Lactating cow	0.15±0.1	0.27±0.19	0.25±0.25	0.00±0.00	0.87
Dry cow	0.23±0.17	0.09±0.09	1.00±0.58	0.50±0.50	0.10
Total mature cows	0.38±0.24	0.36±0.28	1.25±0.48	0.50±0.50	0.37
Pregnant heifers	0.08±0.08	0.00±0.00	0.00±0.00	0.00±0.00	0.75
Growing heifer	0.23±0.12	0.55±0.55	0.00±0.00	0.00±0.00	0.82
Sucking heifer calves	0.23±0.17	0.27±0.19	0.00±0.00	0.50±0.50	0.78
Total replacement heifer	0.54±0.24	0.82±0.72	0.00±0.00	0.50±0.50	0.86
Mature bulls/steers	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	-
Grow bulls/steers	0.08±0.08	0.18±0.12	0.00±0.00	0.00±0.00	0.70
Suckling male calves	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	-
Total male cattle	0.08±0.08	0.18±0.12	0.00±0.00	0.00±0.00	0.70

The animals remained for almost similar days in milk production among the four categories under study. Average milk production per cow, calving interval, and lactation length were also recorded to be non-significant (Table 4). The ideal lactation length is 305 days, but, in the present study it reached up to 415 days in category C for the reason to extend the length of day open cows, unavailability of the bull at the time of heat, and silent heat among the females.

Age at first calving was significantly decreased with the increased herd size of the dairy farms. The observed trend could be due to different managerial aspects at different categories of dairy farms. Though, the variation in age at first calving in different countries was ranging between 24 and 63 months (Nordlund et al 2007). It was advised best to have 27 months of age at this stage. Generally, heifers are the most neglected class of dairy animals, especially in nutritional supply, and as such, they attain higher age of sexual maturity.

There was a significant difference in economic opportunity for lactation length, milk production, health care cost/cows, and total economic opportunities in different categories of SCD (Table 4). The opportunity for milk production was increased and health care costs per cow decreased with an increase in herd size, but, the same for lactation length or total economic opportunity did not present any

specific trend. The other parameters of economic opportunities, namely calf mortality, age at first calving, calving interval, and the number of dead/total number of born calves either alive or dead remained statistically non-significant among four categories of SCD.

Table 4: Average animal Performance and Economic Opportunities

Parameters	A	B	C	D	P-value
(I) Average animal Performance					
Days in milk (d)	138.92±22.42	164.45±25.7	242.50±42.02	172.00±54.00	0.87
Milk per day/cow (l)	10.31±1.13	10.91±1.16	9.25±1.25	11.50±0.50	0.24
Age at first calving (d)	36.31±2.24	31.27±1.04	30.75±2.72	28.50±2.50	**0.02**
Calving interval (d)	14.77±0.54	15.64±0.83	15.75±0.48	14.00±2.00	0.32
Lactation length (d)	334.92±15.14	290.73±20.90	415.25±23.99	318.50±8.50	0.64
(II) Economic Opportunities					
Opportunity from calve mortality	1315.4±972.6	500.0±309.0	0.00±0.00	0±0	0.72
Opportunity from age at first calving	17899±7045	6631±2689	8790±8790	4785±4785	0.27
Opportunity from calving interval	153.08±62.48	575.76±428.88	400±317.4	900±900	0.62
Opportunity from lactation length	8176±2029	25755±8460	0.00±0.00	0.00±0.00	0.04
Opportunity from milk production	81451±24978	131005±24725	205403±38936	332150±142	0.02
Health care cost/cows	289.6±35.3	200.13±23.69	136.91±14.99	124±41	0.01
Total economic opportunities	252347±4682	151725±14295	285450±27210	175585±25585	0.00
No dead/total No born alive or dead	0.15±0.1	0.32±0.14	0.25±0.25	0.6±0.4	0.54

Most of the farmers were highly interested in keeping reproduction records. This exercise they were completed as a result of training given by the Government to him. About 86% of the farms kept production, reproduction, and feeding records, but only as a simple notebook. The production record has been just to know the amount of milk sold.

Recommendations

Based on the present investigation, it can be recommended that the Government needs work hard to increase the awareness of the farmers on scientific managerial practices of dairy cattle and provide subsidies. Dairy producers should have a continuous assessment of the profitability of their farms. They should develop their pastures because of fluctuation in the market supply of the green fodders. An area of economic opportunity, according to their importance to take accurate intervention to get the profit, should be identified. The balanced ration should be formulated for each class of animals. Full records of the farm activities including detailed information on individual animals should be maintained on the farm.

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