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ORIGINAL ARTICLE

A survey to identify economic opportunities for smallholder dairy farms in Bangladesh

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Abstract Identified economic opportunities for planning interventions greatly increase farmers' compliance with an extension programme. We investigated opportunities for interventions to increase dairy farmers' income in four areas of Bangladesh, including the districts of Mymensingh, Khulna-Satkhira, Sirajgonj-Pabna and Chittagong. The data were collected from 1440 dairy farms at a one-day visit and were summarized as the difference between management targets and each herd's calculated management indices. The average number of lactating cows, feed cost as a percentage of income from milk, milk sold as percentage of milk produced, lactating cows as a percentage of mature cows, and lactating cows as a percentage of total cattle varied from 1.5 to 3.4, from 52.5% to 92.1%, from 78.7% to 92.6%, from 81.9% to 86.7% and from 34.3% to 37.7%, respectively. The average age at first calving, calf production interval, lactation length, and milk production were 35.0–44.3 months, 14.0–17.6 months, 249–286 days and 3.5–7.2 litres, respectively, depending on the locality. The average cost for producing 100 litres of milk was 18.9–35.1 US dollars. The production cost increased when daily milk production per cow decreased ($r^2 = 0.43$–0.55). Management improvements directed towards increasing average milk production per cow per day, increasing lactation length, decreasing age to first calving, and decreasing calf production interval could expect to yield an average income increase up to a range of 676.3–1730.6 US dollars depending on the milk-producing area.

Keywords Economic opportunities · Mixed farming · Market oriented · Milk production · Small-scale

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Abbreviations

BDT	Bangladesh taka (1 USD = 58 BDT)
EOS	economic oppurtunity survey
INR	Indian rupee
USD	US dollar

Introduction

In Bangladesh, milk is the most important livestock product of smallholder crop–livestock farmers. Increased mechanization of crop production has resulted in a gradual reduction in the need for draft animals. This

has created an opportunity for increasing the number of dairy farms. The number of dairy farms was only 2490 in the year 1990–91 and increased to 29 600 by 1997–98 (Anon, 2000a). Milk production increased from 1.29 million metric tons in 1987–88 to 1.74 million metric tons in 2001. Owing to this increased production, the importation of milk powder has decreased from 55 000 metric tons in 1991–92 to 17 000 metric tons in 2001.

However, current domestic milk production is inadequate to meet the demand. The per capita availability of milk was 41.2 ml/day in 2000 compared to the daily requirement of 250 ml (Miah and Mandal, 2002). Milk production in Bangladesh needs to grow by 4.2–5.6% per annum to meet the increased demand of an expected 1.6% population growth by 2010. Given the prospect of such a high growth rate in the dairy industry, there is an opportunity for recruitment of many smallholder producers and others involved in milk processing and marketing. Dairy farming generates more regular cash income, while dairy production, processing and marketing generate more employment per unit value added than do crops (Asaduzzaman, 2000; Omore *et al*., 2002).

If such a high growth rate in the dairy industry of Bangladesh is to be achieved, several factors need to be addressed. These include the poor genetic base of cattle, feed shortages, widespread infectious and production diseases, and inefficiencies leading to low productivity. Farm owners have largely overlooked the economic importance of these factors. Identification of the general areas of management where intervention is possible and needed is of utmost importance for profitable dairy farms. An economic opportunity survey (EOS) ranks the problem areas with regard to the amount of potential income if the problems were solved. Also, with involvement of the farmers in the survey, increased intervention compliance is more likely. Our purpose was to carry out an EOS on 1440 dairy farms in four agroecological zones representing the dairy industry of Bangladesh, and to rank the identified management factors on the basis of their potential opportunity for economic gain.

Materials and methods

An EOS was conducted on 1440 farms representing the dairy industry of Bangladesh in four agroecological zones, based on land type, soil pH, temperature and rainfall (Table 1). The zones were Old Brahmaputra floodplain, Ganges tidal floodplain, Karatoya-Bangali floodplain and Chittgong coastal plain. The areas belonged to the administrative districts of Mymensingh, Khulna and Satkhira, Pabna and Sirajgonj, and Chittagong, respectively.

In Mymensingh, crop production is the main source of livelihood and per capita income is low. Dairy farming is mostly of subsistence type because capital investment is not possible. The soil of Khulna and Satkhira has a sodium ion concentration of 2.56–5.12 g/L. Owing to close proximity to the Bay of Bengal, the area is flood prone and the infrastructures are poorly developed. Socioeconomic conditions are similar to those of Mymensingh, except in Kulna Metropoliton area, where living standards are slightly better. The land of Sirajgonj and Pabna is submerged under floodwater during the monsoon season. A major part of this area has access to the Bangladesh Milk Producers'

Table 1 Land type, soil pH and annual temperature, humidity and rainfall variations in different districts of Bangladesh

	Project area			
Geoclimatic parameters	Mymensingh	Khulna-Satkhira	Sirajgonj-Pabna	Chittagong
Land type[a]	Medium high	Medium low	Medium low	High
Soil pH	5.5–7.5	4.5–5.5	5.4–7.5	4.5–6.5
Temperature (°C)[b]				
Minimum	11.7–25.6	12.1–26.1	10.1–26.0	13.9–25.2
Maximum	24.8–32.9	25.9–35.0	24.6–35.9	26.0–32.3
Humidity (%)[b]	67–87	68–87	58–87	62–87
Rainfall (mm)[b]	8–395	8–346	5–288	5–744

[a]Land type is classified on the basis of the depth of seasonal flood. High land, medium high land and medium low land indicate <30 cm, 30–90 cm and >90–180 cm flood depth, respectively (Anon, 1997)
[b]Meteorological information is an average of 51 years data

Cooperative Union (BMPCU) Ltd. 'Milk vita' is the official trade name of BMPCU. Dairy farming is the major means of livelihood here because most farmers can cultivate only one crop per year (usually, three crops are cultivated per year in other areas of Bangladesh). Many farmers cultivate high-yielding fodder. Chittagong is the largest commercial city of Bangladesh. Living standards are higher than in the other areas studied. Dairy farming is commercial and intensive here.

Preparation of the survey schedule

The field survey was conducted from March 2001 to June 2002. The survey form was designed by the School of Veterinary Medicine, University of Wisconsin Madison, USA and referred to as the Economic Opportunity Survey (EOS) form. A Microsoft Excel spreadsheet was programmed to enter and record data from the EOS form. The programming was done in collaboration between the Field Fertility Clinic, Bangladesh Agricultural University, Mymensingh, Bangladesh and the School of Veterinary Medicine, University of Wisconsin Madison, USA. The survey form had five sections: farm milk production on the day before the visit; expenses of cattle health care and management; inventory of herd culls and death; calf production per cow; and summary of herd management.

Data collection

Because the project focused on the development of the small-scale market-oriented dairy industry in Bangladesh, farms that sell the majority of the milk produced were selected. They were visited once, and information was recorded by interviewing the farmers. If available, farm records were reviewed to obtain additional information and, if required, the animals were examined. All the prices and expenses were recorded in Bangladesh taka (BDT); however, after calculation, the figures for the economic opportunity and milk production cost were converted to US dollars (USD) (1 USD = 58 BDT) .

Setting the targets

The 20th and 80th percentiles of the management indices listed in Table 2 were calculated using the data from surveyed farms of the individual regions. Then the performance targets were identified for each region using the 20th or 80th percentile from farms depending on the index. Finally, the performance targets were entered in individual farm data to calculate the economic opportunity for different regions according to methods described in the next section.

Calculation of management indices

Age at first calving. The age at first calving was recorded in months and calculated by subtracting the birth date from the first calving date. The economic opportunity for age at first calving was calculated as follows:

> (Herd average age at first calving − target age at first calving) × (cost of feeds per month × number of first lactation cows in the herd)

Average calf production interval. Average calf production interval was expressed in months and calculated as the interval between two successive calvings of the cow.

Table 2 Performance targets using the 20th or 80th percentile based on farms from each respective region of Bangladesh

Management indices	Target			
	Mymensingh	Khulna-Satkhira	Sirajgonj-Pabna	Chittagong
1. Milk sold as percentage of milk produced	90	90	98	90
2. Calf mortality (%)	4	9	10	7
3. Age at first calving (months)	40	35	37	33
4. Calf production interval (months)	15	14	13	16
5. Lactation length (days)	304	289	282	304
6. Lactating cows as percentage of total cattle	50	50	40	40
7. Milk production (litres/cow per day)	5	7	9	8
8. Feed cost as percentage of income from milk	50	50	30	30

The economic opportunity for calf production interval was based on the number of calves born in the past year and was calculated as follows:

> {[(Herd calf production interval/target calf production interval) × number of calves born in past year] − number of calves born past year} × value of newborn calf.

The values of male and female calves were averaged. This economic opportunity took no account of any effect of change in annual milk production.

Lactation length. Lactation length was expressed in days and was calculated by subtracting the date of first milking from the date the cow went dry. The economic opportunity for average lactation length was calculated as

> {[(milk per lactating cow on one day) × (value of milk per litre)] × average lactation length × (targeted lactation length/herd average lactation length) × 0.85)] − {[(milk per lactating cow on one day) × (value of milk per litre)] × average lactation length)}

To correcting for overestimation because milk production would be less during the lean period, the lactation length was multiplied by 0.85 (Nordlund *et al*., 2002).

Lactating cows as percentage of total mature cows and total cattle. All the animals, including lactating cows, dry cows, pregnant heifers, growing heifers, suckling and milk-fed male and female calves, mature bulls and steers, with their present values were recorded. The percentages of lactating cows out of the total of mature cows and of all cattle were calculated respectively as follows:

> Lactating cows as a percentage of total cows = total lactating cows in a herd/total mature cows (i.e., lactating + dry cows) × 100
> Lactating cows as a percentage of all cattle in herd = total lactating cows in a herd/total cattle in the herd (i.e., cows + heifers + males + calves) × 100

Feed cost. The total feed (kg), both forages and concentrates, given to milking cows during the whole day of the visit were determined by interviewing the farmers. Any left over at the end of the day was also determined and subtracted from the total given to determine total feed consumed by the cows. The cost (BDT) of feed was determined by summing the average prices of forage and concentrate per kg fresh weight. Feed cost as percentage of income from milk was calculated as

> {[(Cost of feeds fed to lactating cows on one day/number of lactating cows)/milk (litres) per lactating cow on one day] × price of 1 litre of milk × 100.

Milk yield The average milk per lactating cow on one day and average milk production on one day per farm were recorded. The average price (BDT) achieved of 1 litre of milk sold on the day before the farm visit was recorded. The economic opportunity for milk production was computed as

> (Local target milk per lactating cow on one day − herd average milk per lactating cow on one day) × number of lactating cows × 365 days × price of milk per litre

Milk production cost In addition to the information collected using EOS forms, we interviewed farmers to record the costs (BDT) of building cattle houses and their repairs for one year and the longevity of such houses. The building cost was divided by the longevity of the house to determine the yearly depreciation values. Interest rate per year on money on deposit was found by inquiring of a bank. The number of labourers (family and hired) and costs of labour, including salary, food, clothing and lodging, covering 12 months preceding the date of visit were recorded by asking farmers. Generally, family labourers spent 25% and hired labourers spent 50% of their working hours in dairying. Data on average feed cost per cow on one day were converted to one year by multiplying by 365. The milk production cost per litre (BDT) was determined as

> {Average feeding cost for lactating cows during one year + labour cost per year (family labourers × 0.25 + hired labourers × 0.5) + housing cost (yearly depreciation of the house building cost + repair cost for one year + interest on average value of housing of running year) + average health care expenses and AI per year [(veterinary services + medicines + AI)/total number of cattle] / 365} / average amount of milk production (litres) in one day

Milk production cost was finally expressed as USD/100 litres milk.

Calf mortality Calf mortality, defined as death up to one year of age and those born dead, during the previous 12 months was recorded. The gross economic opportunity from survivability of calves was estimated as

> Total number of calves born alive or dead over a period that covers a year preceding the date of visit × (farm's percentage calf mortality - tolerated mortality of calves) × average value of male and female calves

Statistical analysis

The collected information was recorded utilizing Microsoft Excel 2000. A custom-designed workbook was created to record the data from five sections of the EOS form on four sheets. A macro was designed to transfer the data from the farm data workbook to a summary worksheet containing multiple farm data. We calculated the 20th, 50th and 80th percentiles of the variables studied. Because the data were nonparametric, Kruskal–Wallis test was used to test the null hypothesis that the districts did not differ between each other with respect to the parameters studied (Altman, 1991; Anon., 2000b). Mann–Whitney test was used to determine whether the differences between sources of economic opportunities were significant (Altman, 1991; Anon. 2000b). Data were plotted taking the milk production (litre/cow on one day) and cost of milk production (USD/litre) as X and Y axes, respectively.

Results

Herd inventory

The average numbers of cattle in different categories in the four regions are shown in Table 3. The farms were biggest in Sirajgonj-Pabna, followed by those in Chittagong, and were smallest in Mymensingh.

Management indices

The average values of management indices are shown in Table 4. Considerable variations exist between regions. Some of these—feed costs as a percentage of income and percentage of milk sold—were statistically different. Table 5 shows more health and productivity

Table 3 The average number (range) of cattle in different management categories in surveyed farms of four regions of Bangladesh

Inventory indices	Mymensingh	Khulna-Satkhira	Sirajgonj-Pabna	Chittagong
Total lactating cows	1.5 (1–6)	2.2 (1–22)	3.4 (1–20)	2.8 (1–18)
Total mature cows	1.9 (1–9)	2.7 (1–25)	4.2 (1–24)	3.5 (1–21)
Total replacement heifers	1.5 (0–10)	2.0 (0–13)	3.7 (0–22)	2.6 (0–15)
Total male cattle	1.2 (0–6)	1.4 (0–9)	2.5 (0–17)	1.9 (0–12)
Total head of cattle	4.6 (1–22)	6.0 (1–47)	10.5 (2–63)	8.0 (2–43)
Number of farms	433	309	412	286

Table 4 Average management performance indices (range) in the surveyed farms of the four regions of Bangladesh

Management indices	Mymensingh	Khulna-Satkhira	Sirajgonj-Pabna	Chittagong
Feed cost as percentage of income from milk	67.0^{b} (10–200)	92.1^{a} (20–300)	52.5^{c} (20–200)	66.7^{b} (14.5–284.4)
Milk sold as percentage of total produced	78.7^{c} (30–100)	84.2^{b} (30–100)	92.6^{a} (50–100)	80.2^{c} (40–100)
Lactating cows as percentage of total mature cows	86.7 (20–100)	84.3 (30–100)	84.3 (20–100)	81.9 (30–100)
Lactating cows as percentage of total cattle	35.7 (10–100)	37.7 (10–100)	34.3 (10–80)	34.6 (10–60)

[a,b,c] Values with different superscript letters in the same row differ significantly from each other ($p < 0.01$)

figures. Variations are considerable between regions, and again some of these are statistically significant. Calf mortality was zero in 92%, 83%, 72% and 80% of farms surveyed from Mymensingh, Khulna-Satkhira, Sirajgonj-Pabna and Chittagong, respectively. The average calf mortality for the respective districts was 4.1%, 9.0%, 9.8% and 7.2%.

Milk production costs

The milk production cost was highest in Mymensingh followed by Chittagong and Khulna-Satkhira, and lowest in Sirajgonj-Pabna ($p < 0.01$; Table 6).

Economic opportunity

The average economic opportunity was 676.3, 868.2, 1730.6 and 1209.0 USD per farm per year for Mymensingh, Khulna-Satkhira, Sirajgonj-Pabna and Chittagong, respectively (Table 7). The economic opportunity was highest for the average milk production per cow on the day before the visit (503.4–1052.5 USD) and lowest for calf production interval (8.0–9.0 USD) ($p < 0.05$).

The milk production cost was greatly influenced by level of milk production (Figure 1). The milk production cost decreased if average milk production per cow on the day increased ($r^2 = 0.432$–0.548; $p < 0.05$). Farms that produced on average 7 litres or more milk from a cow on one day had production cost of 0.20 USD/litre, regardless of the region.

Discussion

The present study showed that farmers' income could be substantially increased if the milk production by individual cows and their lactation length could be increased and the age at first calving could be reduced (Table 7).

Increasing milk production relies heavily on appropriate feeding practices for cows with genetic potential. Cattle feed in Bangladesh is rice straw based with limited-availability forages in certain seasons, and milling by-products are the only feed supplements (Shamsuddin *et al.*, 2002). Forage conservation and improvement of the nutritional value of crop residues could be the most appropriate options to increase milk

Table 5 Average reproduction and production indices (range) of cows on the surveyed farms of the four regions of Bangladesh

Management indices	Mymensingh	Khulna-Satkhira	Sirajgonj-Pabna	Chittagong
Age at first calving (months)	44.3[a] (28–61)	40.2[b] (30–75)	40.8[b] (25–65)	35.0[c] (28–45)
Calf production interval (months)	17.6[a] (12–38)	15.4[c] (12–24)	14.0[d] (11–32)	17[b] (11–27)
Lactation length (days)	285[a] (122–571)	251[b] (123–365)	249[b] (141–395)	286[a] (198–396)
Milk production per cow per day (litre)	3.5 (1–17)[d]	4.8 (1–15)[c]	7.2 (2–17)[a]	5.1 (1–14)[b]

[a,b,c,d]Values with different superscript letters in the same raw differ significantly from each other ($p < 0.01$)

Table 6 Average expenses (USD) (range) to produce 100 litres of milk in the four regions of Bangladesh

Cost of milk production	Mymensingh	Khulna-Satkhira	Sirajgonj-Pabna	Chittagong
Health care	0.07 (0.0–0.6)[d]	0.4 (0.1–3.1)[b]	0.2 (0.0–1.7)[c]	0.5 (0.02–2.4)[a]
Feed	21.1 (5.0–67.2)[a]	22.1 (5.9–81.7)[a]	13.8 (4.6–52.6)[c]	20.0 (5.0–78.4)[b]
Labour	13.4 (0.9–75.9)[a]	8.3 (0.4–53.9)[b]	4.4 (0.6–23.9)[c]	13.3 (1.2–63.2)[a]
Housing	0.5 (0.03–1.8)[b]	0.7 (0.02–5.9)[a]	0.5 (0.03–2.7)[b]	0.8 (0.04–4.7)[a]
Total	35.1 (6.9–109.0)[a]	31.5 (7.6–106.9)[b]	18.9 (5.8–66.7)[c]	34.6 (7.7–119.3)[a]

*1 USD = 58 BDT
[a,b,c] Values with different superscript letters in the same row differ significantly from each other ($p < 0.01$)

Table 7 Average economic opportunities (USD) (range) for a farm during one year in the four regions of Bangladesh

Source of opportunity	Mymensingh	Khulna-Satkhira	Sirajgonj-Pabna	Chittagong
Age at first calving	292.5[b] (27.5–951.7)	257.4[b] (19.9–911.9)	561.1[b] (39.8–3209.0)	265.1[b] (21.9–2526.2)
Calf production interval	13.4[d] (0.8–183.9)	11.8[c] (1.1–77.6)	13.0[c] (2.3–78.2)	14.2[d] (1.7–96.5)
Lactation length	94.2.[c] (1.4–787.9)	258.1[b] (5.3–1676.6)	552.3[b] (31.6–2976.7)	206.0[c] (1.2–1962.6)
Milk production	594.9[a] (50.3–2454.3)	737.6[a] (50.3–4531.0)	1298.4[a] (37.8–5097.4)	1078.6[a] (85.6–5940.7)
Total economic opportunity	676.3 (3.4–3098.5)	868.2 (4.1–4934.2)	1730.6 (56.9–8605.3)	1209.0 (6.9–6037.2)

[a,b,c,d] Values with different superscript letters in the same column differ significantly from each other ($p < 0.05$)

production or reduce its production cost. Our pilot study showed an additional income of 0.3 USD/cow per day in a farm with 14 lactating cows if 10 kg/day Napier grass silage was added to rice straw during a 4-month period of the monsoon when forages are not available (unpublished data). With regard to genetic potential, many attribute the advantages of indigenous over exotic animals to their superior adaptation to local conditions (Shamsuddin *et al*., 2002). However, the indigenous cattle are of low production potential. More productive animals and alien breeds and their crosses are less tolerant to diseases, heat and humidity. Therefore, a 12-month feed planning cycle including forage production and conservation and concentrates with good nutritional value is needed for higher-yielding animals to deliver their genetic potential and thereby to increase individual cow's milk production.

The lactation length was shorter in Sirajgonj-Pabna and Khulna-Satkhira, where the calf production interval was also found to be shorter (Table 5). The shorter lactation period may be due to poor nutrition management of pregnant but lactating cows, calf death, lack of an udder health programme and cattle genetics (Alam *et al*., 1994; Vaccaro *et al*., 1999). Poor nutrition of cows in these regions may result from unavailability of feed when needed. During the monsoon in Sirajgonj-Pabna and the dry season in Khulna-Satkhira, green forages are not available. Because of poor feeding, the production falls so low that the cow might as well be dry in terms of the costs of feeding additional concentrates. Alam and colleagues (1994) stated that local cows reared with less nutrition and attention in Bangladesh often exhibited a short lactation length. Some breeds of zebu cows, for instance Shahiwal, spontaneously wean calves and stop milking within a short time after conception (Islam *et al*., 2002). Pregnant cows tend to cease lactation earlier than non-pregnant cows. *Bos indicus* and the crosses between *Bos indicus* and *Bos taurus* are managed with calves at their side to stimulate milk letdown (Vaccaro, 1999). Thus, the death of a calf often results in the cessation of milk production.

Milk production cost was high on many farms and differed between the regions (Table 6). The production cost was inversely related to the average amount of milk a cow produced on one day (Fig. 1). Average milk yield per cow on one day needs to be increased substantially in all regions to achieve a milk production cost equal to that of India (5.20 INR; 1 USD = 42 INR; Gupta and Agarwal, 1996). Further, dairy processors in Bangladesh usually pay 0.25 USD for a litre of milk at their collection centres. This means that the farm should produce a litre milk for less than 0.25 USD. According to our data, this can only be achieved if farmers can consistently produce on average 7 litres of milk per cow on one day, provided feed costs per cow do not increase. Better nutrition to increase individual daily milk production but also to help shorten intervals between calvings may nevertheless be necessary.

The expenses for animal health care seem minimal compared with other expenses in this study. Windsor (2002) has shown that countries that invest more in animal health earn more from livestock. The author highlighted the contribution of livestock to Botswana's economy, where a large investment is made in animal health care. More investment in animal health care, especially to reduce the mortality of cattle and the incidence of foot and mouth disease, mastitis, anoestrus and

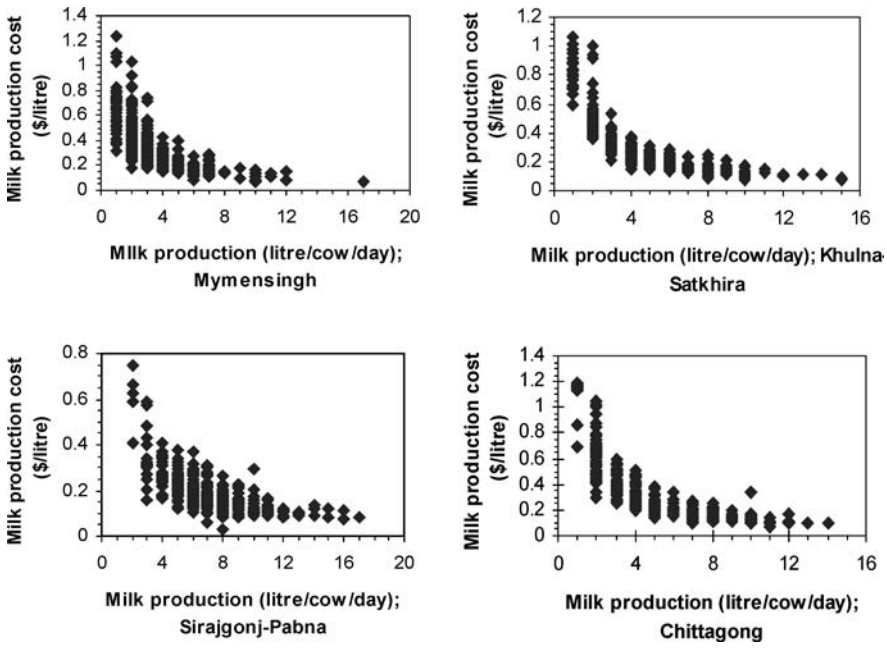

Fig. 1 Relationship between milk production per cow (litres) on one day and milk production cost (USD) in four regions of Bangladesh

repeat breeding, might increase production and thereby decrease total milk production cost in Bangladesh.

Feed cost is the major recurring expenditure on a dairy farm. Feed costs represent approximately one half of the total costs in most livestock operations (Kennedy *et al*., 1993). The feed cost as a percentage of income from milk was lowest in developed dairy areas and highest for subsistence-type dairying in this study. Small numbers of lactating cows with low milk production and high feed costs are responsible for higher feed cost as a percentage of income from milk in Mymensingh and Khulna-Satkhira. In Satkhira-Khulna, lack of suitable cropland and fodder cultivation leads to the increased price of cattle feed. On the other hand, a low milk price due to the unorganized market network, low local demand and lack of facilities for milk preservation have decreased income and thereby increased feed cost to about 90% of income from milk. Feed costs need to be reduced. Alternative feeding systems such as the introduction of urea - molasses blocks as a substitute for concentrates may be helpful in reducing the feed cost (Bandla and Gupta, 1997).

In the regions studied, lactating cows formed a high percentage of mature cows (Table 4). Nordlund and colleagues (2002) indicated that in herds with calving intervals of 13 months and dry periods of 60 days with annual turnover rates of about 35%, lactating cows are expected to be approximately 85–90% of all cows. Smith (1985) reported lactating cows as a percentage of all cows as 48%, 62%, 64%, and 66% from a variety of countries in South America. The high percentage of lactating cows out of total cows in this study resulted partly from the fact that we included a majority of farms that had only one to three cows. Therefore, a farm with one, two or three lactating cows as their only mature stock produced a figure of 100% cows in lactation. On the other hand, the lactating cow as a percentage of total cattle is quite low. In Bangladesh, calves are reared with dams because suckling stimulates milk letdown. Farmers also rear their bull calves. The sale price of a well-grown bull augments the farm income. Therefore, the distribution of cattle categories on a smallholder dairy farm in the crop–livestock farming system of Bangladesh is likely to differ from that on a farm in countries with developed dairy industries.

The calf mortality was generally low and the majority of the farms did not experience any calf deaths during a period of one year previous to the date of survey. The average calf mortality was lower than or close to the target for individual districts, indicating that the farmers in fact do not have a goal for reducing calf mortality. Therefore, the economic opportunity figures for calf mortality were excluded in calculating the total economic opportunity for individual regions (Table 7).

From a large government dairy farm, Samad and colleagues (2001) reported a 9.2% mortality of calves up to 6 months old. However, the management of this farm was different from that of small private dairy farms we studied. Earlier, Rao and Nagarcenkar (1980) reported 7.9% death of calves within 6 months after birth in India. In Bangladesh, calves are regularly fed with colostrum *ad libitum*. The colostrum provides essential antibodies that help calves develop immunity and thereby reduce calf mortality (Le Blanc, 1986). However, poor feed and health management of replacement heifers and genetic factors–the cattle population in the present study was either zebu or crossbred between zebu and Holstein-Friesian—perhaps resulted in the delayed age at first calving (Table 5). Effective calf and young stock health care and feed supplementation programmes are needed to reduce this.

The economic opportunity from the calf production interval in this study was low. This is because it included only the value of additional calves that would have been born from a shorter interval. No attempt was made to estimate the additional milk yield per annum that could be expected to result from shortening of the interval between calvings, as the data available did not allow this.

The economic opportunity is a measure relative to a target based on the production level of the best 20% of surveyed farms selected on the basis of individual best measures of performance. This means, in all areas, that farmers in the 20th percentile and 50th percentile ranges will earn more if they can achieve the measures of indices achieved by the 80th-percentile farmers. This helps the farmers to take appropriate measures and researchers and policy makers to design correct interventions. The EOS can be used to motivate farmers because they can see the best way to earn more money and take example from their neighbours who are more profitable than they are.

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Étude visant à identifier les opportunités économiques des petites fermes d'élevage de vaches laitières dans le Bangladesh

Résumé – Les opportunités économiques identifiées pour les interventions de planification augmentent considérablement l'adhésion des fermiers à un programme d'extension. Nous avons étudié les opportunités d'intervention pour augmenter le revenu des éleveurs de vaches laitières dans quatre régions du Bangladesh, y compris dans les districts de Mymensingh, de Khulna-Satkhira, de Sirajgonj-Pabna et de Chittagong. Les données ont été recueillies de 1440 fermes laitières lors d'une visite d'une journée et elles ont été résumées comme étant la différence entre les cibles de gestion et les indices de gestion calculés pour chaque troupeau. Le nombre moyen de vaches allaitantes, le coût de l'alimentation à titre de pourcentage du revenu dérivé du lait, le lait vendu à titre de pourcentage du lait produit, les vaches allaitantes à titre de pourcentage des vaches adultes et les vaches allaitantes à titre de pourcentage du bétail total ont varié de 1.5 à 3.4, de 52.5 à 92.1%, de 78.7 à 92.6%, de 81.9 à 86.7% et de 34.3 à 37.7% respectivement. L'âge moyen au premier vêlage, l'intervalle de production des veaux, la durée de l'allaitement et la production de lait ont été de 35.0 à 44.3 mois, de 14.0 à 17.6 mois, de 249 à 286 jours et de 3.5 à 7.2 litres respectivement, en fonction de la localité. Le coût moyen de la production de 100 litres de lait a été de 18.9 à 35.1 dollars US. Le coût de la production a augmenté lorsque la production de lait par vache avait diminué ($r^2 = 0.43$–0.55). On pourrait s'attendre à ce que les améliorations de la gestion orientées vers une augmentation de la production moyenne de lait par vache par jour, une augmentation de la durée de l'allaitement, une diminution de l'âge jusqu'au premier vêlage et une diminution de l'intervalle de production de veaux produise une augmentation du revenu moyen jusqu'à une plage de 676.3 à 1730.6 dollars US en fonction de la zone de production du lait.

Estuio para identificar las oportunidades económicas de las granjas lecheras de pequeños productores en Bangladesh

Resumen – El identificar las oportunidades económicas para planificar intervenciones incrementa en gran manera la sumisión de los granjeros al programa de ampliación. Investigamos las diferentes oportunidades de intervención para incrementar el ingreso de los granjeros lecheros en cuatro áreas de Bangladesh, incluyendo los distritos de Mymensingh, Khulna-Satkhira, Sirajgonj-Pabna y Chittagong. Los datos fueron recopilados a partir de 1.440 granjas lecheras, en visita de un día, y resumidos como la diferencia entre los objetivos de la gestión y los índices de gestión calculados de cada rebaño. El número promedio de vacas en ordeño, el coste alimenticio expresado como porcentaje de ingreso proveniente de la leche, la leche vendida como porcentaje de la producida, las vacas en ordeño como porcentaje de vacas maduras, y las vacas en ordeño como porcentaje del ganado total variaba de 1.5 a 3.4, 52.5 a 92.1%, 78.7 a 92.6%, 81.9 a 86.7% y 34.3 a 37.7%, respectivamente. La edad media en el primer parto, el intervalo entre partos o intervalo de producción de becerros, la longitud de la lactación y la producción de leche fueron de 35.0 a 44.3 meses, 14.0 a 17.6 meses, 249 a 286 días y 3.5 a 7.2 litros, respectivamente, dependiendo de la localidad. El coste medio por producir 100 litros de leche fue de 18.9 a 35.1$ de EE.UU. El coste de la producción incrementaba cuando decrecía la producción de leche diaria por vaca ($r^2 = 0.43$–0.55). Las mejoras en la gestión destinadas a aumentar la producción de leche media por vaca y por día, incrementar el periodo de lactación, disminuir la edad en el primer alumbramiento y disminuir el intervalo entre partos, esperaba producir un incremento del ingreso medio del orden de 676.3 a 1.730.6 $ EE.UU. dependiendo de la zona de producción de leche.