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ORIGINAL PAPER

Participatory rural appraisal to identify needs and prospects of market-oriented dairy industries in Bangladesh

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Abstract We assessed resources, challenges and prospects of the dairy industries in four districts of Bangladesh (Mymensingh, Satkhira, Chittagong and Sirajganj) with the participation of 8 to 12 dairy farm families in each district. We used ten participatory rural appraisal (PRA) tools, namely social mapping, semi-structured interview, activity profiles, seasonal calendar, pie charts, mobility diagram, matrix ranking, preference ranking and scoring, system analysis diagram and focus group discussion in 57 PRA sessions from September through October 2002. Dairying contributed more to family income (63 to 74%) and utilized a smaller portion of land than did crops. Twenty seven to 49% of cattle feed is rice straw. Only Sirajganj and Chittagong had limited, periodic grazing facilities. Fodder (Napier; *Pennisetum purpureum*) cultivation was practiced in Sirajganj and Satkhira. Fodder availability increased milk production and decreased disease occurrence. Friesian crossbred cows were ranked best as dairy cattle. The present utilization of veterinary and AI services was ranked highly. Farmers outside the milk union desired milk purchasing centres as the most required service in the future. They identified veterinary and AI services as inadequate and desired significant improvements. The PRA tools effectively identified resources, constraints, opportunities and farmers' perspectives related to the dairy industries in Bangladesh.

Keywords Constraints · Dairying · Diseases · Feeding · Prospects · Small-scale

Abbreviations

BMPCU	Bangladesh Milk Producers Cooperative Union, Ltd.
FFC	Field Fertility Clinic
PRA	Participatory Rural Appraisal

Introduction

Dairy farming plays a pivotal role in the village micro economy of Bangladesh. Market-oriented dairies

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generate more regular cash income and dairy production, processing and marketing create more employment per value added unit than crop production (Asaduzzaman 2000; Omore et al. 2002). As a result, dairying has shown a positive trend of development both in numbers and in production levels (Anon 2005; BBS 2004). The number of dairy farms increased from 2,490 in 1990–91 to 32,531 in 2004 (Anon 2005). Milk production increased from 1.29 million metric tons in 1987–88 to 2.52 million metric tons in 2003 (FAOSTAT 2006). Consequently, milk powder import has decreased from 44,325 metric tons in 1990 to 23,724 metric tons in 2003 (UNSD 2004). However, for further establishment and development of dairy farms in Bangladesh, several factors must be addressed, including the poor genetic base of cattle, feed shortages, wide spread infectious and production diseases, limited access to farm inputs and inefficiencies leading to low productivity.

In the past, many research projects have been initiated for the development of dairying in Bangladesh. Acceptance of the research findings by the greater proportion of the stakeholders (the farmers, extension workers, entrepreneurs, to mention a few) is far behind researchers' expectations. A likely explanation for this low level of acceptance is that stakeholders were not involved enough in the studies to accept the findings or the findings were not within the capacity of their implementation. Stakeholders expect immediate economic benefits from the research. They want the proposed interventions to fit into their farming system, social structure, investment opportunities and capabilities. Additionally, farmers want changes proposed from the research to maximize utilization of their resources. They will hesitate to make major changes in their systems unless the new interventions are locally proven. The sustainability of the interventions and their impacts on the environment are also major concerns of stakeholders. Sands and Collion (1993) stated that user participation is a crucial ingredient for relevant and efficient technology development and user participation ensures uptake of the technology.

Use of participatory rural appraisal (PRA) methods ensures that stakeholders are involved in assessing their resources, identifying opportunities for future development, defining constraints and suggesting possible solutions. This involvement makes it likely that they will continue to the conclusion of the project. Furthermore, since most of the interventions are based on the stakeholders' proposal, they will feel comfortable adopting the interventions.

The PRA is a widely used method to judge the opinion of a target group (Morgan 2001; Dessie and Ogle 2001; Rew and Rew 2003). It is as reliable as the sample survey (Temu and Due 2000). Furthermore, it does not only efficiently collect information but also ensures farmers participation in decision making (Watson and Cullis 1994). Therefore, a participatory approach in Bangladesh would be an ideal means for assessing the present status of dairies and formulating interventions to overcome the current constraints for dairy farmers. The present PRA (Devendra 2007) was conducted with the objectives of assessing farmers' resources and the degree of their involvement in dairying. Further, it explored farmers' ideas and views on problems, constraints, expectations and priorities for an economically viable small scale dairy industry in Bangladesh.

Materials and methods

The PRA was conducted in four agro-ecological zones of Bangladesh containing commercial dairy activities. The zones were the Old Brahmaputra floodplain, Ganges Tidal floodplain, Chittagong Costal plain and Karatoya-Bangali floodplain; the areas belonged to the administrative districts of Mymensingh, Satkhira, Chittagong and Sirajganj, respectively. Dairy farming in these four zones differs with regard to resource availability, level of production, management practices, market facilities and farmers' socio-economic conditions. These four zones broadly represent the different types of dairying in Bangladesh. Each of the zones differs in soil types and climatic conditions. The Meteorological conditions reported were based on 55 years of monitoring by the Bangladesh Meteorological Department (Agargaon, Dhaka).

Mymensingh has a medium-high type land with soil pH varying from 5.5 to 7.5 and is usually unaffected by flooding. The daily average temperatures range between 11.7 and 24.8°C in the winter and between 25.6 and 32.9°C in the summer. The daily humidity and rainfall varied from 67 to 87% and 8 to 395 mm, respectively.

The land of Satkhira is medium-low type with highly acidic soil (pH 4.5 to 5.5) with high concentrations of

ionic sodium (4 to 8 dsL^{-1}). The minimum and maximum daily temperatures were 12.1 and 25.9°C respectively in winter and 26.1 and 35°C in summer. The humidity and rainfall varied from 68 to 87% and 8 to 346 mm, respectively. Due to the close proximity to the Bay of Bengal, the area is flood prone and the infrastructure is less developed than in Mymensingh.

The Chittagong has coarse textured soil with pH 4.5 to 6.5. The minimum and maximum temperatures were 13.9 and 26°C respectively in winter and 25.2 and 32.3°C in summer. The humidity and rainfall varied from 72 to 87% and 5 to 744 mm, respectively. The area is not usually affected by flooding.

The land of Sirajganj is medium-low type with a soil pH of 5.4 to 7.5 and is submerged by floodwater during the usual monsoon. The minimum and maximum temperatures were 10.1 and 24.6°C respectively in winter and 26 and 35.9°C in summer. The humidity and rainfall varied from 58 to 87% and 5 to 288 mm, respectively. The dairy producers of the Sirajganj district belong to the Bangladesh Milk Producers Cooperative Union (BMPCU) Ltd. There are 1,300 primary societies with a total of 125,000 members. This is a farmers' organization where the primary societies produce and collect milk together. The Union then transports milk to the chilling/dairy plant where further processing and product making take place. The Union then markets milk and milk product and, thereby, ensures a better margin (50–60%) of the consumer price to the producer.

The target groups of farmers were those who relied for at least 25% of their income to be from dairy farming for their livelihood. These farmers had at least 4 breedable cows and sold 80 to 90% of the milk produced. From 8 to 12 farmers and their spouses were selected from four districts. Table 1 shows the distribution of farmers across the four zones. In total, 57 sessions were conducted between 9 September and 13 October 2002. To establish a congenial working atmosphere and obtain spontaneous responses from the respondent farmers and housewives, rapport was built up before starting the actual PRA sessions through individual farm visits and meeting farmers in groups.

PRA tools used

Participatory resource mapping

The participant groups drew the resource maps at the beginning of the PRA sessions on a large sheet of paper. The physical characteristics of the community, particularly the dairy related resources, were drawn carefully. Separate colours and various legends were used to mark different resources.

Semi-structured interview

We prepared an interview guide, listing a predetermined set of questions or issues as checklists. The same member of the PRA team in each of four regions conducted the interviews. The respondents were given a great deal of flexibility. Within the list of topics or subject areas, the interviewer was free to pursue certain questions in greater depth.

Activity profiles

Two separate sessions with only men or women were conducted in each zone to learn how farm couples

Table 1 Participant farmers in the PRA in four districts of Bangladesh with their family dependence on dairying and the number of sessions

District	Number of participant villages	Number of participant families	Families' dependence on dairying			Number of PRA sessions
			100 %	50%	< 50% to 25%	
Mymensingh	3	8	0	6	2	14
Satkhira	3	12	0	5	7	13
Chittagong	7	9	1	6	2	14
Sirajganj	1	8	0	6	2	16

spend their days, and to determine each person's role in the dairying activities. The respondents drew a circle on a large piece of paper and drew two lines perpendicularly crossing the centre of the circle to obtain four cut points on the periphery of the circle. The cut points were sequentially marked as morning, noon, evening and midnight. The respondents identified their daily activities along the periphery of the circle starting from the sunrise as a land mark. Their daily activities were divided into personal care (washing, eating, resting, sleeping, etc.), recreation (watching television and movies, visiting tea stall, visiting personal friends, etc.) dairy-related work and other work (crop cultivation, business, etc.). The number of hours dedicated to each activity was recorded.

Seasonal calendar

Seasonal calendars were drawn to evaluate the monthly variations of fodder availability, milk production and the occurrences of cattle diseases. The months were written on the X-axis of a paper while events were drawn on the Y-axis. Different coloured paper strips were used to draw bar diagrams for indicating fodder availability, milk production and disease occurrence.

The disease occurrence reflected collective prevalence of diseases in individual months. Participants in particular took consideration of foot-and-mouth disease, mastitis, parasitic infections and epidemics of infections like anthrax.

Pie charts

Pie charts were drawn on the utilization of participants' land and on ingredients for formulating cattle feed. The farmers listed different uses of their land. Then they drew a circle on a large piece of paper and divided it up based on the proportion of land they use for different agricultural activities and as homestead area. Similarly, we asked them to list the ingredients they use to formulate cattle feed. Then they were asked to draw a different circle and divide it into blocks representing different proportions of ingredients in the feed. The PRA team recorded the values, entered them in a Microsoft Excel spreadsheet and reproduced the pie charts by using its Chart Wizard.

Mobility diagram

Mobility mapping was used to determine where, why and how often farmers travel, in relation to dairying. The participants' community (dairy farm) was drawn in the centre of the map and other points were added representing the locations to which the farmer travels. Connecting lines were drawn between the farm and the destinations. The thickness of the lines indicated the frequency of visits to the location.

Matrix ranking

Farmers' opinion of dairy cattle breeds was studied by using a matrix ranking method. The participants first listed breeds of cattle they used for dairy farming in the respective zones and the characteristics of dairy cattle that were the most important. Crossbred animals were assigned to different breeds, based on the exotic breed used in the cross. They then assigned scores for the characteristics to each of the breeds. The maximum score for each characteristic was ten. Briefly, the names of the breeds were at the head of the columns (Table 7) and breed characteristics were in the rows. The participants were given 10 small stones. For each characteristic, participants in consensus distributed the 10 stones among the breeds as the breed deserved. The number of stones (score) on the respective column of the breed was recorded. The participants then moved to the next character and repeated the exercise until the last character was covered. The scores given for different characters were summed to determine the composite score for individual breeds. After the exercise was completed in all four districts, the PRA teams sorted the breeds irrespective of the districts with regards to the breed characteristics and corresponding scores. An average of the scores was computed, if a character for a breed was identified and scored by the farmers of more than one district.

Preference ranking and scoring

Preference ranking and scoring methods were used to determine the availability of services in the past and the availability and importance of existing services to the dairy farmers. Further, the tool was used to learn what services they would like to continue and what additional ones they expect as priorities for the future. The participants were asked to list the services that were

available 10 years ago, ones they are utilising at present and the services they would like to have in the future. Each participant was then asked to vote for three services that he or she thought were the most important at the present and those that would be the most important in the future. The votes were indicated by showing a red, blue or white coloured ballot, which represented points of 3, 2 and 1, respectively. All the votes a particular service received were counted and multiplied by the respective point, i.e. 3, 2 or 1, to obtain the score.

System analysis diagram

Constraints limiting the dairy development, like problems in obtaining inputs, selling outputs, development opportunities and availability of services, were discussed by using the system analysis diagram. A central circle was drawn around a photograph to indicate a dairy farm. From this, different problems were mapped, scored and root causes were identified. Then the PRA facilitator moderated a discussion in the farmers' group to find out possible solutions of identified problems and their root causes.

Focus group discussion

Participants were asked to reflect on the questions raised by the interviewers. After the interview, group discussions were initiated. This facilitated the sharing, in a social context, the ideas and experiences related to the sustainable small-scale market oriented dairy farm. In particular, farmers discussed farm size and the amount of daily milk production required for a family completely dependent on dairy farming for subsistence. The farmers calculated the total daily and subsequent monthly expenses (including their daily expenses, recreation cost, children's education and family health care expenses) for their family. Then they calculated the amount of milk required to be produced and sold to earn that much money.

All numerical data were analysed by using Microsoft Excel to compute descriptive statistics and create graphical representations.

Results and discussion

Participatory resource mapping identified the veterinary hospitals, artificial insemination (AI) centres, dairy plant and society milk collection centres of BMPCU Ltd, marketers of cattle feed, including outlets for by-products, shops, veterinary drug house, cattle markets and village doctors as important dairying related resources. These resources are utilized as inputs and services by the farmers. The local milk markets, sweet meat manufacturers, contract consumers, restaurants and tea stalls were also identified and regarded as potential points for milk sales.

Socio-economic situation

Table 2 presents a brief socio-demographic profile of the groups of farmers in the areas studied. An overwhelming majority of farm owners were male (35 of

Table 2 Socio-demographic profiles of farmers in four regions of Bangladesh taking part in a PRA

Parameters	Districts			
	Mymensingh	Satkhira	Chittagong	Sirajganj
Owner: Men	8	12	7	8
Women	0	0	2	0
Age (years): ≤ 25	0	2	2	0
26–50	8	8	6	8
≥ 50	0	2	1	0
Education: Illiterate	0	0	0	2
Sign to primary school[1]	5	7	3	3
SSC[2] and above	3	5	6	3
Average number of Family members (range)	7.4 (4–13)	7.8 (5–11)	7.8 (4–20)	9.8 (9–18)
Land holding in hectares (range)	0.91 (0.27–1.74)	1.60 (0.13–4.05)	1.65 (1.21–2.40)	1.36 (0.08–5.18)

[1] Includes farm family members whose education level ranged from the ability to write name and address to level 5; [2] Secondary School Certificate (from level 6 to 10)

37). Most of the farmers were between 26 and 50 years of age. The average family size was the smallest in Mymensingh and biggest in Sirajganj. Ninety-four percent of the participating dairy farmers were literate, as all but two had attended at least primary school. Slightly less than half of the farmers had attended secondary school.

Table 3 summarizes cattle ownership and sources of farm income. The largest farms were in Sirajganj and the smallest were in Mymensingh. Most of the farmers practiced mixed farming systems, rather than relying solely on dairying. Poultry farming was common among participant farm families in all four areas. These were generally a few backyard reared chickens (1–40 birds per farm), except for some quite big farms in Chittagong (4,000 chickens on one). Small numbers of goats were generally found, except in Sirajganj where there were none. Two sheep were found in one participant farm in Sirajganj. Only one participant farm in Chittagong had buffaloes — two of them.

Sixty-two percent of the farmers earned more than 50% of their family income from dairy production (Table 3). Crop production was less important, but still produced an average of between 28 and 30% of income in all regions except Chittagong (8%). The average yearly family income was US$ 1,040, 1,233, 3,052 and 3,489 in Mymensingh, Satkhira, Chittagong and Sirajganj, respectively.

The pattern of land use in the studied areas is shown in Fig. 1. Except in Sirajganj, the greatest proportion of land was used for cultivation of cereals. However, dairy production contributed a larger portion of income (67 to 80%) to the family (Table 3) except in Satkhira (48%). The farmers of Sirajganj utilized more than half of their land for fodder cultivation because they earn more money from fodder production than they do from cultivation of non-forage crops. The cultivated fodder, in addition to being fed on their own farms, is traded as common practice.

Dairy farming used a lesser proportion of the land for non-forage crop cultivation but contributed a higher percentage of income to the participants' families. The dairy farmers' monthly income was higher than the average monthly income in the rural areas of Bangladesh (Anon 2000). Dairy farmers are a solvent part of the society although many of them only own as little as 0.08 hectares land. Many distressed women (widowed, divorced or left by the husband) and landless or marginal farmers (having about 0.04 hectares of land) in Bangladesh have adopted small sized dairy farming (1 to 5 cows) and generate income to support their essential daily expenses (Rahman et al. 2000; Shamsuddin et al. 2002). Therefore, dairy farming could be the most appropriate means of poverty alleviation for small landholders and marginal farmers.

Gender issues

A summary of time spent on various activities by husbands and wives is shown in Table 4. Although farm owners were usually male, farm wives nevertheless contributed significantly to dairying activities. This was especially true for the activities undertaken on-farm, such as milking and tending the animals. The male farmers were much more likely to spend their time doing off-farm dairy related activities. In contrast, women spent more time taking care of other family members. Accordingly, in crop production, the rural women in Bangladesh are usually engaged in the

Table 3 Average numbers (range) of cattle owned by the farmers in four regions of Bangladesh taking part in a PRA and a comparison of relative income from livestock and crop farming

	Districts			
	Mymensingh	Satkhira	Chittagong	Sirajganj
Cattle population	6.6 (4–11)	12.3 (4–31)	19.2 (7–37)	19.3 (6–36)
Sources of income (US$ per year)				
Dairy	701.4	598.0	2,440.6	2,493.1
{Percentage of family income from dairying}	{67}	{48}	{80}	{71}
*Other livestock and Fisheries	42.9	262.6	367.1	15.3
Crops	295.9	372.8	244.4	981.0

*Includes buffaloes, goats, sheep and poultry

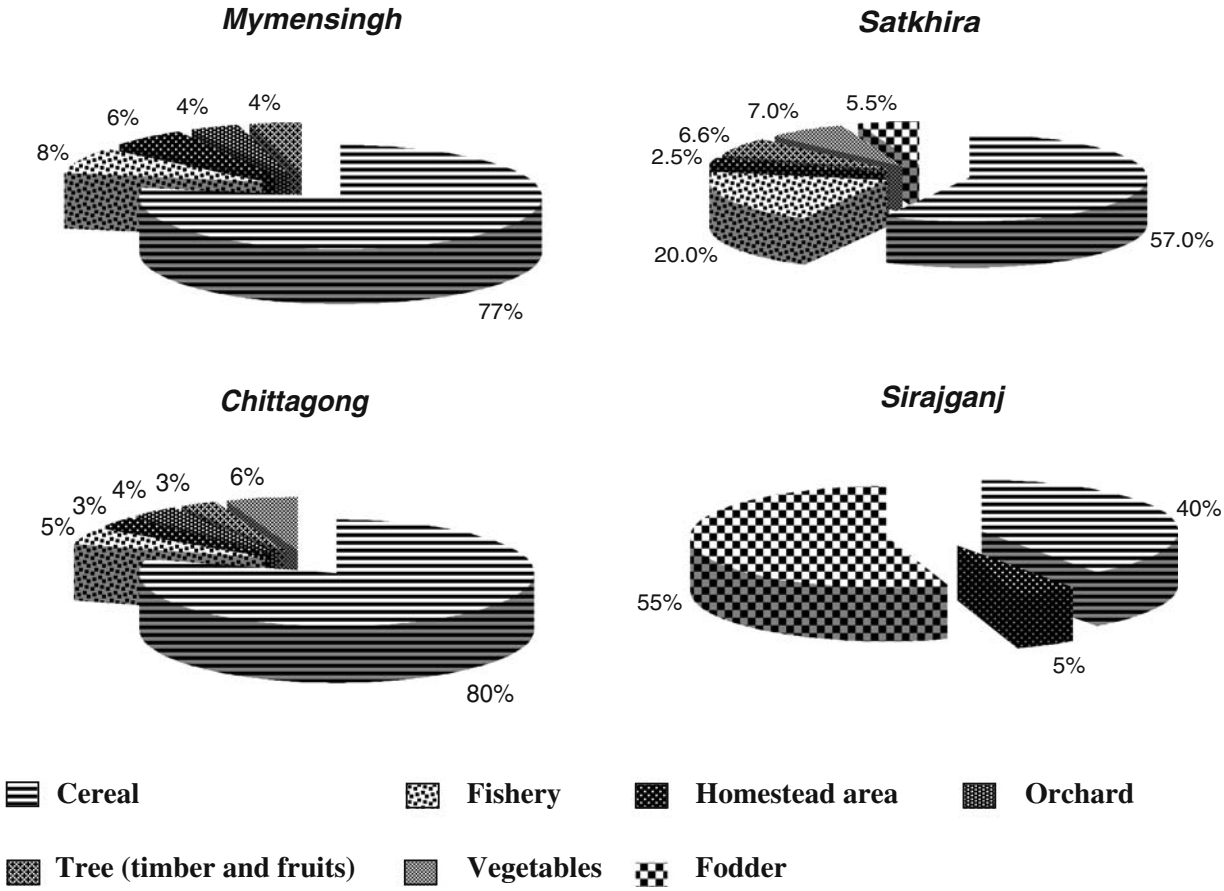

Fig. 1 Land utilization by farm families in different districts of Bangladesh

post harvest activities. The cultural tradition of the studied area restricts rural women from being involved in off-farm jobs like marketing.

Unemployment is a severe problem in Bangladesh. The problem is more serious among women, whose labour is usually under-utilized. Dairy farming could be an excellent means of utilizing family labour. Because women usually do the cattle husbandry on the farm, it is critical to improve women's skills and knowledge of dairy farm management through training and workshops. Women should be targeted in parallel with the men so that they are empowered in

Table 4 Average percentage each 24 hours of activities of husband (H) and wife (W) in dairy farming families participating in a PRA in four regions of Bangladesh

Activity	Mymensingh		Satkhira		Chittagong		Sirajganj	
	H	W	H	W	H	W	H	W
Personal[a]	49	42	44	44	44	48	50	47
Recreation[b]	0	0	6	6	6	4	13	0
Dairy[c]	38	19	42	42	42	17	38	22
Other[d]	14	40	9	9	9	31	0	31

[a] Toilet, washing, eating, resting, sleeping and praying

[b] Watching television and movies, visiting tea stall and visiting personal friends

[c] Men mostly do the off-farm work and women do the on-farm jobs

[d] Crop cultivation, business and taking care of other family members, particularly by the wives

decision making in addition to the utilization of their labour.

Feeding, production and occurrence of diseases

The fed freshweight and composition of cattle rations in the four areas are shown in Fig. 2. Straw and grass are the major dairy cattle feeds in all areas, with their relative proportions differing between regions depending on the availability.

Figure 3 shows fodder availability throughout the year in the different regions, and associated milk yield and disease incidence. Generally milk production increased with the availability of fodder and disease occurrence was higher when less fodder was available.

Considerable seasonal variation was found in the occurrence of diseases (Fig. 3). Identified major problems were foot-and-mouth disease, mastitis, parasitic infections, and epidemics of anthrax. Non specific diseases manifested by diarrhoea and respiratory distress were also claimed to be present across the districts studied. Mymensingh had two peaks of the occurrence of diseases; one during July through September — the monsoon — and the other from the middle of March to April, the hottest month. In Satkhira, the occurrence of diseases was higher from December through to the middle of April than the rest of the year. This is a dry period and non availability of forages was blamed by the farmers to be associated with the higher occurrences of diseases. Chittagong had two peaks of diseases; one during monsoon (mid June to mid September) and the other during winter (mid December to mid February). Sirajganj had the highest peak of diseases during August through to mid December. Two situations were identified associated with the disease peaks; (1) the monsoon during July and mid October and (2) moving cattle to pasture during November and December. Such cattle movement initiates foot-and-mouth disease outbreaks. A second lower peak occurred from March to May; the

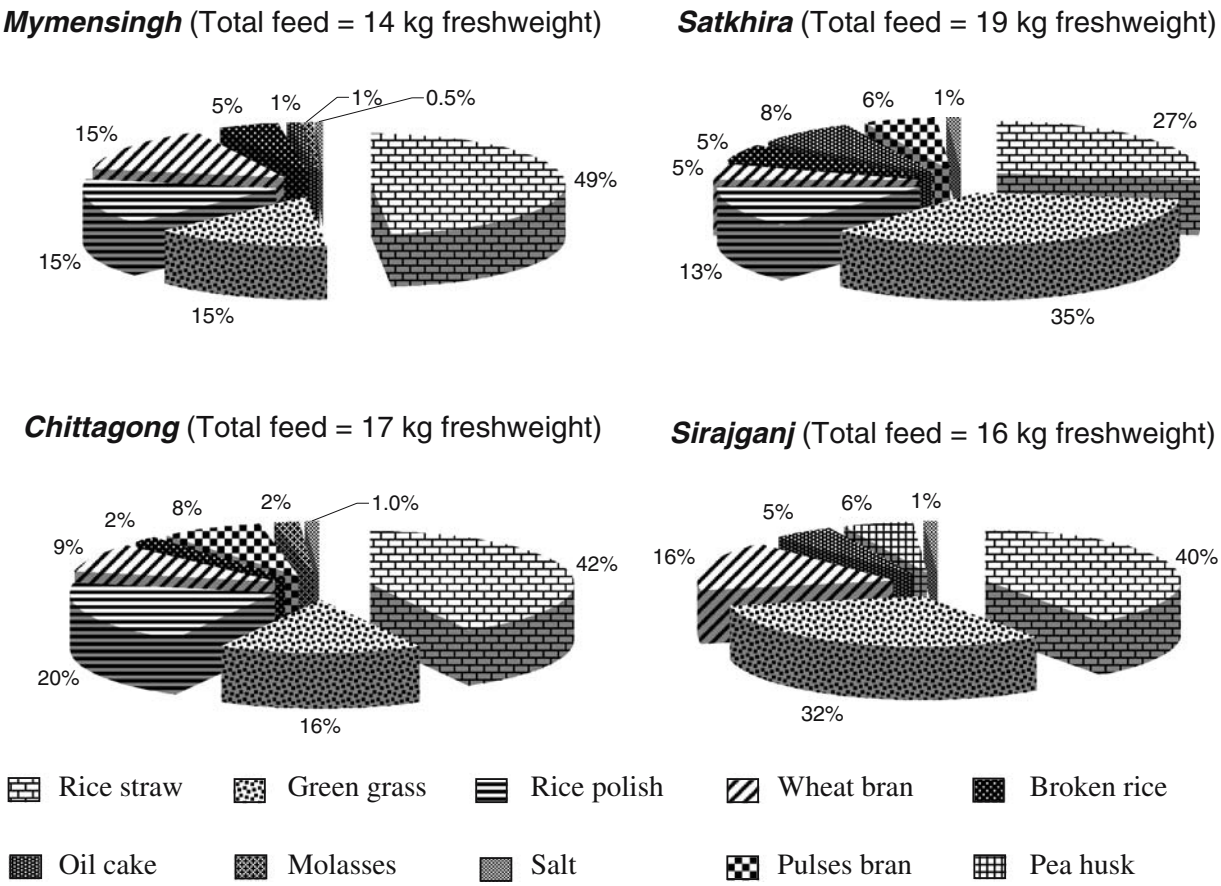

Fig. 2 Feed ingredients in the daily ration of a dairy cow in four different districts of Bangladesh

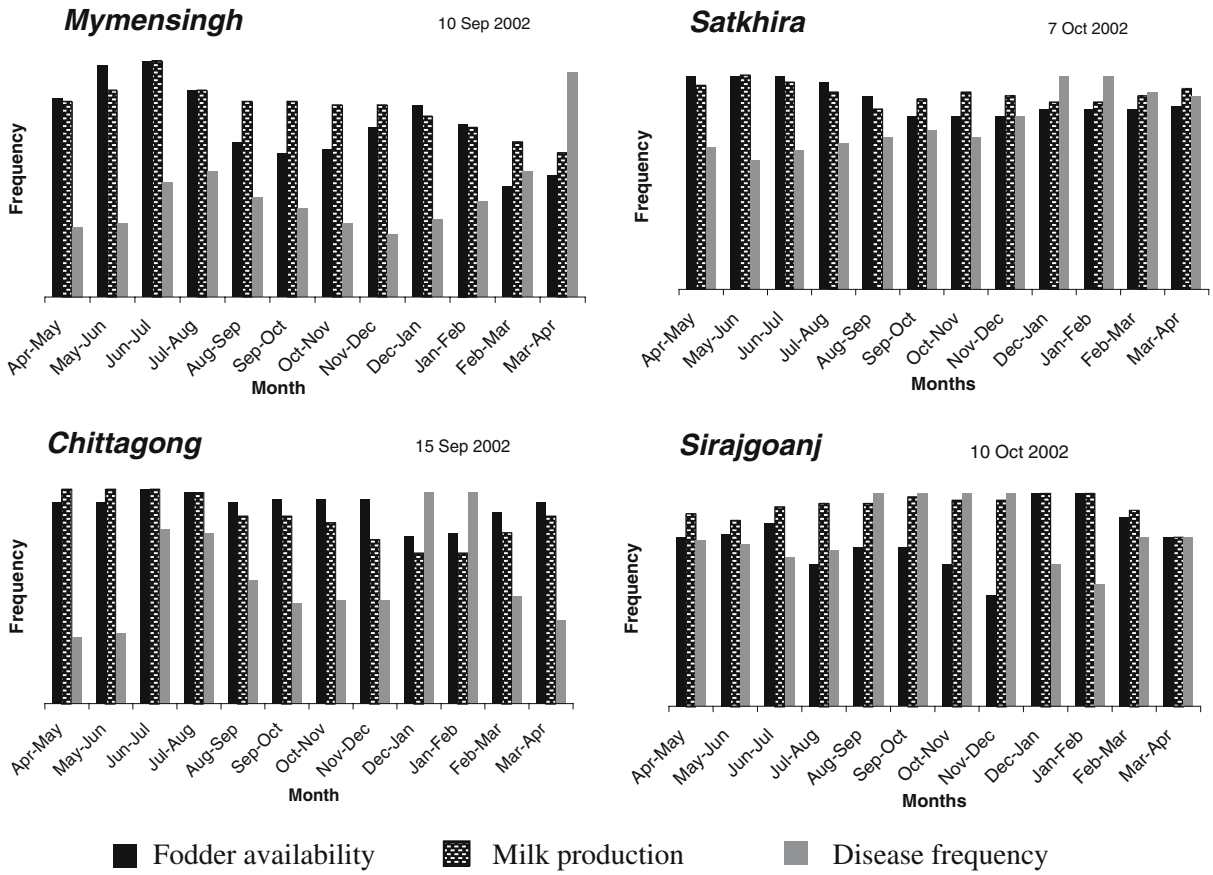

Fig. 3 Monthly availability of fodder, production of milk and occurrence of disease in four different districts of Bangladesh

hottest months of the year. Across the districts, February through April is dry and windy and is associated with most of the foot-and-mouth disease outbreaks and July through October is the monsoon when compromised hygienic practices leads to a high prevalence of mastitis.

Farmers' mobility

Farmers' mobility in relation to dairying is shown in the Table 5. The farmers belonging to the dairy cooperative (Sirajganj) travel to 11 places, while farmers from the other three regions without cooperative benefits, travel to 22–24 places to accomplish their dairy related activities. These activities include selling milk, collecting feeds and fodder, getting various dairy-related inputs, and receiving veterinary and AI services.

The major problems for small and marginal farmers outside cooperative areas are selling milk for a consistent price and receiving inputs and services. Cooperatives greatly reduced travel requirements by concentrating milk sale, input and services procurement in one place. Similar benefits of farmer cooperatives were reported by others where dairy inputs, extension and training services, veterinary care and artificial insemination were delivered to the dairy farms from one place (Uotila and Dhanapala 1994; Shamsuddin et al. 2002). Members of dairy cooperatives in Bangladesh produced milk at a lower cost than did farmers from the other areas (Shamsuddin et al. 2006). This suggests that cooperatives not only ensure a consistent milk price but also help by reducing milk production costs for the small and marginal farmers.

Farmers' preference for dairy cattle breeds

Friesian crossbred cattle were ranked top by total score by farmers in all areas except Satkhira (Table 6). In Chittagong, Sahiwal received 1 score higher than Red Chittagong Cattle — a zebu found in Chittagong

Table 5 Places for dairy related business visited in a year by dairy farmers participating in a PRA in four districts of Bangladesh

Activity	Mymensingh	Satkhira	Chittagonj	Sirajganj
Milk selling	Milk market, Contract consumers	Milk dealer, Milk market at Baithaghata, Chalna and Khulna city	Milk dealer, Contract farms in the Chittagong city, Milk market, Sweet meat, Tea stalls	Milk collection centre
Procurement of feed	Feed store, Home grown	Neighbouring farmers, 8 Feed markets	Neighbouring farmers, Community, grassland, Fodder plots, Feed stores	Straw dealer, Grass Fields Feed store
Other inputs	Livestock office, Dispensary, 5 Cattle markets, Electricity office, 2 Banks Housing materials Hawkers, other dairy farms, Cattle dealers, Grocery shops	Local market 4 Cattle markets	Cattle businessman 5 Cattle market Grocery store Dispensary Other farms	Cattle market Hawkers Society office Dispensary
Services	Veterinary hospital, AI centre, Bangladesh Agricultural University, Mymensingh Field Fertility Clinic, traditional healer	Veterinary hospital, AI centre, 5 Village doctors Traditional healer	Veterinary hospital, 2 AI centres	Milk Vita, veterinarians, Field fertility clinic, Inseminators
Total places	24	24	21	11

and Chittagong Hilltract districts. Details of the characteristics of the cattle breeds and average scores given to them by the farmers are shown in Table 7, irrespective of the districts studied. Farmers ranked Friesian crossbred cows higher than native zebu cattle and Sahiwal crossbreds for milk production, female cattle price, age at puberty, feed intake, milking ease and temperament. Native zebu cattle and Friesian crossbred cattle were favoured for fertility and oestrous behaviour. Meat was valued more for the native zebu cattle and Sahiwal crossbreds and bull prices were higher for the Sahiwal crossbreds, particularly for the holy sacrifice. Although the native non-descript cattle scored highest in 14 out of 26 characteristics, they were not favoured for dairy characteristics except for a high percentage of fat in their milk. The 13 other characters related to disease resistance, adaptability to the environment in Bangladesh, oestrous behaviour and fertility, meat value, capacity to work as draft animals, and inexpensive husbandry.

Bangladesh needs to continue its crossbreeding programme for cattle with set national milk production goals and a clear direction towards achieving that. In the year 2025, the availability of milk per head per day will be only 120 ml if the milk production grows at 6% per year against an expected 1.6% population growth rate (FAOSTAT 2006). A 6% annual growth rate in the dairy industry will be

Table 6 Cattle breeds scored for good characters by the farmers taking part in PRA in different districts of Bangladesh

Cattle breeds	Scores			
	Mymensingh	Satkhira	Chittagonj	Sirajganj
Friesian crossbred	79	53	49	58
Sahiwal crossbred	49	46	42	48
Native zebu cattle				
[1]Pabna Milking Cattle	–	–	–	49
[2]Red Chittagong Cattle	–	–	41	–
Non-descript cattle	71	55	38	55
Holstein graded	–	46	–	–
Highest score	*79*	*55*	*49*	*58*

[1] Zebu cattle found in Sirajganj and Pabna districts; [2] Zebu cattle found in Chittagong and Chittagong Hilltract districts — none of them are recognized as a breed by the international community.

Table 7 Characteristics of cattle breeds identified by farmers from four regions of Bangladesh and average scores given by them for the breeds, irrespective of region

Breed characteristics	Crossbred			Native		
	Frisian	Sahiwal	Graded Holstein[1]	PMC[2]	RCC[3]	Non-descript
Yield more milk	4.5	2.8	3.0	2.0	2.0	1.0
Long lactation period	5.0	2.0	4.0	1.0	1.0	1.5
Cows price high	4.5	2.8	4.0	2.0	1.0	1.0
Heifers price high	4.8	2.8	4.0	1.0	1.0	1.0
More fat in milk	1.5	2.0	2.0	–	3.0	4.0
Dry cows price high	3.0	3.3	4.0	2.0	1.0	1.3
Bulls price high	2.0	4.3	3.0	3.0	3.0	1.5
Meat values high	1.5	3.0	1.0	3.0	–	3.5
Good draft animal	1.0	3.0	1.0	–	3.0	5.0
Early puberty	4.5	3.0	2.0	2.0	2.0	1.3
Good conception rate	2.5	1.8	2.0	3.0	3.0[a]	3.8[a]
Short calving to conception interval	3.7	2.0	–	2.0	–	4.0[a]
Evident oestrus sign	3.0	2.0	–	–	–	5.0
Good dam for crossbreeding	2.0	3.0	–	–	4.0	1.0
Feed costs low	1.5	2.8	1.0	3.0	–	4.5
Good appetite	4.7	2.0	–	2.0	2.0	2.0
Low husbandry cost	1.5	2.3	1.0	–	3.5	4.3
Easy milking	4.7	1.7	3.0	2.0	–	2.0
Milking without calf	6.0	2.0	–	1.0	1.0	1.0
Good temperament	4.7	1.7	2.0	1.0	–	2.7
Keeps barn clean	1.0	2.0	–	3.0	–	4.0
Low investment to own a cow	1.5	1.5	–	–	3.0	5.5
Disease resistance	1.8	2.3	1.0	3.0	3.0	4.3
Less mastitis	2.3	1.3	2.0	4.0	–	4.3
Low calf mortality	1.3	2.3	1.0	3.0	–	5.0
Good heat tolerance	1.5	2.5	1.0	3.0	3.0	4.3

1=Large Holstein-looking cows found in Satkhira; 2=Pabna Milking Cattle; 3=Red Chittagong Cattle; — = The character is not identified and scored; a=Natural breeding used mostly

difficult to achieve. To be self sufficient in milk by 2025, Bangladesh needs to produce 19.02 million metric tons milk annually, given a population estimated to grow to 208 million. This will need a 9.6% growth rate of milk production in contrast to the current rate of 2.05% (FAOSTAT 2006). The former does not exist any where in the world. Although the native zebu cattle received top scores in 14 out of 26 characters (Table 7), they are currently supporting, together with the crossbred cattle, a national average of 2.0 litre milk per cow per day. Bangladesh will require 26 million lactating cows leading to 65 million total native zebu cattle, calculated on the basis of 40% of total cattle in lactation at the best management practice (Shamsuddin et al. 2006). The land of this country can not support that many animals. The country needs an average milk production level of 3000 kg milk per cow per 305 days lactation. This will lead to a population of 5.2 million lactating cows (13 million total cattle). Such a dairy industry will require 526 thousand hectares of land for fodder cultivation, which is 4% of the available cultivable land in Bangladesh (BBS 2004). Our group found that by using a feeding system that includes cut and carry Napier grass, rice straws and concentrates, 0.04 hectare land can support one lactating cow with 15 litres milk on one day, provided an efficient 12 month fodder calendar is practiced (unpublished observation). This job is not impossible. Pakistan's current national herd average is 3000 kg milk per lactation and many herds in India are getting that level of production (Hemme et al. 2004). In Sirajganj milk shed area of BMPCU Ltd, Bangladesh, the 20% best herds produce in average 9.0 litres milk per cow in

one day with an average lactation length of 282 days, estimated 2538 litre per lactation (Shamsuddin et al. 2006). In support of farmers scoring Friesian cross-bred cattle top for dairy-related characters (Table 7), Bangladesh should set the breeding goals and the milk production, selling and distribution system to be able to be self sufficient in milk and other dairy products by the year 2025.

Preference ranking and scoring of services to dairy farmers

The farmers' views of services currently available and those that they expected to be available in the future are shown in Table 8. Among currently available services, veterinary services scored the highest in importance for three of the four regions. The exception — in Sirajgani — was much the highest score for milk collection and processing centre of the BMPCU Ltd, i.e. the milk union. It does not only buy milk from the farmers but also provides veterinary and AI services, training and fodder seeds. The farmer perceives that, as long as the milk union is in place, the veterinary and AI services will reach them automatically. Therefore, milk union-affiliated farmers, who receive veterinary services from the union, put less importance on them separately (Table 8). The benefit of BMPCU Ltd to its affiliated farmers is also evident from the fact that they need to travel to less than half the number of places for dairy related transactions compared to farmers who are outside the union operation area (Table 5).

The first and second most desired services for the future in all the districts were either milk collection and processing centres, the increased availability of bank loans, centres for training farmers on the efficient management of dairy farms, veterinary services, feed shops, or concrete roads. Farmers not only desired making new services available to them but also valued continuation of some of the services already in place. In Sirajganj, the collection centre scored the highest as a future service as well; showing how much the farmers in that region valued their existing facility. Farmers in two regions, Mymensingh and Chittagong, judged bank loan facilities to be most important for the future. The Mymensingh farmers were the most resource poor and therefore wanted bank loans to extend their herd size by buying additional

Table 8 Farmers' views, expressed in composite scores, in four regions of Bangladesh on the importance of present dairy farm-related services and the needs for the future

Services	Mymensingh		Satkhira		Chittagonj		Sirajganj	
	Present	Future	Present	Future	Present	Future	Present	Future
Veterinary services (treatment and advice)	19	3	21	15	23	0	6	2
Government supply of medicine and vaccine	0	3	–	–	–	–	0	0
Artificial insemination	8	2	20	8	7	0	7	1
Private veterinary pharmacy	0	3	4	0	6	0	0	0
Feed (milling by-product) shop	5	0	12	4	18	0	5	0
Milk market	6	2	–	–	3	0	–	–
Cow market	3	1	0	0	0	0	0	0
Fodder (roughage) market	1	0	0	0	0	0	0	0
Traditional healer	0	0	16	0	–	–	6	0
Milk collection and processing centre of BMPCU Ltd.	–	2	–	38	–	13	20	15
Training & training centre	–	12	0	5	7	13	2	4
Bank loan facilities	–	14	1	2	6	20	–	1
Milk businessman	–	–	10	6	–	–	–	–
Telephone	–	–	–	–	–	–	–	6
Post office	–	–	–	–	–	–	–	6
Concrete road					–	–	–	12
Govt. cattle feed shop	–	–	–	–	0	14	–	–
Top scores in each column	19	14	21	38	23	20	20	15

BMPCU = Bangladesh Milk Producers' Cooperative Union

(Dash — means service not identified; zero means service identified but given no weight)

cows. The farmers of Chittagong are periurban and they have ample opportunities of selling milk to the metropolitan city of Chittagong. Therefore, they wanted to enlarge their farms and make more money.

The farmers outside the milk union operation area did not identify milk collection centre as one of the currently available services but they were aware of the milk union and would like to have those facilities available in their areas in future. In Satkhira a desire for a milk collection and processing centre massively outscored everything else. This was because the current milk price in Satkhira was lower (US $18–20 for 100 litres of milk) than that in Mymensingh and Chittagong (US $28–34 for 100 litres of milk). The milk union will pay US$ 28–31 for 100 litres of milk. Perhaps that motivated Mymensingh and Chittagong farmers who scored training and bank loan higher than collection centre.

Constraints limiting dairy development

Factors that hinder dairy development in the participants' communities were summarized and are shown in Table 9. Lack of training was found to be a very important problem for all regions (scoring first in two and second in two). It was considered especially critical by farmers in Mymensingh, obtaining more than twice as many points as any other constraint. Lack of support from the government was also universally important, ranking first, second or third in all districts. Other major problems were more specific to each region, such as lack of a milk collection centre in Sathkhira and lowland flooding in Sirajganj. Participants in three districts identified corruption and political instability as causes of poor development in the dairy sector. This problem was considered the most important constraint of all by dairy producers of the Chittagong District.

Farmers reported that they were not getting the necessary veterinary services because of inaccessibility to qualified veterinarians and high call-out charges. Therefore, animals are treated by unlicensed field workers with 1–3 months training and unauthorized practitioners with inconsistent results. Moreover, veterinarians have no opportunity to receive new training on updated methods, particularly for fertility and herd health management. Veterinary practices are mostly hospital based and the veterinarians are primarily concerned with treating the individual animals. Therefore, they do not pay attention to the economics and the whole production system of the dairies of their clients.

In accordance with the findings of Khan et al., (1998), the results of the present study showed that dairy farmers anticipate government help for credit, training and veterinary and AI services. Farmers complained about the AI services, specifically for not incorporating fertility and reproductive health control. In addition, dairy farmers are unable to expand their farms due to lack of capital. Simple credit distribution systems by banks or non-government organizations (NGO) try to encourage farmers, but the gap between credit policy and the lending practices of banks and NGOs needs to be narrowed (Khan et al. 1998).

Table 9 Participating farmers' views of the factors that hinder development of the dairy industry in four districts of Bangladesh

Root causes	Mymensingh	Satkhira	Chittagong	Sirajganj
Highest score in each column	*44*	*29*	*30*	*22*
Lack of training	44	25	29	22
Inadequate Veterinary services	13	9	10	5
Inadequate AI services	3	10	5	2
Inadequate support from the government	13	29	21	18
Hostile condition for high producing cows	12	5	7	1
Corruption and political instability	13	–	30	4
No milk collection centre	2	16	4	–
Lack of capital	17	8	10	–
Insufficient land and low land	10	15	15	18
Insufficient supply of inputs	4	–	–	8
Limited capacity of Milk Vita	–	–	–	6
Inadequate cooperation from neighbour	–	7	–	–
Lack of electricity	3	–	–	–
Scarcity of crossbred cows	–	–	6	–

Government veterinarians mostly provide emergency services. To meet farmers' expectations, a holistic approach to productivity veterinary services, comprising AI, reproductive health management, nutrition, calf health management, udder health management, vaccination and deworming, should be introduced. Farmers are willing to buy effective veterinary and AI services. Therefore, markets for private veterinary and AI services exist. Such services could be delivered through cooperatives to reduce farmers' movements. The farmers of Chittagong claimed that scarcity of better quality bulls hinders the genetic improvement of their local zebus. In Bangladesh, there is no progeny testing of bulls used for semen production. Genetic improvement of zebu cattle, through the use of progeny testing, would increase the number of crossbred cattle (Zebu X Friesian) and thereby raise the productivity.

Size of a small-scale dairy farm that would entirely support a family

Table 10 summarizes farmers' opinions in three of the regions on the inputs needed for a farm family to subsist entirely on dairy farming. The herd size, milk sold per day and land required for a sustainable dairy farm varied slightly from region to region, with some association with the average family size in that region. The farmer groups developed a consensus that the size of a small scale dairy farm to fully subsist a family could consist of from 10 to 30 head of cattle with 4 to 12 lactating cows producing 22 to 70 litres of marketable milk daily. The suggested milk prices ranged from US $ 23 to 28 per 100 litres, depending on the area studied. The variability in education and dairying knowledge influences the expectations of farmers for their dairy. Respondent farmers of the dairy developed area of Sirajganj expected more milk from relatively fewer cows compared to those from Mymensingh (Table 10). The farmers' perceived requirements for a better life were not equal for all regions. It is important that a larger portion of the consumer's price goes back to the producer. This can be ensured by extending milk collection and processing centres to the farm communities that are outside the cooperative's operation areas. A higher milk price will allow a smaller farmer to subsist his/her family entirely on dairy farming.

Conclusions

Good prospects for the smallholders' dairy industry exist in Bangladesh. However, effective veterinary and AI services, efforts to develop milk markets through farmers' cooperatives or associations, increased individual cows' production, decreased feed costs with forage as a major component and breeding with definite goals all need to be addressed. We are at present working to introduce a service package named Field Fertility Clinic (FFC) services. FFC uses some specific forms related to a computer application and breeding calendar, together with other veterinary procedures, as tools to deliver preventive and emergency veterinary services on farm on a routine basis, with necessary follow ups through farmers' associations. The association not only participates in the management of FFC services but also works for selling milk at a good price by negotiating with sweetmeat makers or the formal sector milk processors where the cooperative union does not run its milk collection centres. The calendar helps farmers to keep minimum essential records on vaccination, deworming, breeding, pregnancy diagnosis, drying off and calving,

Table 10 The requirements to sustain an entire family on a small-scale dairy farm, identified by participant farmers in three districts of Bangladesh

Parameter	Mymensingh	Chittagong	Sirajganj
Family members	6	6	7–8
Amount of milk to be produced (litre) per day per family	22–25	40–50	70
Milk price per litre (US$)	0.34	0.28	0.28–0.31
Number of lactating cows	4	12	7
Total cattle	10–12	28–30	18–20
Land required for fodder (ha)	–	0.364	0.4

- They do not cultivate fodder but cut and carry some green grasses from roadsides and other public lands.

as well as deciding the next breeding date of the cow. It helps veterinarians implementing and monitoring the preventive and udder health management activities. FFC developed a feeding system, which is being implemented also during the monthly visits. It uses a corn based concentrate, 2.5 kg per litre of milk, rice straws and green grasses with a targeted intake 4% DM of body weight by a Friesian crossbred cow.

One veterinarian can deliver services effectively to 10 clients a day, covering 250 clients in a month. Economic evaluation shows FFC services made a net income of US$ 0.29/cow/day to farmers (Saha, 2005). Taking an average of two lactating cows per farm, one veterinarian's services will make US$ 4,350.0 in a month for all the clients together (250 clients x 2 lactating cows x US$ 0.29 income per cow per day x 30 days). The FFC signs a contract with a farming community to deliver preventive services and continue farmer education for US$1.4 per month for a farm with 1 to 5 cows, US$ 2.8 for a farm with 6 to 10 cows and US$ 4.3 for a farm that has more than 10 cows. For an emergency call, the FFC veterinarian charges US$ 1.4 for the service only and drugs are sold at the market retailed price. Fully occupied, a veterinarian with good skills will earn US$ 580.0 per month on average using the FFC model of service delivery. The benefit should be both for the FFC and the farmer.

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