East Africa Dairy Development

In partnership with

COST OF MILK PRODUCTION IN RWANDA

2012

J.M.K. Ojango, E. Kinuthia and I. Baltenweck

1. INTRODUCTION

The East Africa Dairy Development Project (EADD) undertook a series of farm level surveys in Rwanda to assess the profitability of their dairy enterprise over the different seasons of the year. Results from the first round of the survey which was conducted in September 2011 showed that medium scale farmers were generating higher profits than small-scale farmers (Table 1). Additionally, farmers practicing more extensive production were making higher profits than those managing animals under a more intensive production system (Table 2). Transportation of milk, hired labour, purchased feeds and animal health were noted as the main factors contributing to higher costs of milk production in both the small scale and the intensive production systems (EADD, 2011).

Table 1. Mean Revenue, Costs and Profits in medium and small-scale farms in 2011

Rwfrancs per litre	Small-scale	N	Medium-scale	N	Significance
Total Milk revenue	175.9	41	174.3	13	ns
Cattle revenue	14.5	41	103.5	13	**
Total Revenue	190.4	41	278.6	13	*
Total Cost	140.6	41	107.8	13	ns
Profit from milk only[1]	35.2	41	66.4	13	ns
Total Profit[2]	49.8	41	170.7	13	**

Table 2. Mean Revenue, Costs and Profits in in intensive and extensive system 2011

Rwfrancs per litre	Intensive	N	Extensive	N	Significance
Total Milk revenue	176.4	29	174.5	30	ns
Cattle revenue	26.7	29	46.6	30	ns
Total Revenue	203.1	29	221.5	30	ns
Total cost	180.2	29	77.7	30	***
Milk Profit only	-3.8	29	96.7	30	***
Total Profit	22.9	29	143.8	30	***

*** significant at 1%;** significant at 5%; * significant at 10%; ns-not significant

The second round of the survey was conducted on the month of December 2012 in the same sites as the first round. The survey aimed to assess changes in the costs of production and profitability of the

[1] Revenues used in calculation do not include cattle sales

[2] Revenues used in calculation include sale of milk and cattle

dairy enterprise since the first round of the survey, and to identify possible interventions that the EADD project should target in order to enhance profitability of the dairy farms.

2. METHODOLOGY

The six sites representing small and medium scale farmers practicing either intensive or extensive dairy production that were selected during the first round of the survey were sampled. Most of the farmers sampled in the first round of the survey were interviewed in the second round with few replacements. Small-scale farmers comprised those owning less than three cows in the intensive production systems and those owning less than 10 cows in the extensive production systems, whilemedium-scale farmers comprised those owning more than four cows in the intensive systems and more than ten cows in the extensive systems[3].A total of sixty farmers participated in the survey, forty two from mainly intensive production systems and eighteen from mainly extensive systems(Table 3).

Table 3. Sample size for cost of milk production survey

	Production Systems[4]		Total
	Mainly Intensive	**Mainly Extensive**	
Hubs per system	**3**	**3**	**6**
Small-scale farmers	25	8	**33**
Medium- scale farmer	17	10	**27**
Total sample size	**42**	**18**	**60**

2.1 Milk production

An estimate of total milk production in the last 3 months preceding the survey was obtained based on farmer recall using a carefully designed set of questions that captured milk production immediately after calving, and milk production on the day prior to the interview. These values were collected for every lactating cow at the time of the survey and used to estimate milk yield for the last three months using the area under the lactation curve. Details on the calculation procedure are provided in Annex2.

2.2 Revenue computation

Two different scenarios were considered in calculating revenues, one which included revenue from the sale of animals, and one in which this was not a factor (Table 4). In the scenario that included cattle sales, an attempt was made to provide some insight into the effects of animal prices on profitability of the dairy enterprise. Milk given to calves and labourers was included as both an expense and revenue since it is a product of the farm. Milk sales were valued using prices from the corresponding marketing channels in a project site. The price reported for a hub (Table 6) was obtained as the mean price from the various market outlets in every hub contributing to the survey. Milk consumed at home, given to labourers and to calves was valued at the same price as that of the nearest hub.

[3] Threshold was determined by mean cows owned from baseline survey (EADD 2010b)

[4]Extensive production system is characterized by more land and less labour use, livestock mainly rely on grazing and there is little use of purchased inputs. Intensive system is characterized by cattle confinement, integration of crop and livestock and use of manufactured feeds.

Table 4. Revenue and cost components included in calculations, per scenario

	Revenues included in calculations	Costs included in calculations
Scenario 1	1. Milk sales	Variable Costs
	2. Milk consumed by household	Fixed costs
	3. Milk given to calves and labourers	Milk given to calves and labourers
	4. Sale of animals	Milk spoilage
		Mortality
Scenario 2	1. Milk sales	Variable Costs
	2. Milk consumed by household	Fixed costs
	3. Milk given to calves and labourers	Milk given to calves and labourers
		Milk spoilage
		Mortality

Information on non-market benefits such as draught power, manure used in the farm and benefits derived from cattle as a form of savings and insurance were not collated in the survey, hence were not included in computation of revenue.

2.3 Cost computation

Costs included in the analyses for the two different scenarios are presented in Table 4.To determine costs resulting from mortality, the farmers were requested to provide information on the number of animals within different age classes that had died on their farms over the last six months. The proportionate mortality within the different animal categories is presented in Table 5.

Table 5. Percent mortality for different animal categories

Animal Type	Mortality rate
Bull>3yrs	9.4%
Castrated males >3yrs	0
Immature males	2%
Dry Cows	2.3%
Lactating cows	0
Heifers	0.6%
Male calves	1.1%
Female calves	0

The highest mortality reported within the six months prior to the survey was among bulls (9.4%).No mortality was reported for castrated males, lactating cows and female calves.To obtain a cost for mortality, the mortality rate was multiplied by the market price for each animal type within the different sites. Information on these prices was provided within the questionnaire. The total cost of mortality within a farm was then calculated as the sum of the mortality costs over all animal types within the farm. The cost of mortality per litre of milk produced was obtained by dividing the total cost of mortality by the total milk production over the last three months.

Fixed costs included depreciation of machines, equipment, buildings, other dairy enterprise structures and their maintenance. Variable costs comprised of hired labour, feeds, animal health

inputs, breeding costs, extension and milk transport. However, cattle purchases were not included in computing expenses. Details of calculations are provided in Annex4.

2.4 Analytical procedure

Profits for the two scenarios presented in Table 4 were calculated as the difference between the revenues and the costs using partial budget analysis. Profitability was compared between hubs, farmers' scale of operation and the type of production system operated. Differences in the mean revenue, costs and profits between the two production systems and depending on the scale of operation were evaluated using ANOVA procedures and compared using t-tests.Descriptive statistics were used to present the distribution of revenue, costs and profits across hubs.

3. RESULTS

3.1 Profits per litre across hubs

Results on the costs and revenues within the different hubs under scenario 1 as detailed in Table 4 are presented in Table 6, while costs and revenues under scenario 2 are presented in Table 7. It should be noted that the price of a litre of milk greatly differed depending on the channel used. In the survey, farmers reported prices of milk given by various buyers and this was used to determine the average price of milk within a hub. However, most of the farmers sold their milk through the hubs, hence the price of milk used to determine their revenue from milk was that offered by each hub respectively.

3.1.1 Profit per litre from milk and cattle revenue combined

Under the first scenario in which revenue streams emanated from both the sale of cattle and from milk, profitability was variable within both the intensive and extensive farming systems (Table 6). Farmers in Gahengeri practicing more intensive production made the highest profits. Within the same intensive systems however, farmers in Muhazi made a net loss, while in the more extensive systems, farmers in Kigabiro made a net loss. Notable in Kigabiro hub was the fact that the price per litre of milk was higher than that in the other hubs, however the costs due to mortality in this hub were also significantly higher than in all the other hubs (Table 6). Sale of manure as a source of revenue was only noted in two hubs, Gahengeri and Muhazi.

Table 6. Average total revenues and costs of dairy production across hubs

	Intensive hubs						Extensive hubs					
RwFrcper Litre	**Gahengeri**	**N**	**Muhazi**	**N**	**Matimba**	**N**	**Kigabiro**	**N**	**Mudacos**	**N**	**Rwabiharamba**	**N**
Av.Price per litre	200	9	219.1	11	160	8	237.4	13	178.1	16	164	15
Milk revenue*	195	10	195.6	9	150	7	176	5	170.6	10	163	10
Cattle revenue	433.7	10	63	9	136.3	7	461.4	5	143	10	76	10
Manure revenue	41.7	10	9.5	9	0	7	0	5	0	10	0	10
Total revenue	**670.4**	**10**	**268.3**	**9**	**286.7**	**7**	**637.4**	**5**	**313.7**	**10**	**239**	**10**
Variable cost	26	10	166.8	9	132.8	7	230	5	74.2	10	57	10
Fixed cost	5	10	10.4	9	3.8	7	30.2	5	3	10	4	10
Milk given out	0	10	130.7	9	0	7	71.5	5	2.8	10	0	10
Calf milk	0	10	21.5	9	0	7	20.7	5	12.8	10	0	10
Mortalities	2.5	10	32.3	9	66.7	7	284.9	5	68.4	10	45.1	10
Milk spoilage	0	10	0	9	9.6	7	0	5	0	10	0	10
Production cost	**33.7**	**10**	**361.7**	**9**	**212.8**	**7**	**637.5**	**5**	**161.3**	**10**	**106.3**	**10**
Profit per litre	636.7	10	-93	9	73.9	7	-0.1	5	152.4	10	133	10

**Milk revenue is the actual revenue per litre of milk sold while the average price per litre is an average across the various outlets. Milk revenue may therefore be lower than average price.*

3.1.2. Profit per litre from milk revenue only

In all the hubs there was a drastic reduction in profits when revenue calculated did not include that from sale of animals (Table 7).

Farmers in Gahengeri still made the highest profit, however this was much lower than what they made under scenario 1. In the more extensive hubs, farmers in Kigabiro made the highest loss when revenues from the sale of cattle were not considered in determining the profit per litre of milk production. These results indicate the importance of cattle sales to the profitability of dairy enterprises in Rwanda.

Table 7. Average revenues and costs of dairy production without inclusion of cattle sales across hubs

Rwfrnc. per Litre	Intensive hubs						Extensive hubs					
	Gahengeri	**N**	**Muhazi**	**N**	**Matimba**	**N**	**Kigabiro**	**N**	**Mudacos**	**N**	**Rwabiharamba**	**N**
Milk revenue	195	10	195.6	9	150	7	176	5	170.6	10	163	10
Production cost	33.7	10	361.7	9	212.8	7	637.5	5	161.3	10	106.3	10
Profit per litre	**161.3**	**10**	**-166**	**9**	**-62.4**	**7**	**-486.3**	**6**	**9.3**	**10**	**60**	**10**

* Production costs are same as those from Table 6

3.1.3.Percentage contribution of milk and cattle sales to dairy enterprise

The proportional contribution of revenue from the sale of cattle to the dairy enterprise relative to that from milk and manure sales is presented in Figure 1. It was in only two of the hubs, Gahengeri and Kigabiro that farmers had more than 40% of their revenue emanating from the sale of cattle.

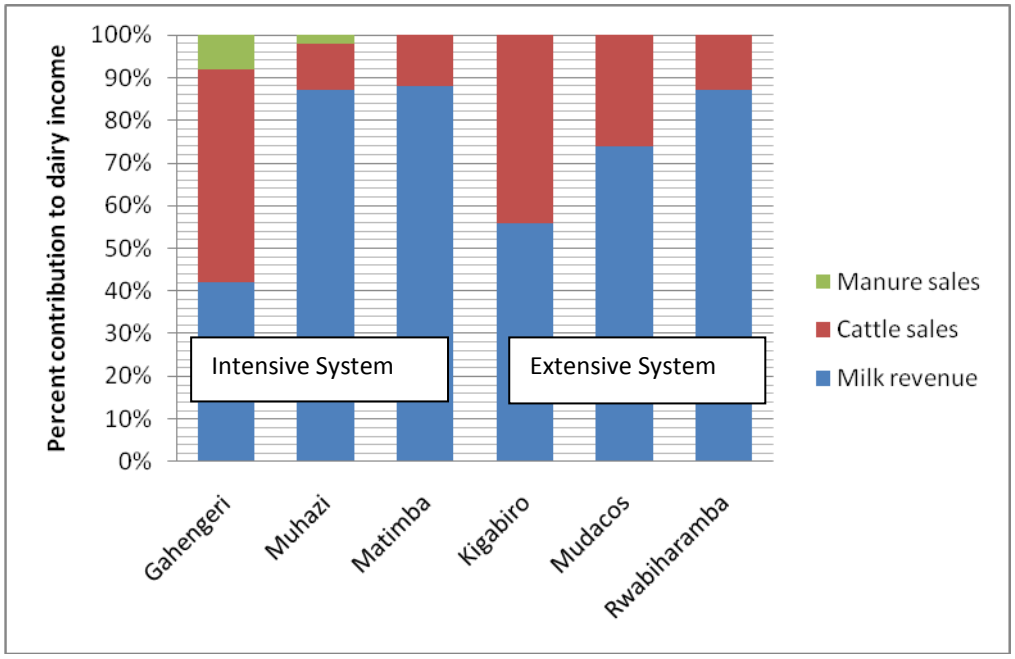


Figure 1. Percent contribution of cattle, milk and manure sales to income from dairy production across hubs in Rwanda

3.2 Profits in different scales of farm operation and for different systems of dairy production

3.2.1.Comparison of revenue, costs and profits between small-scale and medium-scale farmers

Revenue*s*

Differences in revenue due to scale of farming operation are presented in Table 8. Small scale farmers made higher total revenue from dairy production than the medium scalefarmers ($p<.01$). This emanated mainly from thesignificantly higher revenues from cattle sales($p<.05$) within the small scale farming operations relative to sales within the medium scale farms.

Costs

Overall costs of dairy production tended to be higher under the small-scale farming systems relative to medium-scale systems (Table 8). The small-scale farmers incurred significantly higher fixed cost per litre of milk produced ($p<0.1$), however, when both the fixed and variable costs of production combined were compared between the two systems they were not significantly different.

Profits

In this second round of the survey, under both Small scale and medium scale operations, the farmers made losses when profit was calculated using revenues from milk sales only (Table 8). The loss was higher for small scale farmers. This was different from the results of the first round of the survey when under both scales of operation the farmers made a profit when profit was calculated using revenue form milk sales alone (Table 1). When profits were calculated using combined revenue from milk and cattle sales, small scale farmers made more profit than the medium scale farmers. The difference in profitability between the two systems was however not significant (Table 8).

Table 8. Mean Revenue, Costs and Profits in medium and small-scale farms

Item in RwFrc. per litre	Small-scale	N	Medium-scale	N	T-test
Consumed milk	32	24	19.8	27	-1.4976
Milk sales	108.6	24	114.2	27	0.2913
Total Milk revenue*	185.6	24	167.7	27	-1.4754
Cattle revenue	315.6	24	103	27	-2.1086**
Total Revenue	**519.6**	**24**	**272.9**	**27**	**-2.4673*** **
Variable cost	121.9	24	82.6	27	-1.1506
Fixed cost	12	24	4.3	27	-2.6405***
Milk given out	36.2	24	25.6	27	-0.6633
Milk to calves	8.6	24	8	27	-0.1570
Milk spoilage	0	24	2.5	27	1.0000
Mortalities	78.3	24	54.1	27	-0.7472
Total Cost	**256.8**	**24**	**177.1**	**27**	**-1.2947**
Profit from milk only	-71.2	24	-9.4	27	0.9776
Total Profit	**262.8**	**24**	**95.9**	**27**	**-1.5469**

**Total milk Revenue = Consumed milk+ Milk sales+ Milk to calves+ Milk given out*

3.2.2. Comparison of revenue, costs and profits between the intensive and extensive production systems

Revenues

Farmers practicing intensive dairy production generated significantly higher total revenues than those practicing extensive dairy production ($p<0.1$, Table 9).Within the intensive production systems, the farmers generated significantly higher revenues from the sale of milk ($p<0.05$) than those operating extensive dairy production. Revenue from sale of cattle though not significantly different between the two types of production was higher for intensive systems than for the extensive systems. These results were quite different from those obtained in the first round of the survey carried out in 2011 (Table 2), where farmers practicing extensive dairy production generated higher revenues than those practicing intensive dairy production.

Costs

As in the first round of the survey (Table 2), results from the second round of the survey show that farmers practicing intensive dairy production incurred significantly higher total costs per litre of milk produced ($p< 0.1$) than those practicing extensive dairy production (Table 9). The higher costs resulted from significantly higher fixed and variable costs of production within the intensive systems.

Profits

The total profit from the dairy enterprise though slightly higher for the intensive systems relative to the extensive systems was not significantly different (Table 9). This was different from what was obtained in the first round of the survey when farmers from the more extensive production systems made a significantly higher total profit than those from the more intensive systems (Table 2). When revenue was calculated without taking into consideration that from the sale of animals, farmers operating more intensive production of dairy animals made a net loss, while those operating

extensive systems just managed to break even (Table 9). This result was similar to that obtained in the first round of the survey (Table 2).

Table 9. Mean revenue, costs and profits in intensive and extensive system

RwFrc per litre	Intensive	N	Extensive	N	T-test
Consumed milk	29.8	34	17.2	17	-1.6840*
Milk sales	97.4	34	139.8	17	2.8218
Total Milk revenue	183.9	34	160.5	17	-2.4030**
Cattle revenue	246.2	34	116.9	17	-1.3288
Total Revenue	**444.8**	**34**	**277.5**	**17**	**-1.7112***
Variable cost	104.6	34	94	17	-3.1261***
Fixed cost	9.8	34	3.4	17	-3.1261***
Milk given out	45.7	34	0.5	17	-4.0256***
Milk to calves	11	34	2.9	17	-2.3346**
Milk spoilage	0	34	4	17	1.0000
Mortalities	70.7	34	55.2	17	-0.6471
Total cost	**241.9**	**34**	**160**	**17**	**-1.7560***
Milk Profit only	-58	34	0.5	17	1.2102
Total Profit	202.9	35	117.5	17	-0.8583

3.2.3. Comparison of revenue, costs and profits between small and medium-scale farmers within production system

Revenues

Small scale farmers practicing intensive dairy production generated significantly higher total revenues than their medium scale counterparts ($p<0.05$, Table 10). They also generated higher revenue from cattle sales. Under the extensive dairy production systems, although small-scale farmers made more revenue form the dairy enterprise than their medium scale counterparts, the difference was not as great as that evident under intensive production systems (Table 10).

Costs

Though within the intensive production systems the small-scale farmers incurred significantly higher fixed costs than the medium scale farmers, the overall costs of production was not significantly different between small and medium scale farmers under both intensive and extensive production systems (Table 10).

Profits

On average, small-scale farmers tended to make higher total profits from their dairy enterprise than their medium-scale counterparts in both the intensive and extensive production systems (Table 10). However, these differences were not significant. When only revenue from milk was considered without taking into account revenue from the sale of cattle, all the farmers practicing intensive dairy production made a net loss. It should however be noted that small-scale farmers practicing extensive dairy production were able to break even when only revenue from milk was considered.

Table 10: Mean revenue, costs and profits between medium and small-scale farmers practicing intensive and extensive dairy production respectively

	Intensive Dairy Systems			Extensive Dairy Systems		
RwFrc per litre	**Small scale**	**Medium scale**	**T-test**	**Small-scale**	**Medium scale**	**T-test**
Consumed milk	23.5	27.1	-0.4880	31.1	7.5	-2.7081**
Milk sales	100.4	94.4	-0.2255	128.4	147.9	1.3436
Total Milk revenue	194.7	173.1	-1.2720	163.6	158.4	-0.5372
Cattle revenue	387.2	105.1	-2.2762**	141.7	99.6	-0.2806
Total Revenue	**607.9**	**281.8**	**-2.7189****	**305.3**	**258**	**-0.3110**
Variable cost	135	74.2	-1.3046	90.2	96.8	0.2241
Fixed cost	15	4.7	-2.8368***	3.3	3.5	0.1053
Milk given out	51.2	40.1	-0.4863	0	0.8	0.8284
Milk to calves	10.6	11.5	0.1456	0	6.7	0.8284
Milk spoilage	0	0		4	2.1	-0.5085
Mortalities	93.2	48.2	-0.9872	42.2	64.2	1.4523
Total cost	**305**	**178.8**	**-1.4992**	**139.8**	**174**	**0.9215**
Milk Profit only	-110.3	-5.7	1.2019	23.8	-15.8	-0.9510
Total Profit	302.9	103	-1.4255	165.5	83.8	-0.5649

3.3 Distribution of costs within hubs

3.3.1. Distribution of costs in hubs where farmers practiced intensive dairy production

The proportional contribution of various factors to the costs of dairy production within the different hubs where farmers practiced intensive production are presented in Figure 2. The relative contribution of different factors to the costs of production was variable between the hubs. Farmers from Gahengeri incurred the highest costs of purchased feeds (39%), while those from Muhazi incurred highest costs from milk given out to labourers (36%) and those from Matimba incurred highest costs from the mortality of animals (31%). Other significant contributors to costs of milk production within the hubs were animal health and extension services (Figure 2).

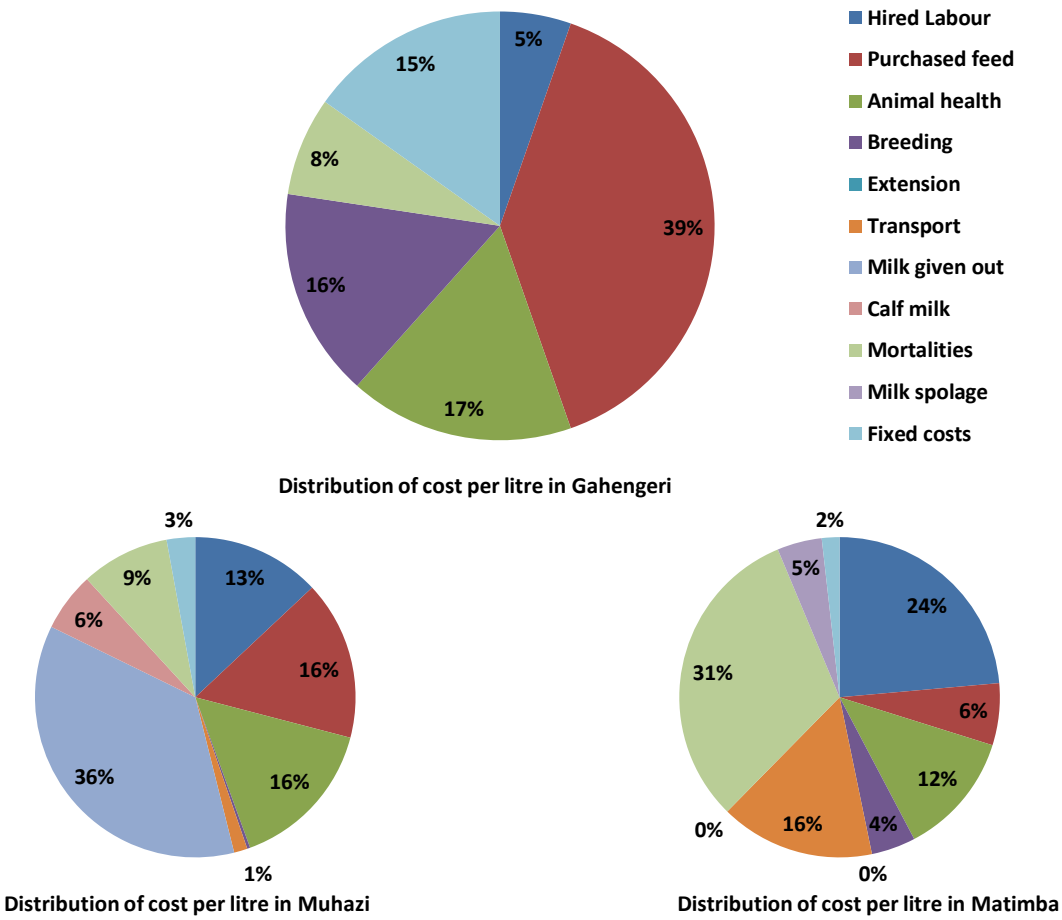
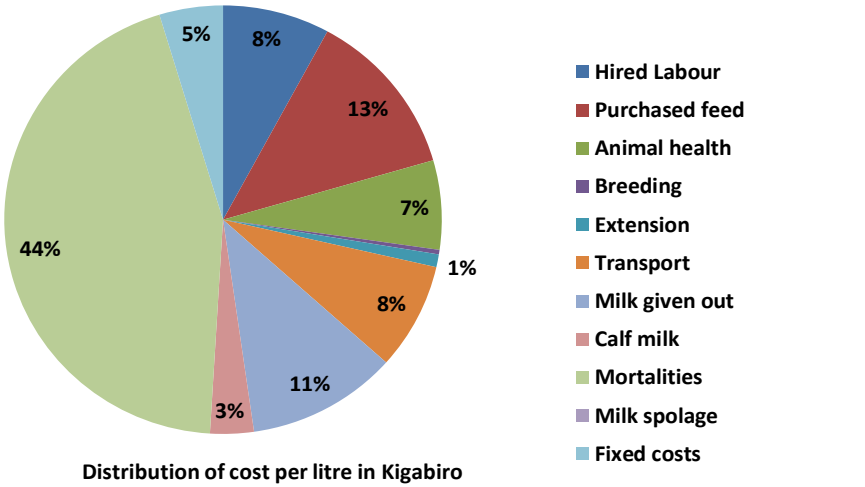


Figure 2: Distribution of cost per litre in intensive system hubs

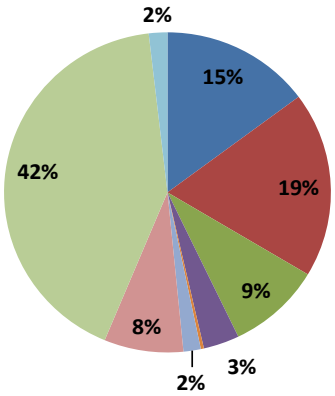
3.3.2. Distribution of costs in hubs where farmers practiced extensive dairy production

The proportional contribution of various factors to the costs of dairy production within the different hubs where farmers practiced extensive dairy production are presented in Figure 3. In all the three extensive hubs, mortality and hired labour contributed to the highest proportion of costs incurred. In Kigabiro and Mudacos hubs, costs of feeds also significantly contributed to the overall costs of production while hired labour contributed significantly in Rwambiharamba.

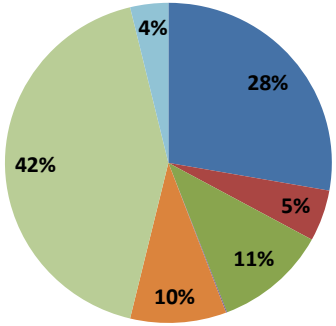
Improved animal health services and management interventions are required to reduce the high costs of mortality within these hubs.



Distribution of cost per litre in Kigabiro



Distribution of cost per litre in Mudacos



Distribution of cost per litre in Rabiharamba

Figure 3: Distribution of cost per litre in extensive system hubs

4. CONCLUSIONS

Result from the second round of the survey showed that farmers practicing intensive dairy production system incurred significantly higher production cost per litre than those practicing extensive dairy production.The higher costs were mainly due to costs of milk given to calves and to labourers, fixed costs, and in some hubs, feeds and mortality. Small scale farmers also made more total revenue than the medium scale farmers from their dairy enterprise. Sale of cattle significantly contributed to revenue of the farmers. Strategies that EADD is implementing to improve feeding practices and avail feeds during dry seasons should be promoted in all hubs to assist farmers cut down on feed expenditure. Improvement of animal health services and provision of training to farmers on improved animal health management are also critical in order to reduce disease incidences and curb mortalities. There is also a great need to improve productivity per animal in order to further reduce the costs of production and enhance profitability.

The difference in results on costs of production from the second round of the survey relative to the first demonstrate annual variations in revenues and costs of raising dairy animals within the different areas of the country.

5. REFERENCES

East Africa Dairy Development Project (EADD), Livestock Disease Challenges and Gaps in Animal Health Service Delivery, June, 2010.

East Africa Dairy Development Project (EADD), Dairy Production and Marketing, March, 2010.

East Africa Dairy Development Project (EADD), Cost of Milk Production, November, 2011.

ANNEXES

Annex 1: Sample size by hub

Hub				
	System	**Small scale**	**Medium scale**	**Total**
Gahengeri	Intensive	8	2	**10**
Muhazi	Intensive	5	5	**10**
Matimba	Intensive	2	0	**2**
	Extensive	4	4	**8**
Kigabiro	Intensive	10	0	**10**
Mudacos	Intensive	**0**	**6**	**6**
	Extensive	**2**	**2**	**4**
Rwabiharamba	Intensive	0	4	**4**
	Extensive	2	4	**6**

Annex2: Three months milk yield estimation

Milk Yield Calculation;

A regression was done for milk production levels the day preceding the survey and at calving against time, for the different breeds. Lactating cows were grouped into two categories per breed;

- Those whose current lactation length is greater or equal to three months
- Those whose current lactation length is less than three months

The area under the lactation curve was calculated for these categories to get three months milk yield estimates.

Annex 3:Revenue and cost components included in calculations, per option

	Revenues included in calculations	Costs included in calculations
Option 1	5. Milk sales 6. Milk consumed by household 7. Milk given to calves and labourers 8. Sale of animal	Variable Costs Fixed costs Milk given to calves and labourers Milk spoilage Mortality
Option 2	4. Milk sales 5. Milk consumed by household 6. Milk given to calves and labourers	Variable Costs Fixed costs Milk given to calves and labourers Milk spoilage Mortality

Annex 4 Three months total cost computation

Cost	**Components**
Variable costs	Hired Labour • Casual wage • Monthly wage
	Purchased Feeds • Purchased fodder/forage • Concentrates

	• Minerals • Water
	Animal health • Deworming • Vaccination • Tick control • Curative treatments • Milking salve • Teat disinfection • dehorning
	Breeding • AI and Bull services
Fixed costs	Depreciation • Machines • Equipment and tools • Buildings • Other structures
	Maintenance • Buildings • Other structures
Other costs	➢ Milk spoilage ➢ Milk given to labourers ➢ Milk given to calves ➢ Cattle mortality

Annex 5:**Average variable, fixed and other costs per litre in hubs**

	Gahengeri		**Muhazi**		**Matimba**		**Kigabiro**		**Mudacos**		**Rwabiharamba**	
Cost per litre inRwFrc	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N
Hired Labour	1.8	1	47	9	50.2	7	50.9	5	24.2	10	29.5	10
Purchased feed	13.2	10	58.1	9	13.3	7	81	5	30.6	10	5.5	10
Animal health	5.7	10	55.6	9	26.5	7	43.2	5	15.2	9	11.9	10
Breeding	5.3	10	1.1	9	9.5	7	2.2	5	5.8	9	0.1	10
Extension	0	10	0	9	0	7	6.2	5	0	9	0	10
Transport	0	10	4.9	9	33.2	7	51.7	5	0.5	10	10.1	10
Milk given out	0	10	130.7	9	0	7	71.5	5	2.8	10	0	10
Calf milk	0	10	21.5	9	0	7	20.7	5	12.8	10	0	10
Mortalities	2.5	10	32.3	9	66.7	7	284.9	5	68.4	10	45.1	10
Milk spoilage	0	10	0	9	9.6	7	0	5	0	10	0	10
Fixed costs	5.1	10	10.4	9	3.8	7	30.2	5	3	10	4	10