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ECONOMIC IMPACT OF CALF MORTALITY ON DAIRY FARMS IN KUWAIT

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ABSTRACT

Objective of this study was to investigate the economic impact of mortality of pre-weaned calves on dairy cattle enterprise in Kuwait. Cost/benefit analysis model was applied to two different situations: in the first situation, a baseline scenario, field survey data without intervention using 1,280 newborn calves was used in first calving season. In the second situation, the intervention scenario (improved management), 665 newborn calves were used in second calving season during the following year. Calving seasons extended for 7 months from September to March. Calf performance studies were conducted from birth to weaning. Economic model was constructed on Microsoft Excel and used to evaluate the impact of calf mortality on calf enterprise.

Results showed that gross margins increased from 13 to 35% as a result of implementation of intervention measures during the second calving season over baseline scenario. A significant correlation between increased veterinary expenses and an increase in revenues ($r^2 = 0.65$, $P<0.05$) was observed. If the intervention measures such as colostrum feeding, nutrition and hygiene had not been implemented, the farms would have lose income from 12 to 51% of the gross revenues. Net income was influenced by costs of feeds, veterinary services and laborers. Discounted cash flow studies on a whole farm basis revealed that the impact of interventions was small (0-3%). Calf mortality could not be isolated from whole farm for assessing its impact on dairy farm economics. Economic studies demonstrated the cost/benefits of using the improved techniques of calf rearing.

Key words: Calf mortality, dairy, interventions, cost/benefits, gross margin.

INTRODUCTION

Dairying is one of the most important part of livestock sector (Habib *et al*., 2007). Heifers are future herd of a dairy farm. They must be produced to replace the old and uneconomical females of the farm through voluntary culling. When genetic trends are positive, such replacements help harvest the benefits of genetic gain (Bhatti *et al*., 2007).

Dairy farmers in Kuwait are facing the problem of a high calf mortality rate and are usually unable to raise their replacement dairy herds (Razzaque *et al*., 2007; Razzaque *et al*., 2008). A previous study showed an average of 44% crude mortality in pre-weaned dairy calves in Kuwait, while in a poorly managed dairy farm, the crude mortality rate was found to be as high as 90% (Razzaque *et al*., 2001). High losses of young calves were due to inadequate management practices leading to diarrhoea, pneumonia, dehydration and infection by *E. coli*, Rotavirus, Salmonella species and *Pasteurella haemolytica* (Razzaque *et al*., 2008). The economic loss caused by morbidity and mortality of calves was high with a loss of KD 70 (US $ 62.50) per calf died (Razzaque, 2005). Calf losses were significantly reduced by introducing new techniques of management including on-time colostrum feeding, hutch housing, feeding and nutrition (Razzaque *et al*., 2008; Razzaque *et al*., 2009).

Recording systems of Kuwait's dairy operations were found to be inadequate for carrying out economic assessment of calf mortality and decision making process in the farms (Razzaque *et al*., 2001). Cost/benefit analysis data of calf rearing were not available, therefore, dairy producers of Kuwait resorted to import dairy heifers as an only option. Also, due to very high calf morality, the dairy producers of Kuwait have presumed that import of pregnant dairy heifers for milk production was more economical than rearing their own replacement heifers. Earlier, Kossaibati and Esslemont (1997) assessed the veterinary costs of diseases of dairy herds in the UK and observed losses ranged from £ 1,200 to 1,360 per 100 cows. Calf mortality and its effects on dairy production economics was rarely understood by Kuwait's dairy producers, as evidenced by the lack of reliance on their farm records for decision making. The objective of this study was to investigate the economic impact of calf mortality on calf enterprise of commercial dairy operations before and after improved management in Kuwait.

MATERIALS AND METHODS

Baseline situation and dairy farm survey

Without intervention, a baseline situation (BS) of the first year calving season represented the prevailing management performance prior to the introduction of any intervention programme (Table 1). The economic model was developed by Woolcock (1998) and presented in detail by Razzaque *et al*. (2001) and Razzaque (2005). A survey questionnaire and an economic analysis model were used to evaluate the impact of pre-weaned calf mortality on

Table 1: Summary of parameters used in the financial and economic analyses

Situation	Without intervention (baseline scenario)	With intervention (improved health and management)
Intervention	Without disease control feeding/nutrition programme	With implementation of feeding/nutrition disease control intervention.
Data source	1st year calving season baseline survey	2nd year calving season intervention measures
Performance parameters applied	Actual survey data	Actual survey data and mortality rate from 2nd year calving season field results were compared.
Performance parameters held constant	Actual survey data	Calving rate, replacement, mating, sales and milk yields
Intervention strategy	None	Intervention measures implemented for colostrum feeding, nutrition, hygiene and disease control and treatment of calves. Farm staff members were trained.
Parameters of studies	Date of birth, colostrum feeding practices, level of antibody in serum, morbidity, mortality, causes/diagnosis of diseases, cost of input on feed, laborers, veterinary services	Calf performance, from birth to 90 days was monitored, disease incidences, morbidity and mortality, cost of input on feed, laborers, veterinary service etc were recorded for the cost/benefit analysis.

farm income in 6 farms A, B, C, D, E and F. Cost/benefit analysis model was applied to two situations of calf mortality: a baseline scenario, i.e. use of field survey data without intervention measures (commercial management), when 1,280 newborn Holstein Friesian calves were under investigation in first calving season extending for 7 months from September to March.

With intervention measures

In "with interventions situation (WI)", actual field data resulting from the introduction of improvement management and disease control intervention of the second calving season were assigned to the model to calculate the discounted cash flow. In the intervention scenario, a total of 665 newborn Holstein Friesian calves were used in second calving season of similar time frames mentioned for the first calving season. Calves were raised under the improved management practices from the date of their birth to weaning at 90 days of age (Table 1). These practices included: isolation of late pregnant cows in clean maternity barns prior to their delivery, assisting cows during calving, cleaning/disinfecting navels of newborn calves, timely colostrum feeding, isolation of calves to the clean individual calf pens and providing heating/ cooling as needed. Treatment calves for scours, pneumonia and dehydration, feeding appropriate milk replacers as per NRC (2001) standards, weighing of calves at 90 days and isolating them for group feeding were also important elements of intervention measures.

The economic model was applied for dairy herd structure analysis using parameters such as mortalities, input costs, calving and culling rates, animal classes, ages of locally born progeny for selling, use of artificial insemination and milk yields of imported or locally bred cows. The model was constructed on Microsoft Excel and it could produce a herd size with a specific number of milking cows and use to represent an individual farm and group of farms.

Data collection

Herd performance and economic data of input and output were collected from six dairy farms (Razzaque *et al*., 2008). The survey data of first calving season were used as a baseline record to evaluate the impact of intervention programme applied in second calving season with each farm serving as its own control. The impact of calf mortality was evaluated using both financial and economic analysis of the calf mortality (Razzaque *et al*., 2001).

Financial analysis

For gross margin analysis of calf mortality, all other farm parameters remained constant except the calf mortality and the calves were sold at 3 months of age. These analyses evaluated and compared the baseline survey data of first calving season with those of intervention programme of second year calving season, its effectiveness and how reduced mortality rates affected gross margins. Income losses were derived from the baseline data considering that the interventions had not been implemented (Razzaque *et al*., 2001; Razzaque *et al*., 2008).

Economic analysis

The economic analysis used discounted cash flow techniques (present value calculations) and was based on the incremental economic costs and benefits attributable to interventions.

RESULTS

Financial analysis

Table 2 shows that the highest cost was for feeds and the other cost components of the calf rearing enterprise for each farm were laborers and veterinary service costs. With the implementation of intervention measures, gains in gross margins for five out of the six farms ranged from 13 to 35% (Table 3). Farm C showed little change, as the mortality rate was very low and the farm had an optimal level of calf survival rate (96%) prior to the implementation of intervention measures. Table 4 shows that potential losses of income varied among the farms, ranging from 12.22 to 61.14%, depending on crude mortality rates of calves or the number of calves died prior to reaching their 90 days of age. Multiple regression analysis showed a significant correlation between increased veterinary expenditure and an increase in revenue (Table 3) (r^2=0.65, P<0.05). Increase in revenue was due to the fact that for every KD 1 (Kuwaiti Dinar 1 = US Dollar 3.75) spent on veterinary items, there was a KD 15 (US $ 56.25) return in revenue.

Economic analysis

Table 5 shows that reduction in mortality had a minimal effect on farm cash flow, because pre-weaned calves formed only a minor part of the total dairy herd. Comparing the pre-intervention situation (baseline) with the intervention outcome, the results showed little or no impact on the whole farm production performance. Therefore, the reduction in mortality rates for each of the farms had a minimal effect on farm cash flows as the analysis covered calves up to 90 days of age. The reduced mortality rates on three farms resulted in zero growth, while the other three farms were only able to achieve growth rates between 1 and 3% over the analysis period.

DISCUSSION

Gross margin

The financial analysis clearly demonstrated the benefit of ontime veterinary intervention measures to dairy farms. One Kuwaiti Dinar (1 KD = 3.75 US $) increase of calf health care resulted in KD15 (US$ 56.25) return in revenue, which is a significant benefit to calf rearing enterprise in Kuwait. This analysis supports the findings of Harash *et al*. (1998). A reduction in calf mortality rates by intervention measures had a positive impact on gross margins. These benefits of taking on-time intervention measures with a minimum fund input to the farms were not known to the dairy producers in Kuwait, therefore they lived with the losses and continued to import replacement heifers from abroad. If the calf rearing enterprise was separated from the whole farm, gains in gross margins per calf in five of the six farms ranged from 13 to 35%. Only in farm C, mortality rates were very low during first calving season, therefore, no measurable change in gross margins was noticed due to intervention in the second calving season at that farm. The effectiveness of the interventions was demonstrated by the potential loss of income (Table 4) and significance of spending money on calf enterprise for their greater financial gains. Had the interventions not been introduced, high calf mortality for five of the six farms would have resulted in high losses ranging from 12.22 to 61.4% (Table 4).

Financial and economic analysis

Financial analysis showed good returns in rearing calves for sale at 3 months of age. The results of the economic analysis with interventions showed that the reduction in calf mortality rates had little or no impact on whole farm performance which was expected (Gabler *et al*., 2000). Published studies on the impact of calf mortality, calf and heifer rearing under the similar intensive dairy management of Kuwait are scanty. However, present studies have provided a baseline and intervention data indicating cost/benefits of pre-weaned rearing in Kuwait. The size of farm, market prices of milk and input on feed, laborers, veterinary services etc. could significantly influence the net income, as clearly observed in our studies (Table 3). Present results are consistent with the economic assessment of the whole farm carried out by Groenendaal *et al*. (2004). Further studies are under way for cost/benefit analysis of replacement heifer rearing in Kuwait.

Conclusions

Based on the results of the present study it can be concluded that a reduction in calf mortality by improved management had a positive impact on gross margins. However, it had little or no effect on overall farm performance.

Table 2: Cost analysis without intervention using the baseline survey data (BS) and with intervention data (WI)

Variable cost (KD)*	Labor cost		Feed cost		Veterinary cost	
	BS	WI	BS	WI	BS	WI
Sample mean	12.53	10.19	37.05	30.31	1.15	1.90
Standard deviation	6.76	4.68	7.18	2.97	0.47	0.81
Standard error	2.75	1.91	2.93	1.21	0.19	0.33
Acceptance level (%)	22	18	8	4	17	17

Cost in Kuwaiti Dinar (KD); * KD 1 = US $ 3.75.

Table 3: Impact of reduced calf mortality rates on the gross margin and a comparison between the baseline (BS) and with intervention (WI)

Parameters	Farm identity											
	A		B		C		D		E		F	
	BS	WI	BS	WI	BS	WI	BS	WI	BS	WI	BS	WI
Mortality rates (%)	25	16	20	2	4	4	72	32	51	21	57	28
Revenue from sale of calves (KD)	30,032	35,910	12,234	15,680	27,211	29,185	7,182	13,266	9,907	14,258	9,324	13,654
Operating costs (KD)												
Labor	1,920	1,990	1,600	1,750	1,350	1,350	1,200	1,500	1,080	1,680	1,680	2,050
Feed	10,277	10,483	4,400	5,172	7,546	8,030	2,768	3,978	3,744	4,344	3,586	4,068
*Veterinary	110	515	117	267	375	395	100	450	120	225	110	235
Others (Admin, water, power, bedding)	387	387	181	200	390	390	250	260	215	250	171	97
Total	12,694	13,375	6,298	7,389	9,661	10,165	4,318	6,188	5,159	6,499	5,547	6,550
Gross profit (KD)	17,338	22,535	5,936	8,291	17,550	19,020	2,864	7,078	4,748	7,759	3,777	7,104
Number of calves sold	330	359	126	156	272	291	72	132	99	142	93	136
Cost of rearing a calf	38	37	50	47	36	35	60	47	52	46	60	48
Gross margin per calf sold	53	63	47	53	65	65	40	54	48	55	41	52
Increase in calf gross margin due to intervention (%)	19		13		1		35		14		29	

KD 1 = US $ 3.75

(*r^2=0.65, P<0.05)

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Table 4: Potential loss income: baseline (BS) and with intervention (WI)

Parameter	Farm identity					
	A	B	C	D	E	F
a. Mortality rate difference (%)	9	18	0	40	30	29
b. Extra calf deaths (BS Nos.)	40	29	0	74	54	53
c. Gross margin/calf (BS)(KD)	53	42	65	22	54	34
d. Loss in income (BS)(KD)	2,120	1,218	0	1,628	2,916	1,802
e. Total gross revenue (WI)(KD)	17,338	5,936	17,550	2,864	4,748	3,777
*f. Potential loss (%)	12.22	20.52	**0	56.84	61.14	47.71

*f = d/e x 100

**Farm C already had low crude mortality in the first calving (BS). In the second calving with intervention, no improvement was achieved.

Table 5: Economic impact with intervention (WI) between the baseline situation, (BS), and with intervention on whole farm basis including other mature dairy herds.

Parameter	Farm identity											
	A		B		C		D		E		F	
	BS	WI	BS	WI	BS	WI	BS	WI	BS	WI	BS	WI
Mortality rate (%)	25	16	20	2	4	4	72	32	51	21	57	28
Discounted cash flow (KD million)	1.40	1.40	0.80	0.82	1.60	1.60	1.09	1.10	0.50	0.50	0.88	0.91
Change in discounted cash flow (%)	0		2		0		1		0		3	

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REFERENCES

Bhatti, S. A., M. Sarwar, M. S. Khan and S. M. I. Hussain, 2007. Reducing the age at first calving through nutritional manipulations in dairy buffaloes and cows: A review. Pakistan Vet. J., 27(1): 42-47.

Gabler, M. T., P. R. Tozer and A. J. Heinrichs, 2000. Development of a cost analysis spreadsheet for calculating the costs to raise a replacement dairy heifer. J. Dairy Sci., 83: 1104-1109.

Groenendaal, H., D. T. Galligan and H. A. Mulder, 2004. An economic spreadsheet model to determine optimal breeding and replacement decisions for dairy cattle. J. Dairy Sci., 87: 2146-2157.

Habib, G., A. Hameed and M. Akmal, 2007. Current feeding management of peri-urban dairy buffaloes and scope for improvement. Pakistan Vet. J., 27(1): 35-41.

Harash S., C. Wolf and E. Wittenberg, 1998. Dairy profitability and enterprise efficiency. Project Report, Agricultural Economics Staff Paper No. 2000, Michigan State University, Michigan, USA.

Kossaibati, M. A. and R. J. Esslemont, 1997. The veterinary cost for treatment of dairy cattle herds in the England. Vet. J., 154: 41-51.

Razzaque, M. A., D. Scharp, T. Al-Mutawa, M. Al-Muhanna, S. Abbas, A. Shalabi, E. El-Sawy, A. Al-Awadhi, F. Mulla and A. El-Sanousi, 2001. Field and laboratory investigation of calf mortality in Kuwait and its economic impact on dairy production. Kuwait Institute for Scientific Research, Report No. KISR6004, Kuwait.

Razzaque, M. A., 2005. Field and laboratory investigation of calf mortality in Kuwait: Factors affecting calf and heifer performance: Phase II. Kuwait Institute for Scientific Research, Report No. KISR7651, Kuwait.

Razzaque, M. A., M. Bedair, S. Abbas, N. M. Al-Khozam, T. Al-Mutawa, M. Al-Taqi, M. Al-Khamis and W. Al-Galaf, 2007. Dairy calf and heifer rearing in Kuwait: Impact of applied research interventions. Kuwait Institute for Scientific Research, Report No. KISR8810, Kuwait.

Razzaque, M. A., S. Abbas and M. Bedair, 2008. Mortality of pre-weaned calves in Kuwaits dairy herds, its causes and impact of interventions. Intern. J., Vet. Med., 5(2): 1-12.

Razzaque, M. A., M. Bedair and S. Abbas 2009. Performance of pre-weaned female calves confined in housing and open environment hutches in Kuwait. Pakistan Vet. J., 29(1): 1-4.

NRC (National Research Council) 2001. Nutrient Requirements of Dairy Cattle. 7th Rev. Ed., National Academy Press. Washington, DC, USA.

Thrushfield, M., 1995. The economics of calf diseases. In: Veterinary Epidemiology. 2nd Ed., Blackwell Science Ltd., London, UK, pp: 312-319.

Woolcock, R. F., 1998. Economic analysis of model dairy cattle production in Kuwait. Technical Report, Aridland Agriculture and Greenery Department, Kuwait Institute for Scientific Research, Kuwait.