



Comprehensive study of the Assam dairy sector
Action plan for pro-poor dairy development

ILRI

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Overview

This document outlines an action plan for pro-poor dairy development in Assam. It is based on key findings of a preliminary report on a comprehensive study of Assam's dairy sector. The final version of the action plan contained in that report may be revised based on feedback received from stakeholders.

Dairy production in Assam is mostly characterized by rural smallholder production using indigenous cattle and buffalo, with pockets of more specialized dairy production. While increasing farm-level production and productivity will require more improved animals, improved fodder/feed technology and access to livestock services, access of smallholders to reliable markets to absorb more milk at remunerative prices may remain a critical constraint. Organized marketing of milk in Assam remains relatively insignificant, despite past efforts to develop and promote collective market mechanisms. The traditional markets for fresh liquid milk and traditional dairy products such as sweets account for most of the market opportunities for farmers.

It is in this context that the International Livestock Research Institute (ILRI), in collaboration with the Directorate of Dairy Development (DDD), Government of Assam, led a comprehensive study on the dairy sector in Assam. ILRI is the only international research institute which focuses on livestock systems in developing countries, working specifically to benefit the poor. ILRI brought to the process a strong track record of pragmatic but science-based research, conducted in partnership with national institutions and targeted at increasing the welfare of smallholder dairy farmers in developing countries. Central to the work of the team was strong collaboration with local research and development partners. The overall objective of the study was to generate information and enhance local capacity-building through joint learning to allow subsequent preparation of a pro-poor dairy development action plan.

The specific objectives of the study were to:

- improve the performance of the traditional market, in terms of quality of milk and dairy products, and marketing services and market access to small producers;

- contribute to the evolution of the traditional market towards the more formal milk market and create conditions for convergence of the two;
- facilitate the evolution of smallholder producers to meet new opportunities and threats posed by changing traditional and organized milk markets; and
- contribute to the overall growth and pro-poor development of the dairy sub-sector in Assam.

Components of the study

- Initial qualitative assessment of the dairy sector to guide the subsequent project activities
- Three integrated structured surveys of 1500 consumers, 600 traditional and formal market agents and 3000 dairy producers in eight districts
- Study of successes and failures in the formal sector in Assam
- Sampling and quality analysis of milk and dairy products in traditional and formal sectors
- Regular engagement and discussions with stakeholders to share study design, progress and findings

Highlights of patterns of consumption of milk and dairy products in Assam

This section summarizes the key findings of the consumer survey of approximately 1500 households and institutions in the eight Assam Agriculture Competitiveness Project (AAP) districts plus some selected areas in the North Cachar Hills district.

Fresh milk is the most preferred liquid milk product and is generally consumed by most Assam-based consumers. Most urban and rural households usually or occasionally consume fresh milk, and the widely accepted practice is to purchase raw milk and boil it before consumption. There is general consensus among urban and rural consumers that fresh milk is the most preferred for drinking and mixing with tea or coffee.

Consumption of pasteurized milk is very low and occurs only among urban households. Overall, pasteurized milk was found to comprise less than 1% of all milk consumed, and 1.3% of urban consumption. However, pasteurized milk accounted for half of the liquid milk consumption by the few urban households that consumed pasteurized milk (about 3% of survey respondents). This suggests that demand for pasteurized milk is limited to a very small segment of the urban society in Assam.

Differences in consumption preferences were observed between urban and rural consumers. Consumers were asked to rate specific and overall attributes of different dairy products on a scale of 0 to 10 (10 = strongest preference). Preferred attributes of milk products by both urban and rural consumers were high fat content, fresh smell, milk from local breeds, and generally cow milk rather than buffalo milk. Some of these attributes are generally associated with fresh raw milk and not pasteurized milk, indicating the source of demand driving the traditional market. However, among various product types, overall preferences for powder, skimmed, pasteurized milk and *lassi* were much higher in urban than in rural areas. For raw milk, packed fresh milk, condensed milk and *ghol/matha/whey* the preferences were slightly different or about the same in rural and urban areas (Figure 1). This indicative demand for processed milk products by urban consumers could be attributed to greater availability and awareness of such product types in urban areas and the relatively higher purchasing power of urban consumers.

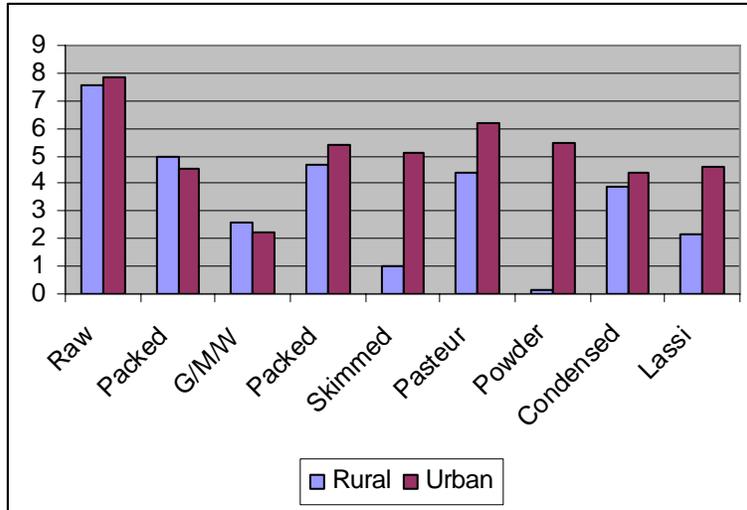


Figure 1: Overall preference rating for various types of dairy products

The quantity and value of fresh milk consumption in urban and rural areas were similar. Average per capita consumption of liquid milk from survey data in nine districts was about 44 and 37 litres per year in urban and rural areas, respectively (Figure 2). These figures are relatively higher than the state average of 26 and 14 litres per capita per year in urban and rural areas, respectively, based on a national household survey conducted by the Government of India in 2000. The observed difference could be attributed to the survey being conducted in districts with a long tradition of milk production and consumption, indicating greater potential for dairy development than the rest of Assam. However, these survey results are still way below the national average annual per capita milk consumption that is estimated at 90 litres, based on the government national household survey.

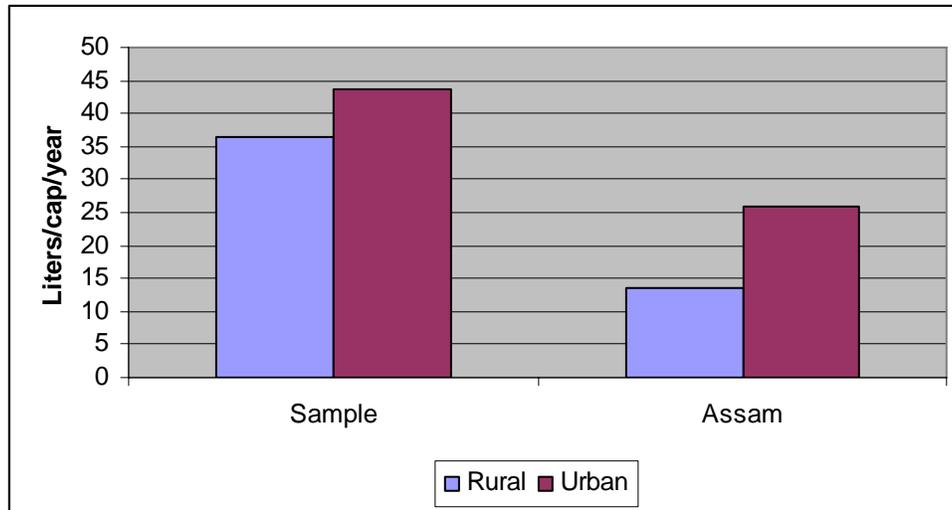
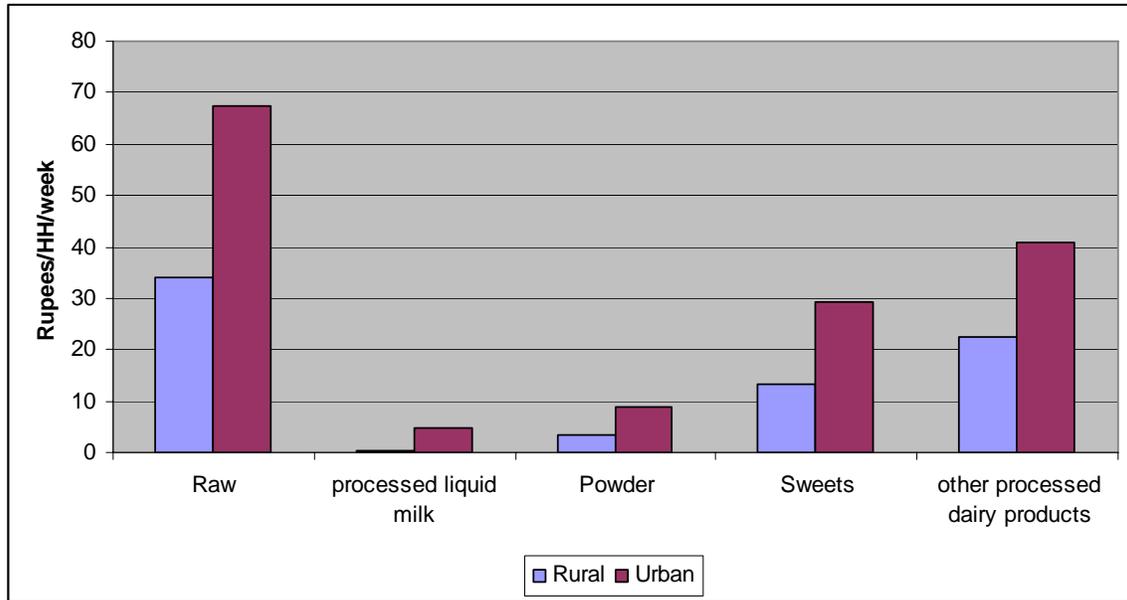


Figure 2: Per capita consumption of fresh milk from survey data and compared with State of Assam estimates

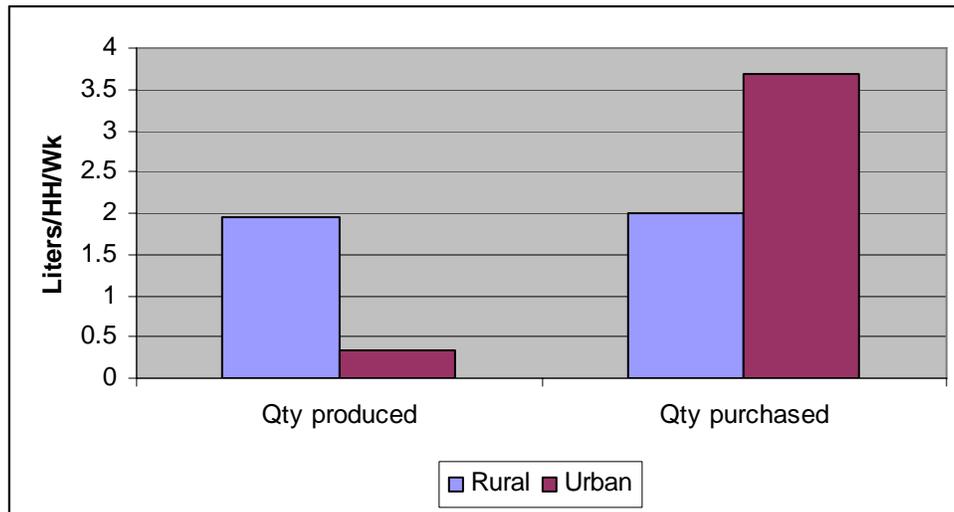
Total expenditure on milk and dairy products was higher among urban areas. On average, surveyed urban households spent 152 rupees per week on home consumption of milk and dairy products compared to 73 rupees by rural households. Raw milk purchases accounted for most of the weekly home consumption expenditures on dairy products; on average, 67 and 34 rupees per household in urban and rural areas, respectively (Figure 3). Powdered milk and other processed milk products (e.g. pasteurized, skimmed and flavoured) formed a small part of dairy product purchases, with urban households spending relatively more on these items than their rural counterparts. Urban consumers also spent twice as much as their rural counterparts on purchases of milk-based sweets and other processed dairy products (e.g. curd, ghee, paneer, butter) for home consumption during the same reference period (Figure 3).



Source: Consumer survey, Assam dairy project (2006)

Figure 3: Weekly household expenditure on milk and dairy products

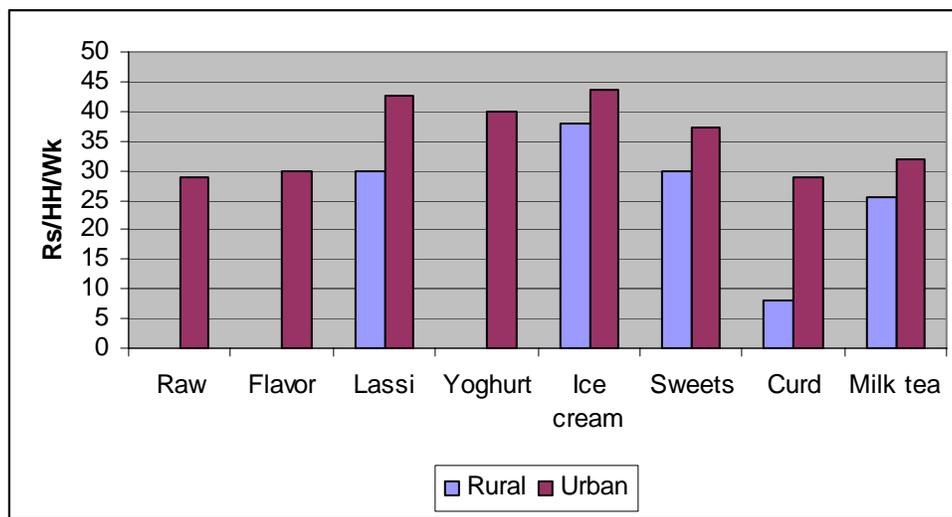
On average, rural households consumed two litres of home-produced raw milk per week. This was more than their urban counterparts who consumed on average only a third of a litre per week (Figure 4).



Source: Consumer survey, Assam dairy project (2006)

Figure 4: Quantity of home-produced and purchased raw milk for home consumption

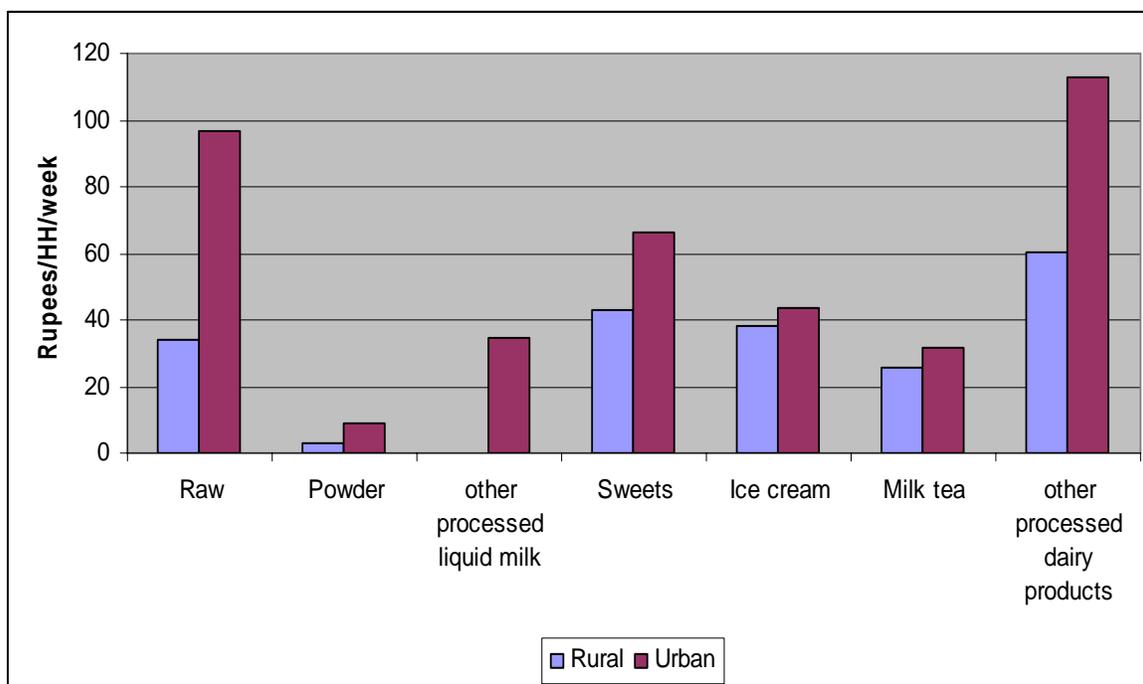
Away-from-home expenditure on milk-based sweets and other processed dairy products (ice cream, lassi, yoghurt and curd) was relatively higher among urban than rural households at 37 and 30 rupees per household per week, respectively (Figure 5). This trend of increasing urban demand for traditional milk-based sweets and other processed dairy products could be exploited for value-adding of liquid milk with employment potential in dairy-based rural enterprises. As income and urbanization are expected to increase, the demand for these traditional milk-based sweets and other dairy processed products will likely expand from current levels.



Source: Consumer survey, Assam dairy project (2006)

Figure 5: Away-from-home weekly expenditure on milk and dairy products

Based on weekly household expenditures of milk and dairy products (for home and away-from-home consumption), consumption patterns in urban and rural areas were still dominated by raw milk and traditional milk-based processed products (Figure 6), with urban households spending more on milk and dairy products expenditures than their rural counterparts. Purchases of powdered milk and other processed liquid milk products (skimmed, ultra-heat treated (UHT), pasteurized and flavoured) were relatively low, particularly by rural households.



Source: Consumer survey, Assam dairy project (2006)

Figure 6: Weekly household expenditures on different milk and dairy products

Purchases from traders and farmers formed the most important part of liquid milk supply. Direct farm sales to consumers formed the largest part of milk supply in most areas, followed by sales by traders (Figure 7).

An apparent growing concern for food safety in milk and dairy products was observed. While both urban and rural consumers were aware of the health and nutritional benefits of milk and dairy products, they were also aware of the health risks associated with consuming unboiled milk. A significant proportion of surveyed respondents (42 percent and 26 percent in urban and rural areas, respectively) indicated dissatisfaction with the present level of milk quality and hygiene (Figure 8).

Dissatisfaction with the quality of milk from milk vendors was also apparent. Almost half of the surveyed urban consumers and 44% of surveyed rural consumers indicated that they were not satisfied with the purity of raw milk being sold by milk vendors (Figure 9). Most urban and rural consumers also agreed that buying milk from vendors was not safe (Figure 10). These health risks were addressed by boiling of raw milk, as is the general custom in urban areas where about 38% of respondents reportedly bought raw milk from vendors.

On the other hand, it was observed that a growing number of urban consumers, especially those with higher income, were also gradually shifting towards pasteurized or UHT milk procured from formal milk markets. Based on unofficial estimates from key informants, some 250,000 litres of UHT milk are being imported per year and sold locally throughout the state by Amul Taza, with other brands supplying UHT milk in smaller quantities in selected areas.

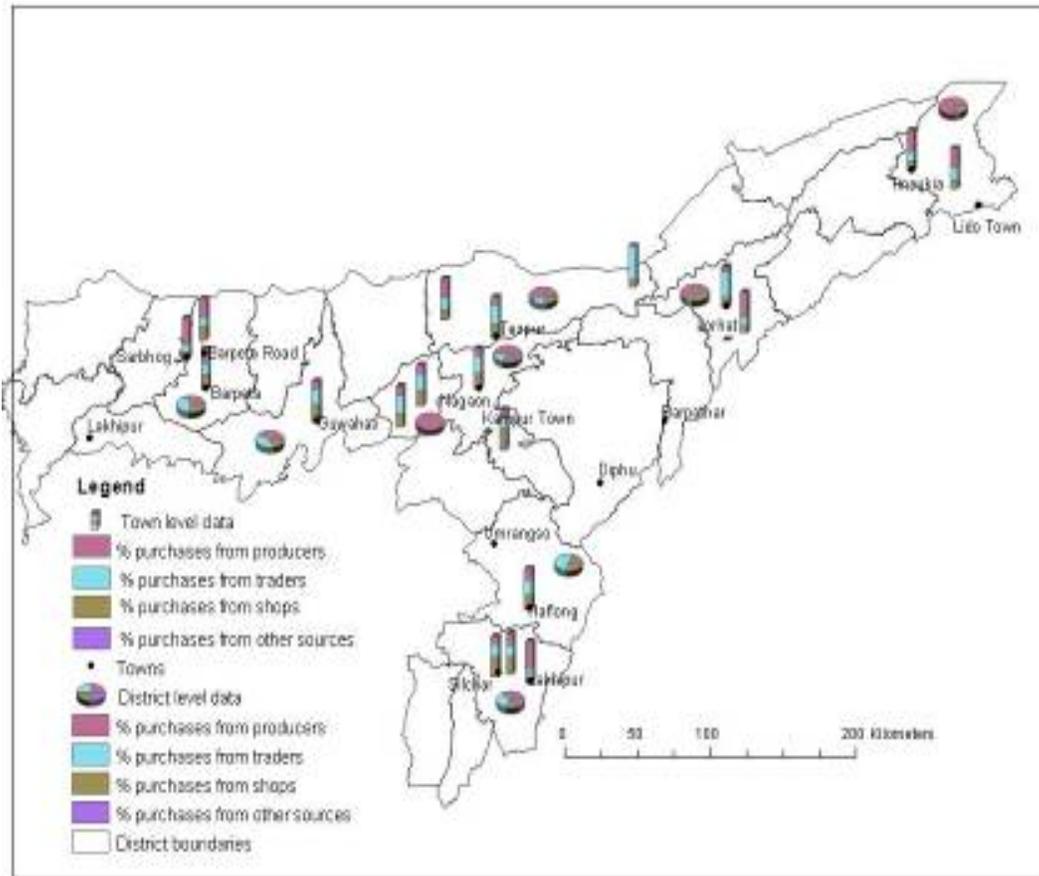
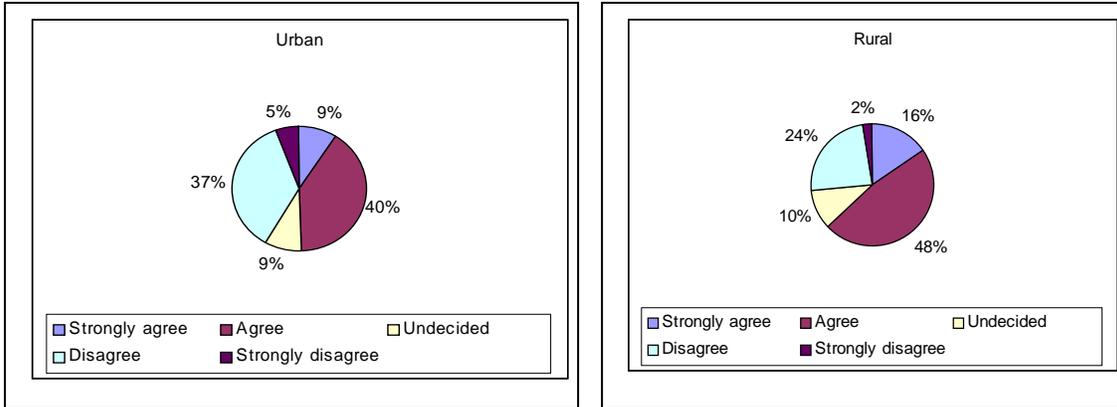
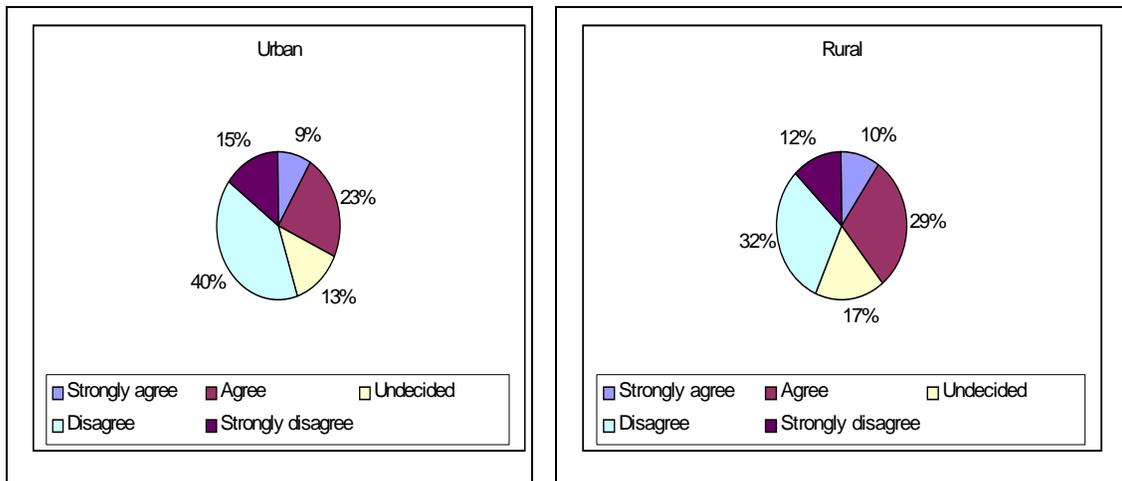


Figure 7: Sources of milk and dairy product purchases by consumers



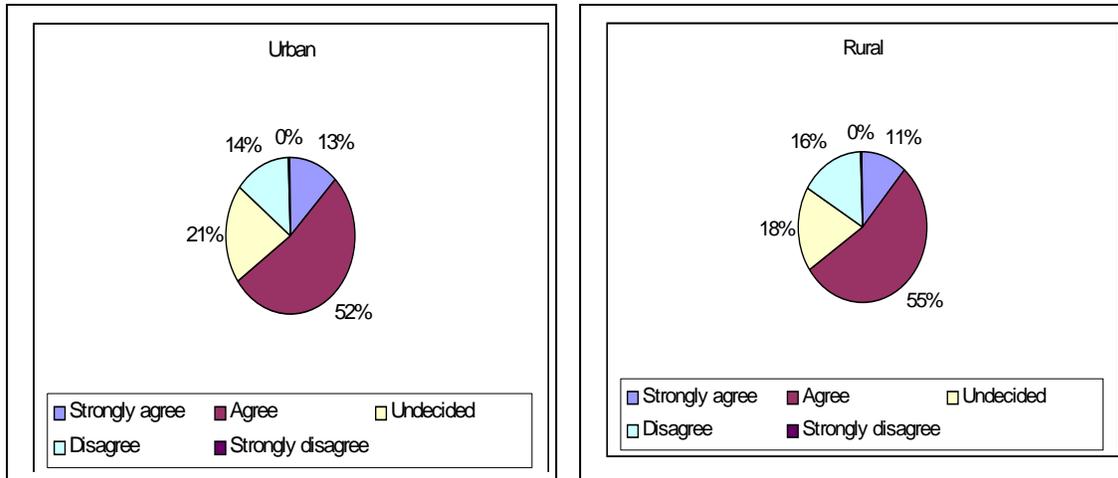
Source: Consumer survey, Assam dairy project (2006)

Figure 8: Proportion of consumer responses to the statement "I am well satisfied with the present level of hygiene and quality of milk available"



Source: Consumer survey, Assam dairy project (2006)

Figure 9: Proportion of consumer responses to the statement "I am well satisfied with the purity of raw milk being sold by milk vendors"



Source: Consumer survey, Assam dairy project (2006)

Figure 10: Proportion of consumer responses to the statement “Procuring milk from milk vendors is not safe”

Direct purchase from producers or close substitutes was the most preferred mode of purchase of fresh milk by urban and rural consumers. Trust in the seller was the most frequently cited reason by most urban and rural consumers in their choice of outlet for purchasing raw milk. Econometric modelling of consumer choice of outlet for fresh milk indicated that this decision is significantly influenced by several factors. These include socio-demographics (e.g. ethnicity, location and income), willingness to pay a price premium for quality/safety, packaging and consumer perceptions on quality and safety.

Specifically, Nepali respondents or those from minority tribal and low-income groups were more likely to buy milk from producers than traders or milk vendors. Conversely, urban consumers were less likely to purchase milk from producers. Those who rated purchased milk as ‘satisfactory’ or ‘poor/bad’ were less likely to purchase from producers than those who rated their purchased milk as ‘good’. Coupled with earlier results about the tendency of urban consumers not to purchase milk from producers, this suggests that producers as outlets are less accessible in urban areas. This is consistent with qualitative results from the survey. Therefore, while urban consumers may indicate preference for direct purchase from producers, it is not likely to be the main source of milk in urban Assam due to lack of access to producers. Consumers who were satisfied with the purity of milk sold by vendors were also less likely to purchase from producers. Those who bought milk from producers

were more likely to be satisfied with the unit cost of milk at a given quality. Also, those who were willing to pay a premium price for quality milk were less likely to purchase milk from producers. These results are linked to consumer concerns about milk quality and indicate that trust in the seller is the most reliable manner of getting assurance on milk quality.

Implications of the study highlights

The consumption study highlights point to the following implications that are directly relevant to the action plan:

- Local fresh (raw) milk forms the most important part of dairy product consumption and is supplied to consumers either directly from producers or through vendors. Any dairy development plan must, therefore, constructively address the local fresh milk market.
- Urban consumers were particularly concerned about the quality of local fresh milk, especially that sold by producers and vendors. They addressed this concern by buying milk only from well-known suppliers. Any plan to increase consumption of milk must, therefore, address local fresh milk quality in a standardized manner that builds consumer confidence in suppliers. Quality will have to be addressed to raise consumption of fresh milk among existing and new consumers.
- Pasteurized milk formed a very small proportion of total milk consumption and was limited almost entirely to the urban areas. It is thus unlikely that a development plan focusing mostly on pasteurized milk supply will have positive impact on a large number of producers and consumers.
- Urban households that bought pasteurized milk depended on it significantly. This suggests that if awareness of and preference for pasteurized milk can be developed, then demand can grow substantially.
- Urban consumers spent significantly more money on milk and dairy products, particularly on high-value products such as sweets. This practice offers good opportunities for value-addition and associated quality and safety assurance in small-scale dairy processing of these traditional products. Such initiatives would also contribute towards small-scale employment opportunities.

Highlights of milk and dairy product marketing in Assam

This section summarizes the key findings of a survey of 598 milk and dairy product market agents from eight AACP districts and the North Cachar Hills. Of the market agents surveyed, 590 were traditional and the remaining eight were formal milk market agents or institutions. Of the traditional agents, 355 (60%) sold raw milk, 222 (38 %) processed traditional dairy products and the remainder did both. Six of the eight formal milk market agents were dairy co-operatives and the rest were self-help groups (SHGs).

The traditional milk market, comprising unprocessed milk and traditionally processed dairy products, sold 97% of all milk and dairy products in the State with the remaining 3% being sold by the formal milk market. However, because producers on average sell only 17% of the milk they produce, the local market only supplies 66% of total consumption. The rest is supplied by dairy products imported from outside the State.

An overview of milk and dairy product flows in the target districts, expressed in liquid milk equivalents, is shown in Figure 11. This is estimated based on a combination of the results of the main surveys (consumer, market agent and producer), and NSSO (Government of India) data. The percentages add up to 100% for each step of the market channel, showing relative shares of the milk flow emerging from that step.

Traditional processors (mainly sweet-makers) were found to have higher levels of education (11 years) compared to raw milk traders (7 years). This indicates that education may be a barrier to entry into value-added dairy activities or that milk processing families were better able to educate their children than raw milk traders. Traditional milk trading was found to be primarily a male activity, as only 2 out of 590 milk traders surveyed were women. Further, the traditional milk trading in the state was dominated by very small traders; 78% of the milk market agents sold a maximum of only 60 litres of milk per day.

Milk marketing and livelihoods

Sixty seven percent of milk market agents depended solely on milk marketing for their household incomes. For the remaining market agents, the role of milk marketing in their household income was still significant. On average, milk market agents had been in

business for about 12 years and 86% of them began their businesses themselves. These findings point to the fact that small-scale milk marketing and traditional processing are becoming family businesses and they form important long-term livelihoods for a large number of people who may have few other opportunities.

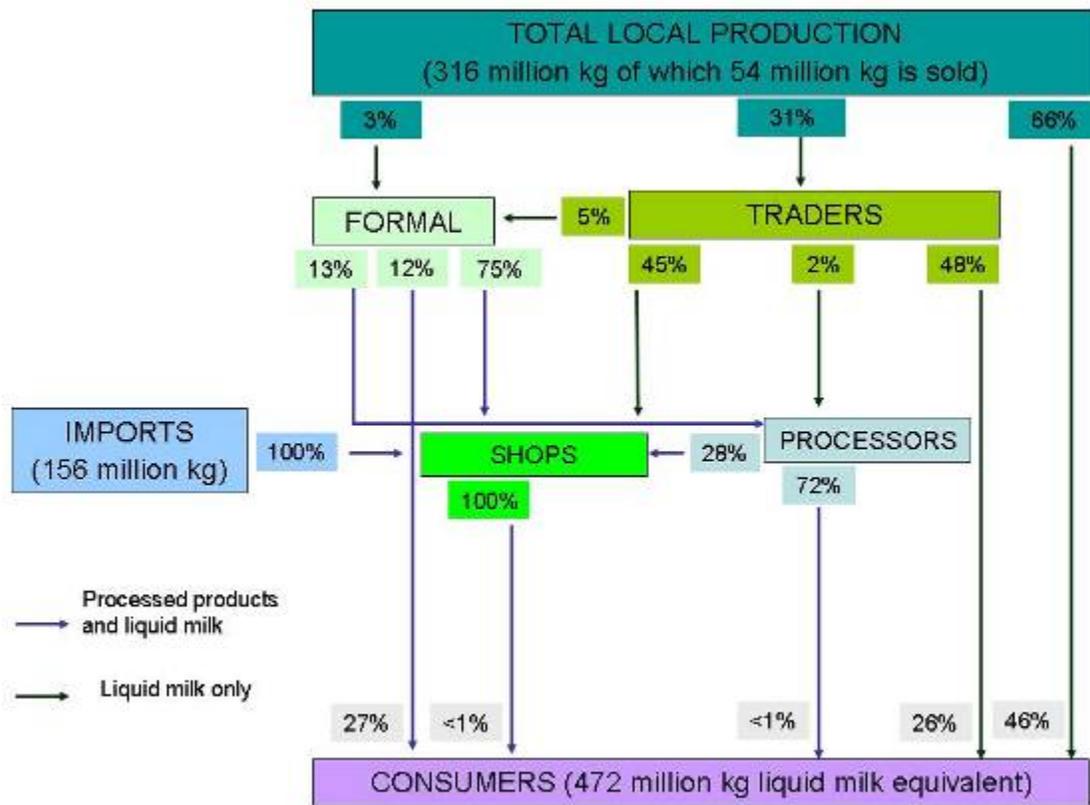


Figure 11: Flow chart of approximate milk and dairy product flow (in liquid milk equivalent) through the nine study districts

Sources of initial capital

Sixty-four per cent of the surveyed market agents started their businesses with their own savings, while 14% and 8% of them, respectively, used informal and formal credit (Figure 12). The high dependence of market agents on their own resources and informal credit may constrain them from scaling up their activities and entering into more remunerative value-addition activities, which are generally more capital-intensive. The econometric analysis indicated capital to be one of the most important factors for scaling up of the business and participation in milk processing activities.

Milk procurement and related activities

Traditional milk traders usually bought milk from rural areas thereby facilitating the links between rural producers and urban consumers. They also almost always purchased and sold milk within their own districts indicating relatively short market chains. Only four out of 590 traditional agents sold milk outside their district of collection and 21% of raw milk traders supplied areas in other districts to access markets nearby their own business location. Most traders purchased milk at a single location, though at the same location they procured milk from different suppliers.

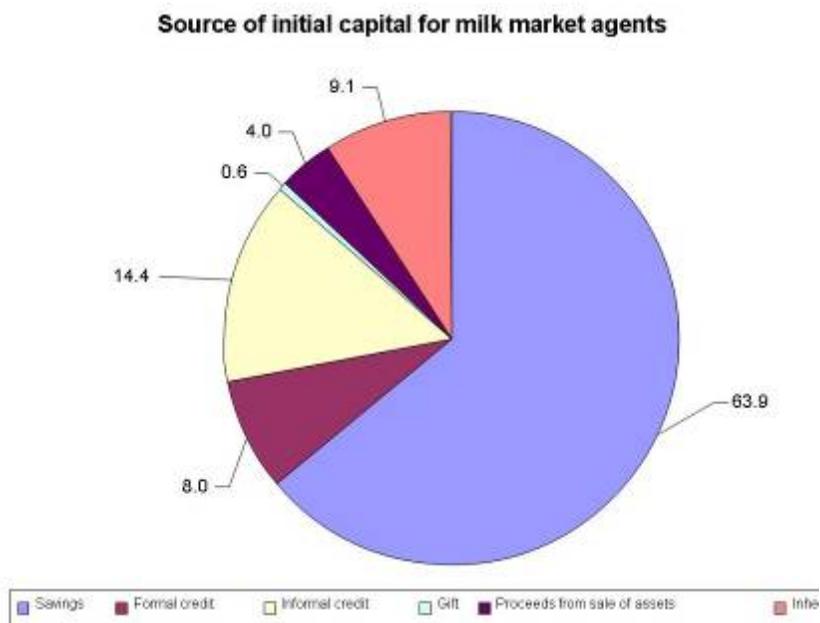


Figure 12: Sources of initial capital for milk market agents

Volume of purchased milk across different suppliers

Raw milk traders purchased 84% of the total volume of milk sold directly from farmers and the rest from dairy co-operative societies, SHGs, wholesalers and other vendors (Figure 13). The market agents who sold raw milk and also processed dairy products purchased 65% of their milk directly from farmers. However, the traditional milk processors mainly relied on milk vendors and procured 59% of their total milk purchase from them and only 27% directly from farmers. This reflects the fact that traditional processors require larger volume of milk that vendors, rather than producers, are better able to supply.

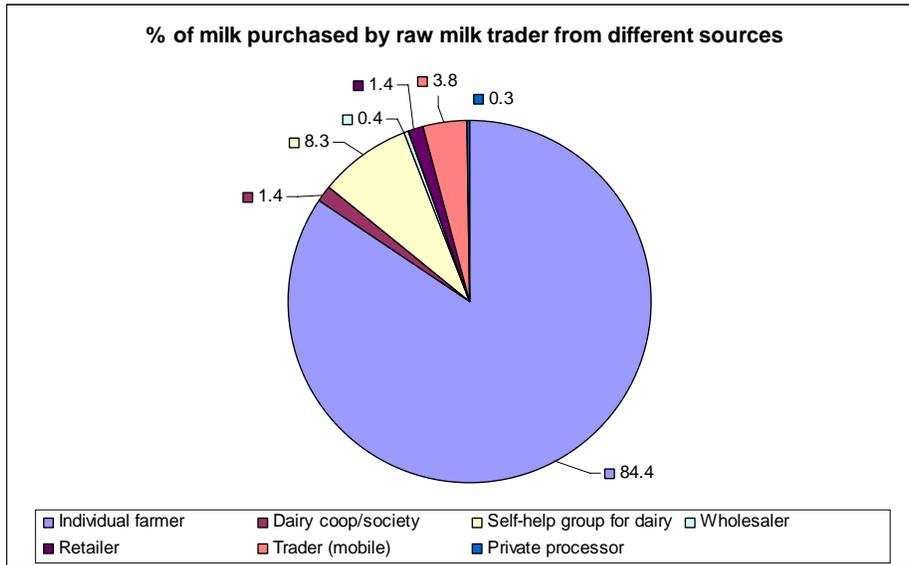


Figure 13: Proportion of milk purchased by raw milk traders from different sources

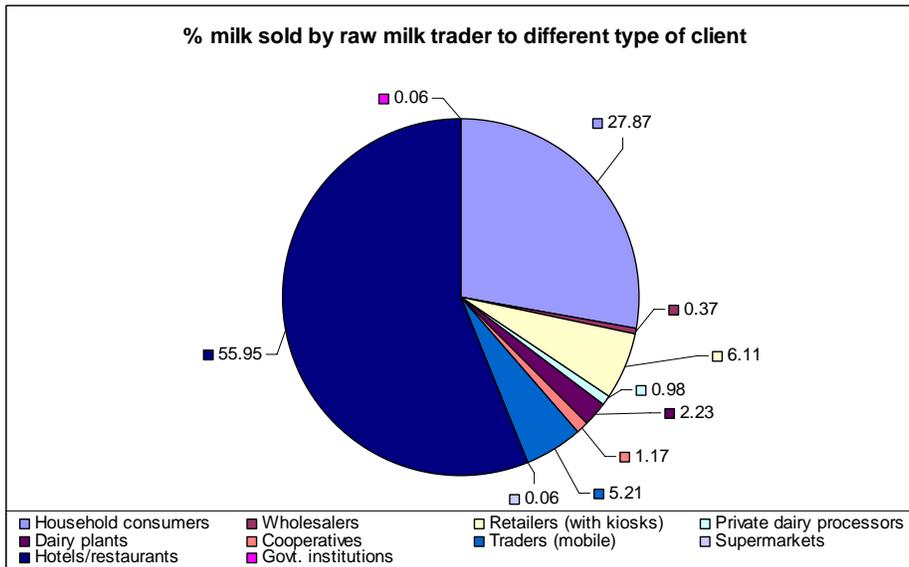


Figure 14: Proportion of milk sold by raw milk traders to different types of clients

Milk prices

The milk procurement prices varied with type of milk market agents and scale of procurement. The price of milk paid by the larger traders (Rs. 14.20/litre) was higher than that paid by small (Rs.13.50/litre) and medium (Rs.13.60/litre) traders. Large milk traders

were able to offer higher prices to their suppliers and maximize total profit by handling larger quantities of milk thereby fetching higher prices from customers and reducing the cost per unit of milk handled. The different markets were relatively integrated as the variation in purchase or sale price was not very large. The price differences with scale, however, point to potential incentives to scaling up and returns to those traders who have access to the capital required to do that. Again, this points to the fact that capital is a constraint to scaling up in the local dairy industry.

Nature and scope of contracts

The terms and conditions for purchase and sale of milk were generally observed to be informal and largely relying on mutual trust. For instance in Kamrup, dairy farmers' associations negotiate prices with traders' associations and the same has to be followed by the member farmers. The mechanism of price determination is flexible so that agreed prices often change. Milk market agents rarely enter into any form of written contract or agreement for the quantity, quality or price of milk procured. The common quality control measures reported by traders were visual inspection and use of lactometer and centrifuges. However, more than one-third of the milk traders did not adopt any quality control measures and relied on mutual trust. Few traders provided services and inputs such as veterinary medicines or cattle feed to producers but 55% of the market agents reported advancing cash to their suppliers without interest to assure future milk supply. Again, this points to the capital needs for larger scale operations, in this case working capital, which can be redressed by providing credit to suppliers.

Processing of milk products

The various types of milk products processed by traditional milk market agents in Assam were sweets, cream, *paneer*, *channa* and other minor products. The volume and frequency of processing a specific milk product depended on demand for the product. Processing of milk products was done in a processing centre in the trading premise or at a simple processing facility at the residence of the agent depending upon the volume of business. On average, up to 60 litres of milk was processed per day. Sixty one percent of milk was processed into milk sweets, 15% into cream, 9% into *paneer* and 9% into *channa*. The rest of the milk was used for to prepare ghee and cultured milk.

Training in milk handling and processing of milk and milk products

Nearly 99% of the respondents started their enterprise without any kind of formal training; many learned from other family members or while working in a milk processing shop before starting their own shops. This, however, leaves some scope for training interventions aimed at increasing the efficiency of these agents and improving the quality of milk they sell because the quality and hygiene of most products were below standard. Interventions to train small-scale milk traders in other countries and regions have been demonstrated to lead to improvements in quality and consumer satisfaction.

Adulteration of milk and other processed milk products

There were instances of widespread adulteration of milk by traders. These were higher among raw milk traders (36% of cases). Water was the most common adulterant of milk and a few traders also conceded to adding skim milk powder to raw milk. The magnitude of adulteration with water varied from 10 to 50% of the volume of the milk. The most common reason for adulteration was to take advantage of increased prices resulting from the demand-supply gap in milk and milk products.

Costs and returns in milk marketing

The returns from milk and dairy product trading (either fresh or processed) appeared to be high in comparison to the available alternatives. On average, the surveyed milk traders earned a profit of Rs. 259 per day that varied across districts and scale of business (Figure 15). The returns per unit of milk handled from fresh milk trade were significantly lower than those from value-added traditional products (Figures 16 and 17). But value-addition requires a higher capital investment and it has its inherent risks. In raw milk trading, small traders turned out to be the most efficient in terms of profit per unit output but their household income was meagre because of the small scale of business. Scaling up of their businesses would be helpful in improving their incomes. The margins in fresh or raw milk trading depended on several factors, e.g. volume of business, distance, level of infrastructure, urbanization, availability of milk with respect to demand, and purchasing power, tastes and preferences of consumers. As these parameters changed across different locations, the net return received by milk market agents also exhibited considerable spatial variations. However, milk processing seems to be scale-efficient in favour of larger units.

This may be partly attributed to the economies of scale in using fixed resources and efficient utilization of time and labour in bigger units.

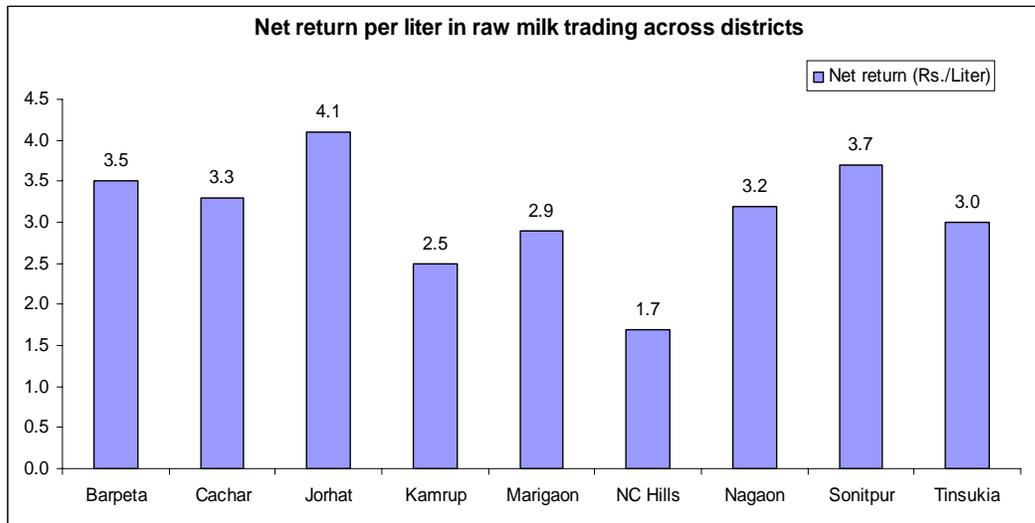


Figure 15: Net return per litre in raw milk trading across districts

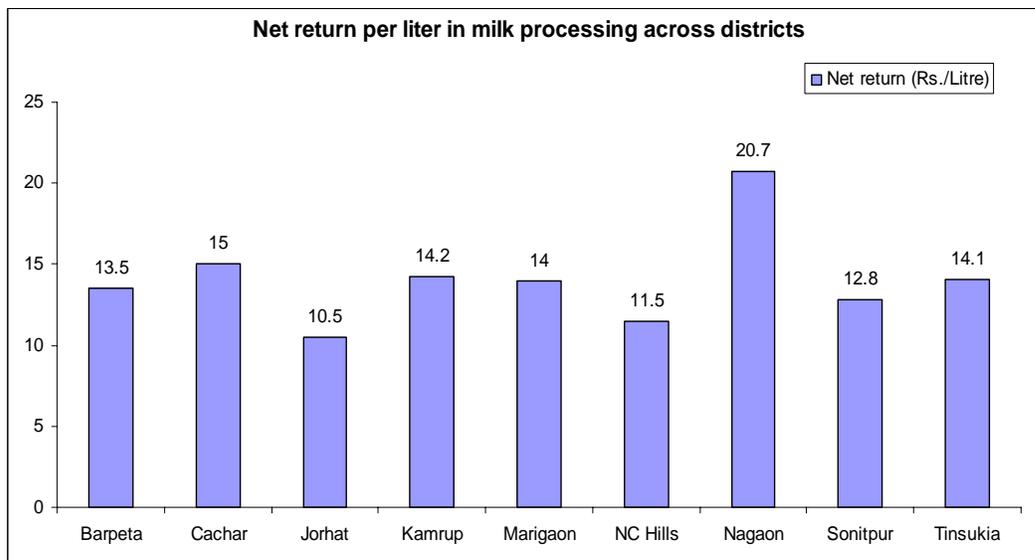


Figure 16: Net return per litre in traditional milk processing across districts

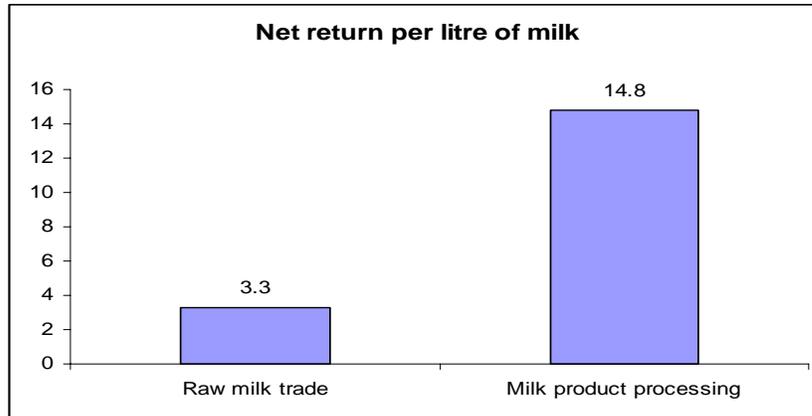


Figure 17: Average net return per litre of milk in raw milk trade and milk product processing

The formal dairy processing units have not made a significant impact on the marketing of milk and milk products, despite several attempts by the state government. The dependence of consumers on the informal sector is likely to continue for the foreseeable future because of several factors such as tastes/preferences, costs and prices. However, the consumer awareness regarding milk quality and safety is increasing. Therefore, quality assurance measures through branding/labelling, licensing, regulation and monitoring need to be considered to link these traditional milk market agents with their formal market counterparts. Such an approach would enhance the credibility of the milk market agents by assuring the quality of milk and milk products and also dispel the generally perceived notion that they are exploiters of the dairy farmers and bad business practitioners.

Marketing through the formal milk sector

Since 1963, eight dairy processing plants have been established in different parts of Assam with a total installed capacity of 109,000 litres of milk per day. Of these processing plants, seven are functional, though not to full capacity. Two more plants with a combined installed capacity of 55,000 litres per day are currently under construction. Additionally, 15 chilling plants with total installed capacity of over 30,000 litres per day have been established but nearly all of them are presently non-functional. Three more are under construction.

Among the functional processing plants, capacity utilization varies from four to 34% and there is a long-term decline in overall capacity utilization. Moreover, there are significant

losses due to handling and curdling (2–8%) and losses of fat and solids-not-fat (SNF). Market returns of packaged products range from 10-27%. All these lead to high costs per unit output, low labour productivity and large overall losses that are subsidized by the government. Reasons for this poor performance include low and inflexible procurement price, lack of adequate collection points and facilities, delayed payments to suppliers leading to inadequate supplies of raw materials, lack of a strategy for procurement and marketing, inappropriate location of plants, establishment of plants without proper economic analysis, poor skills and human resource capacity, lack of product innovation and diversification, and administrative rigidities in running the system.

Any plan to continue operation of these plants or establish new plants under any kind of reorganized ownership and management (private, public-private partnership or cooperative) needs to address these issues. The plan should also (a) take stock of the demand for products that has emerged from this study (types of products, volumes, locations, price and income elasticity of products being offered, local vs. imported products), (b) take stock of the key supply areas identified in this study and their proximity to demand areas, (c) consider alternative low-cost and reliable institutional and infrastructure arrangements for collection, (d) consider economic feasibility analysis (private profitability over time, pay back period, subsidy requirements, alternative sources of investment capital), (e) encompass a business and management plan to run the entire system not just the plants, and (f) focus on maintaining high and reliable quality of products delivered to consumers.

The unreliable quality of locally processed, pasteurized milk may be one of the key barriers to development of the formal dairy industry in Assam. The existing plants may be ranked on the basis of such analysis and those found unviable may be considered as sunk cost and shut down altogether. Alternatively, they may be relocated to more suitable locations if feasible, or new ones if appropriate.

Implications of the study highlights

The market study highlights point to the following implications that are directly relevant to the action plan:

- The study has confirmed the predominance of traditional market agents in Assam. They form the key link between local milk producers and consumers and focus nearly exclusively on local milk products. Any dairy development plan to address the needs of the producers, market agents and consumers should fully address the traditional sector, particularly if the aim is to increase the share of demand that is supplied by local production as opposed to imports from other states and regions.
- Most traditional traders operate on a small scale (handling less than 60 litres per day), have been in business for an average of 12 years and rely solely on their dairy market activities for income. This implies important small-scale employment opportunities along the dairy value chain, again indicating that dairy development activities can be highly pro-poor if they focus on small-scale traditional agents.
- Very few traditional milk market agents have received any type of training; poor hygiene and milk adulteration are commonly encountered in the informal milk market. Training of milk market agents in proper hygiene, milk quality and best business practices should be an essential part of a dairy development plan, to be linked with a branding system that would be easily recognized by the consumers.
- Average returns to labour in raw milk trading are 3.3 Rs. per litre of raw milk and 14 Rs. per litre of milk in traditional processing (sweets, *channa*, etc.). This implies strong value addition in traditional processing. However, there are barriers to entry into the local traditional processing business due to low education and poor access to credit. Access to formal micro- or small-scale credit may alleviate this problem.

Highlights of milk quality analysis

A cross-sectional survey covered six administrative areas (wards) in Guwahati and three types of milk vendor (shops, distribution point and traders). The third type of milk vendor was represented by milk obtained from a household that just purchased from a trader. A total of 345 samples were analyzed; 202 in Guwahati and 143 in Jorhat. Importantly and unusually for such type of analysis, this study used a sampling frame and a stratified, randomized design. Hence, the results can be confidently generalized to the population of interest (Guwahati and Jorhat).

Milk quality results

Most milk (both raw and pasteurized) did not meet standards. Compliance with local standards was low for all samples but generally higher for treated (pasteurized and UHT) milk than raw milk. However, a higher proportion of raw milk samples had acceptable total plate counts than UHT or pasteurized milk samples (Figure 18). The standard for treated milk is considerably higher. All differences between raw and treated milk were significant. None of the milk samples, including those of very poor bacteriological quality, had visible or olfactory abnormalities.

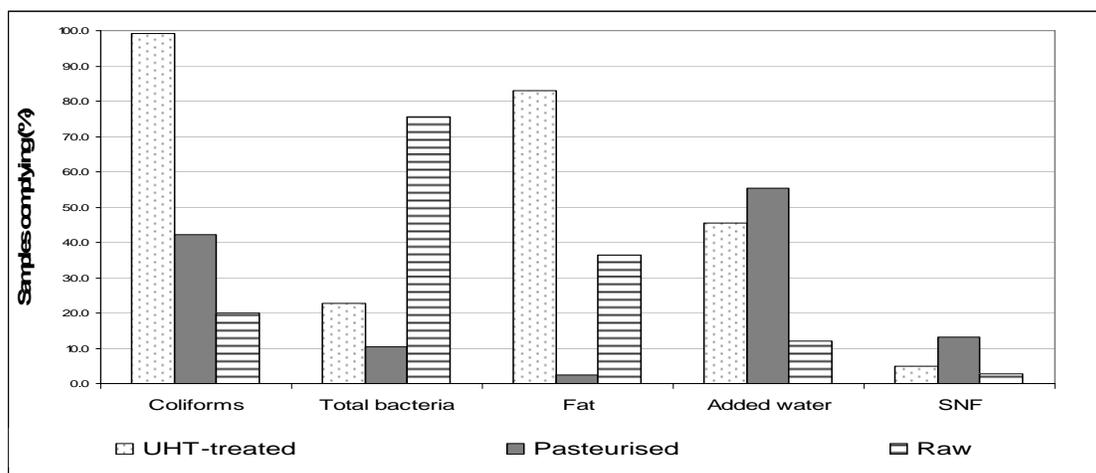


Figure 18: Percentage of milk samples meeting local standards

Results presented in Table 1 show that raw milk had substantially more added water while UHT milk had higher bacteriological quality (because of the method of processing) and higher fat (presumably because it originates from states with a higher proportion of dairy buffaloes). Milk from Jorhat tended to be of higher quality than milk from Guwahati, but only the differences in fat and total bacteria were significant.

Table 1: Median physical and bacteriological quality parameters for raw and pasteurized milk

Type	Fat (%)	SNF (%)	Added water (%)	Total bacteria (log)	Total coliforms (log)
UHT milk	3.6	7.9	6.0	3.5	0.0
Pasteurized	3.0	8.0	4.0	5.5	3.5
Raw	3.1	6.6	20.5	6.1	4.1

Associations between quality and sales point

- There was significantly more added water, less SNF and higher total plate count (TPC) in milk delivered by vendors to consumers (hawked milk) compared to milk bought at distribution points. This indicates adulteration by hawkers.
- Milk sold from an insulated van was sold at a premium price compared to milk from the same dairy sold from a pickup: presumably customers had more confidence in its quality. Surprisingly, it was actually of poorer bacteriological quality (Table 2), indicating a perception-reality gap.
- Milk from local dairies (n=30) contained significantly less fat and significantly higher levels of total bacteria and coliforms than milk from dairies outside Assam (n=134); other differences were not significant.
- However, if we consider only those dairies that produce pasteurized milk, then milk from local dairies had substantially better bacteriological quality than the pasteurized milk from the dairy outside Assam (a mean of 1.1 million bacteria and 47,000 coliforms per ml, versus 16.2 million bacteria and 805,000 coliforms per ml).
- Among local dairies, there was considerable variation in adulteration with water (from 2 to 20%). Bacteriological quality was high in one of the four dairies producing pasteurized milk. In the other three it was moderate to poor and not substantially different from the dairies producing packed but unpasteurized milk.

Table 2: Comparing quality of milk sold from an insulated van and an open vehicle at the same dairy

	Total bacteria	Total coliforms	Added water
Insulated van	2,494,00	5300	14.5%
Pickup	159,000	3,540	14.1%

Exploring the causes of poor quality

- There was a strong statistical association between added water and SNF indicating that adulteration with water rather than powdered milk or sugar/salt solutions (Figure 19).
- In terms of correlation between total bacteria and coliforms, two broad groupings are discernible: samples with good correlation and those with no correlation. This suggests distinct populations (one in which faecal contamination and poor hygiene/storage are related and another in which they are independent problems), and hence different strategies needed to address the problem.
- The weak association between added water and bacterial counts suggests that adulteration with water is not a major factor in poor bacteriological quality. The similar pattern for the association of added water with both total bacteria and coliforms suggests added water is not contaminated by sewage (coliforms are more strongly associated with faecal contamination than is total bacteria count).

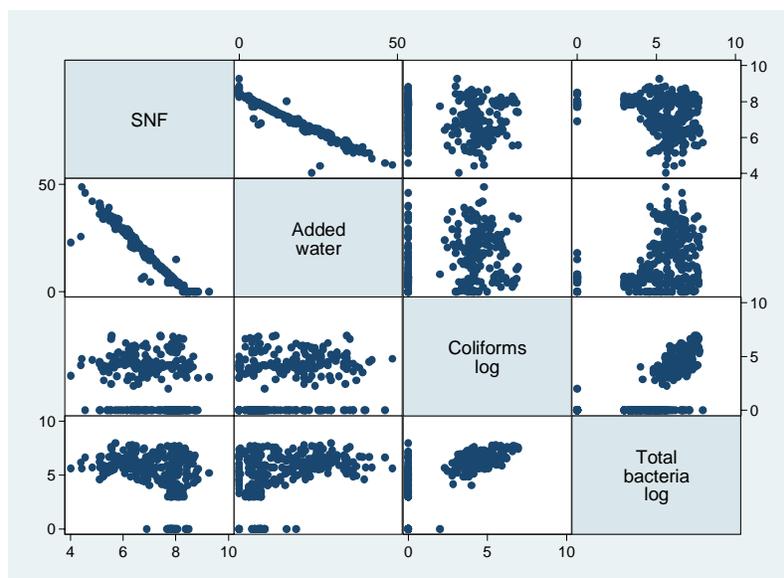


Figure 19: Associations between quality aspects in raw and pasteurized milk

Summary of key findings on milk quality analysis

- All raw, pasteurized and UHT milk samples were unsatisfactory, according to the relevant standards for composition and bacteriological quality.
- Organoleptic properties of milk (clots, colour and smell) were not a good indicator of quality.
- Perceptions that certain products are of higher quality may not be correct.
- There is wide variation in the quality of pasteurized milk from different dairies.

Raw milk pathways in Guwahati and Jorhat, Assam

Introduction

We constructed “farm to fork” pathways for the flow of milk from cow to consumer (Figure 20). This allows a better understanding of where risk from milk hazards originates and how it is amplified or mitigated, as well as identification of critical control points (steps at which action can be taken to prevent or eliminate a food safety hazard or to reduce it to an acceptable level).¹

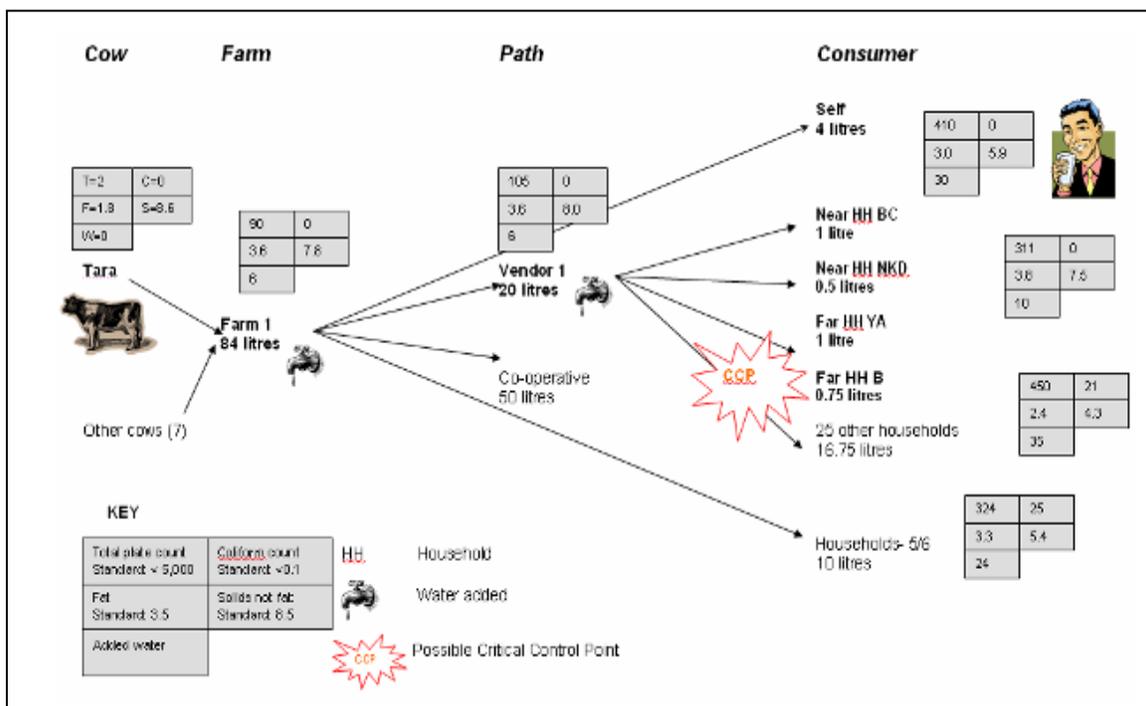


Figure 20: Example of a milk pathway

Pathway structure

Most pathways are short and the predominant model was found to be farmer-vendor-consumer. The private informal, traditional sector models predominate, but two other chains were included in the analysis: dairy co-operatives and “Gosala” (a system in which several hundred cows are housed together and the milk sold directly to consumers without an intermediary). As was demonstrated in the market analysis, there is a high level of

¹ Pathway analysis is also the basis of a risk analysis or quantitative estimate (with range of uncertainty) of the likelihood and type of harm to human health caused by drinking raw milk, which will be presented in the final project report.

diversity. Farmers may market their own or other farmers' milk to a combination of traders, vendors, co-operatives or direct to households. They may also sell milk indirectly via a hired intermediary or consume own-farm milk. Traders may sell to other traders, hotels, sweetshops or households as well as consume their own purchased milk.

Quality of milk at point of consumption

- All raw milk was of acceptable overall bacteriological quality (total plate counts) at the point of consumption. The majority of samples (75%) were of good or excellent quality.
- Coliform quality was not good: only half the samples were of acceptable quality in this regard.
- Nearly all milk had some additional water at the point of consumption and in more than half the chains, the amount was sufficiently high to indicate deliberate addition (>10%).
- The only two path structures without water adulteration were the "Gosala" and the milk co-operative model. The incentives they use to prevent adulteration may be transferable.

Good and bad practices along the raw milk path

A checklist of 30 simple and important farm hygiene practices was administered. Only one farm performed acceptably. Some of the most problematic practices were:

- Using the same container for milk fit and unfit for human consumption: 92% of farms
- Dirty milk storage area: 83% of farms
- Improper disposal of manure: 75% of farms
- Teats and udders of cattle soiled with faecal material: 67% of farms

However, some good practices were widely used, namely,

- Washing hands before milking: 92% of farmers
- Discarding milk unfit for human consumption: 75% of farms

Other good practices were used by a minority, suggesting that farmer-to-farmer extension may be a helpful approach in driving up standards:

- Washing hands between milking: 8% of farms
- Sieving milk to remove gross contamination: 8% of farms

Questionnaires administered at each step along the raw milk chain similarly identified a mixture of good and bad practices (Table 3).

Table 3: Positive and negative food safety practices

	Transporters	Vendors	Customers
Good	Aluminium containers: 100% Wash with soap: 100%	Time from pick-up to distribution < 4 hrs: 64%	Boil milk: 100%
Bad	Milk uncovered: 50% Dirty milk storage area : 50%	Adulterate with water: 73% Possibility of cross-contamination: 100%	Store milk without refrigeration: 29%



Figure 21: Bad practice (improper manure disposal)



Figure 22: Good practice (sieving milk)

The worst offenders

The milk pathways analysis showed that consumer concerns about food safety, raised by other actors in the milk pathways, seem justified. Consumers scored higher than all other actors on milk-handling hygiene (Figure 23). The scores were based on 12 indicators. However, even consumers need to improve their practices: the ideal safe-handling score is 100% while the average consumer score was 57%.

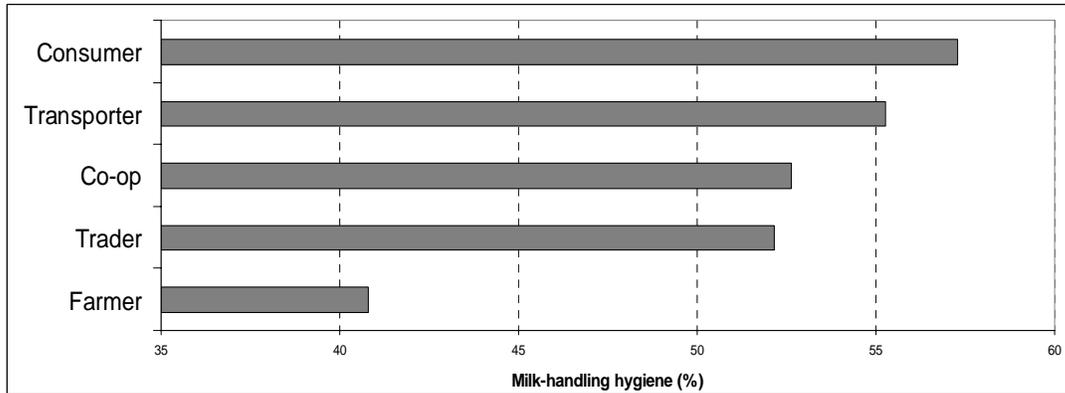


Figure 23: Mean hygiene scores of different actors (n=75)

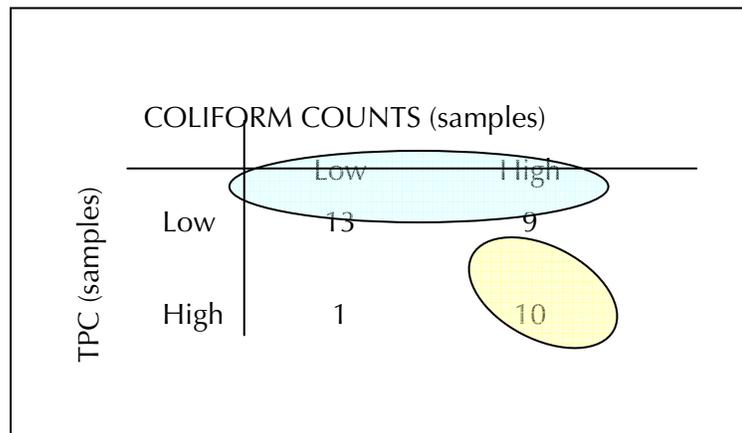


Figure 24: Samples with coliform quality problems fall into two categories

Critical control points for the raw milk pathway

In the case of coliform quality, the main risk amplification step was between the last vendor and the consumer. This may be a critical control point that requires attention. When comparing coliforms and total bacteria counts, two patterns are seen: (a) coliforms

with low TPC and (b) high coliforms with high TPC (this was also seen in the cross-sectional survey). This suggests two different types of problems, firstly a problem with post-farm contamination (66% of cases) and secondly excessive storage and/or gross contamination (30% of cases).

Again, the main point of water adulteration was the step immediately preceding the consumer. Nearly half (46%) of farmers and intermediaries reported adding water to milk, suggesting it is a socially acceptable practice. More investigation is needed of the motivations for, and risks of, water adulteration.

Milk sweet pathway

The process of sweet-making was analyzed in ten shops, five each in Guwahati and Jorhat. A flow chart was constructed of the movement of milk from entry into the shop to finished product. Raw milk and sweets were sampled at the start of display, half way through display and at the end, and checked for total bacteria, coliforms and *Listeria monocytogenes*, an emerging and important pathogen often associated with dairy products.

Change in bacterial quality along the milk sweet pathway

One-third of sweet samples met national quality standards and half – though sub-standard – were of reasonable quality². The remaining 13% were poor. *L. monocytogenes* was not found in any samples. In all cases, bacteria count declined as a result of processing and then increased again with storage time (Figure 25) indicating that storage is a critical control point (CCP) for milk sweets. Samples from Jorhat were of significantly higher quality than Guwahati (67% meeting standards versus 0%; $p < 0.000$ Chi 2).

² Both in absolute terms and compared to other surveys of milk sweets in India

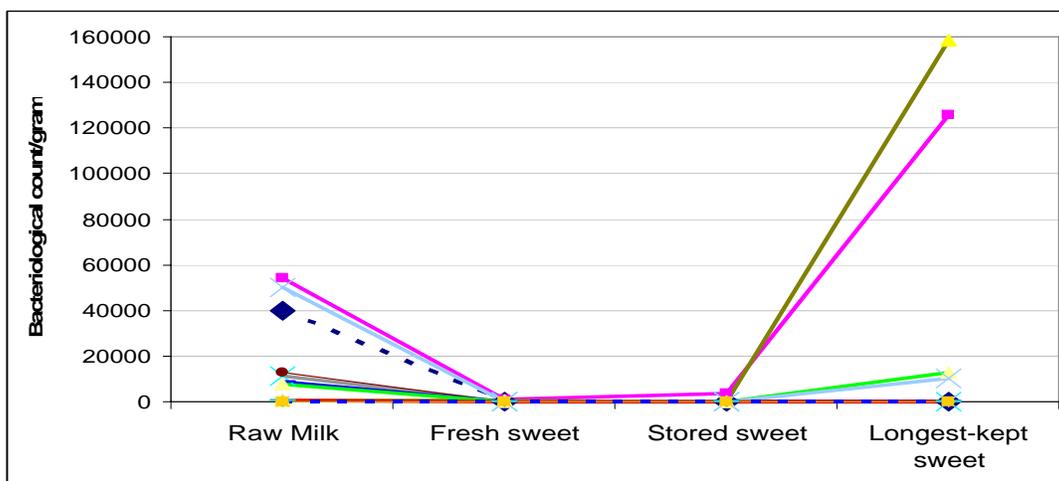


Figure 25: Change in bacterial counts of milk sweets during processing and storage

Influence of food-handler practice on quality of sweets

An extensive basic hygiene check list was also carried out among sweet shops. The average score was 37% indicating considerable need for improvement. Shops which produced sweets of good or moderate quality had a median score of 42% while those producing sweets of poor quality scored 20%; the difference was highly significant, despite the small sample size (10 shops), indicating a powerful influence of hygienic practice on safety of milk sweets.

Comparing shops with good food safety outcomes and those with poor results showed greatest difference in the areas of selling area hygiene, ingredient storage, cold storage and cleaning regime, suggesting efforts to improve sweet safety should focus on these CCPs (Figure 26).

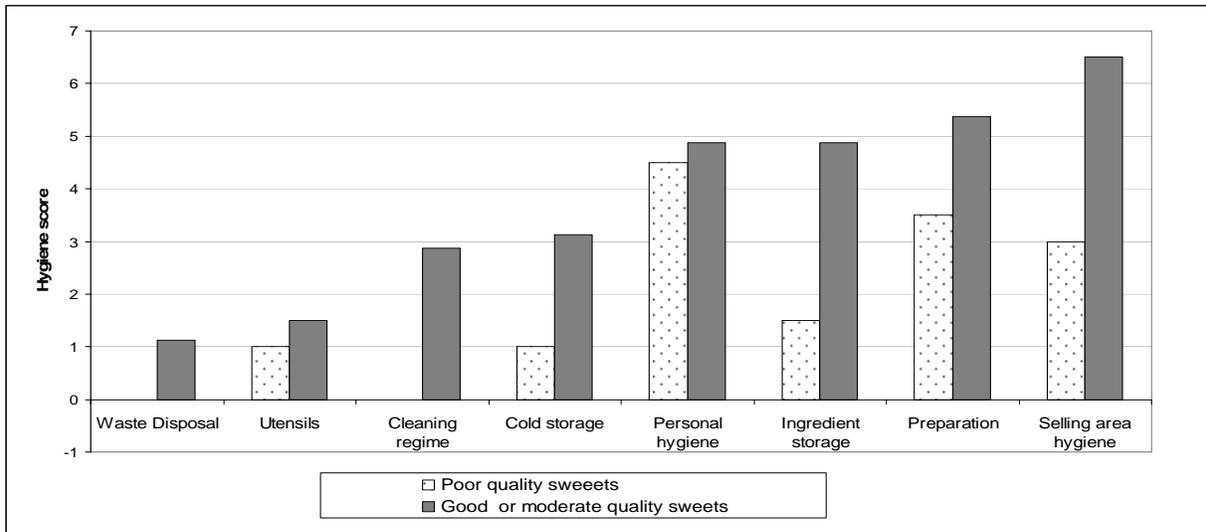


Figure 26: Differences in hygiene practices between shops producing safe and unsafe sweets

Summary of key findings on raw milk pathways

- Short pathways predominate for raw milk, reducing risk to the consumer.
- At the point of consumption, all raw milk was of acceptable overall bacteriological quality.
- Most raw milk samples were adulterated with water and only half of the samples had acceptable coliform counts.
- Hygienic milk handling was highest among consumers, intermediate among traders and vendors and lowest at farm level.
- Quality of milk sweets was generally good to moderate; *Listeria monocytogenes*, a major milk-borne pathogen, is not a problem in milk sweets.
- Transforming raw milk to sweets is strongly risk mitigating: the end product (sweets) is safer than the initial (raw milk).
- Despite the reduction in bacteria associated with processing, only one-third of sweets sampled met national quality standards.
- Good hygienic practice is a powerful predictor of higher milk–sweet safety.
- A preliminary investigation of good and bad practices and critical control points (CCPs) in dairy hygiene, raw milk handling and sweet-making can form the basis of interventions to improve quality and safety of raw milk and milk sweets.

Ability of consumers to judge milk quality

We evaluated one important aspect of milk quality: adulteration. Panel tests were carried out in Jorhat and Guwahati, in which consumers (n=150) blindly assessed milk adulterated with water, sugar solution and reconstituted milk powder at different levels (5%, 10%, 20% and 30%).

Consumers were unable to detect adulteration

Overall, consumers' ability to detect adulteration was not significantly different from chance, i.e. consumers were unable to detect adulterated milk. Receiver operating characteristic curve (ROC)³ analysis, showed an area under the curve (AUC) of 0.52 (95% CI, 0.49-0.54) which was not significantly different from random chance.

Consumers' ability to detect substantial adulteration (milk comprising 20% and 30% adulterant) was slightly better than random chance but still very poor. Although not significantly different from chance, consumers tended to be best at detecting adulteration with water, followed by sugar solution and powdered milk. However, these differences were not statistically significant. In the case of substantially adulterated milk, consumers had no ability to detect adulteration with re-constituted milk, extremely poor ability to detect adulteration with sugar solution and very poor ability to detect adulteration with water. The difference in ability to detect adulterants was significant.

Consumers were poor judges of their own ability to detect adulteration

Most consumers considered they were average (55%) or good (34%) judges of milk. Only 4% considered themselves excellent and 7% poor judges. Those who considered themselves good or excellent judges consumed significantly more milk than (2.4 versus 1.7 litres, respectively). However, there was no significant association between participants' estimation of their ability to detect adulteration milk and their actual ability to do so ($p=0.785$, chi square). Figure 28 shows that most consumers in each self-assigned category were no better than random chance in their ability to detect adulterated milk.

³ Receiver operating characteristic curves are a standard way of evaluating diagnostic ability, which incorporates sensitivity (proportion of true positives) and specificity (proportion of true negatives). An AUC of 0.5 implies the test has no discriminatory power, while (by convention), an AUC of 0.6-0.7 is considered poor, 0.7-0.8 acceptable/fair, 0.8-0.9 excellent/good and >0.9 outstanding.

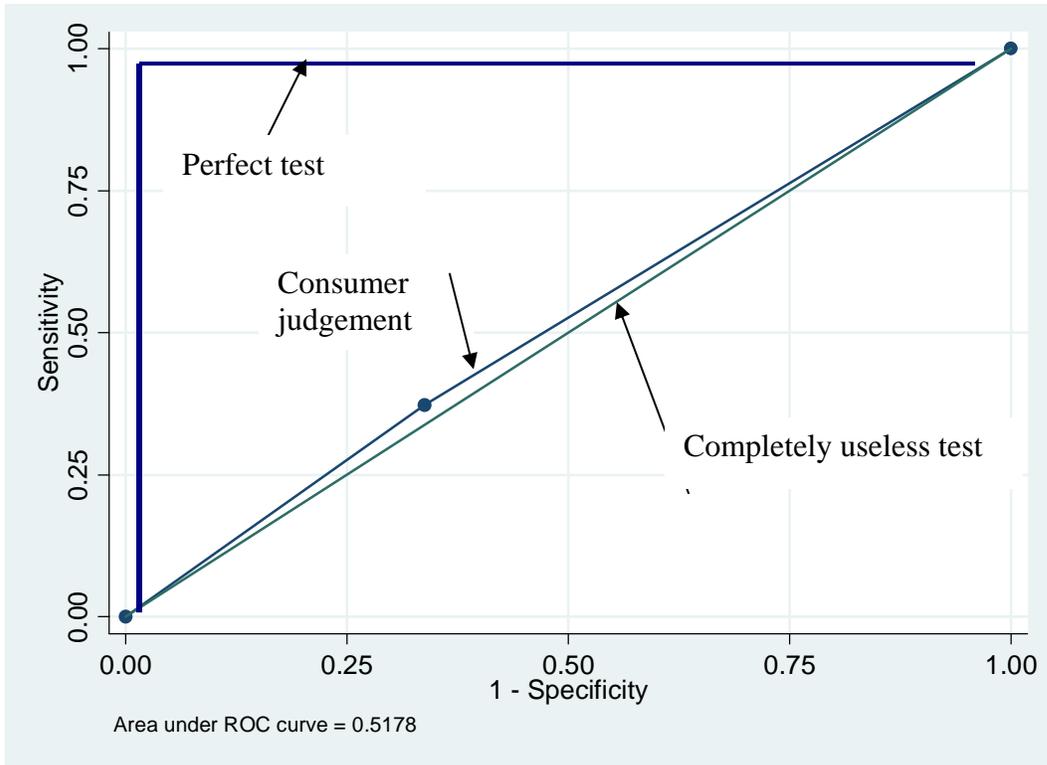


Figure 27: Ability of consumers to judge adulterated milk

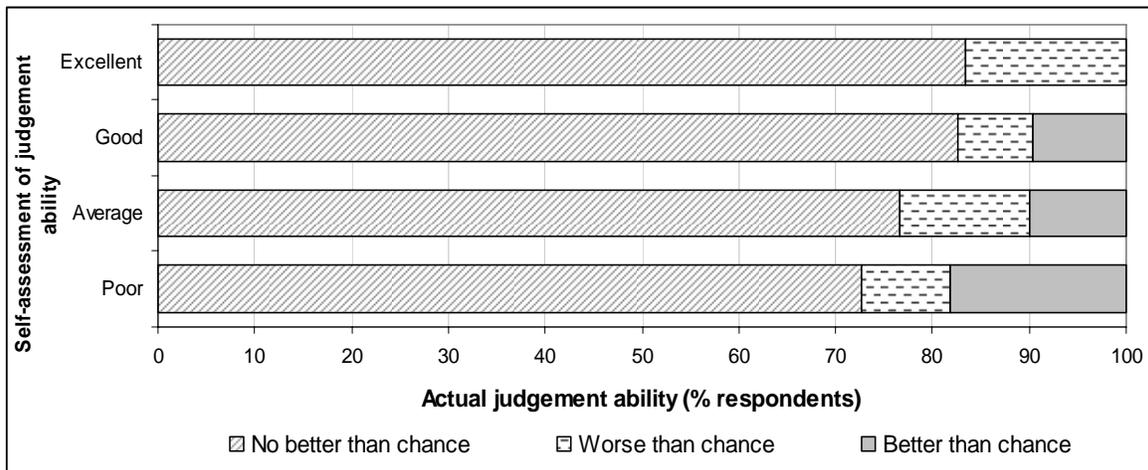


Figure 28: Consumers' actual ability to judge milk compared with self assessments

Factors associated with ability to detect adulteration

There was a small positive correlation between consumption of milk and ability to detect adulteration (0.13).

- Consumers in the age category 41-50 were significantly better at detecting adulteration⁴.
- Differences between test sites, social category and sexes were all small and non-significant.

Why consumers are such poor judges of adulteration and what this implies

Marketed milk has high levels of adulteration – the sample analysis showed that local raw milk contains on average 20% water, with some samples as much as 53%.

- Consumers rarely drink raw milk (since they generally boil it first) and hence are not used to judging its organoleptic characteristics.
- The divergence between consumers' real and perceived ability to judge milk quality has adverse consequences:
 - Health risk: consumers expose themselves to risk because they are unable to judge quality.
 - Lemons market: superior products are unable to signal their higher quality and increase market share.
 - False signalling: consumers may prefer products which they associate with higher quality (packaged milk, milk from an insulated van) although these may be of no better or even worse quality than raw milk.

Summary of key findings on consumer quality perception

- Consumers are very poor judges of milk adulteration.
- Consumers over-estimate their ability to detect adulteration.
- Consumers have little insight into their own ability to detect adulteration.

Key action-oriented implications of the milk quality study

- Consumer concerns over the quality of milk and milk sweets are justified. The majority of samples do not meet bacteriological standards implying a potential risk to human

⁴ Given this was a fishing expedition (there was no a priori hypothesis concerning age and judgement ability and multiple comparisons were made), the finding may be spurious.

health, unless consumers further process the milk before consumption. However, this study looked at general bacteriological quality rather than specific pathogens.

- Action 1: Further studies are needed to identify and quantify specific risks to human health and hence better target interventions. This can be done through risk assessment adapted to the context of developing countries, i.e. “participatory risk assessment”.
- Action 2: There is already enough evidence to warrant interventions to improve milk quality. These should address both the raw and pasteurized milk sectors. In particular, UHT milk (produced elsewhere in India) is generally of much higher quality than local pasteurized milk. Development of demand for locally-processed milk will depend heavily on the quality of local formal processing.
- The high level of coliform bacteria in both pasteurized and raw milk as well as milk sweets is worrying. Coliform bacteria are found only in the intestines of man and animals and their presence indicates faecal contamination. Not only can some coliforms cause serious and sometimes fatal disease, their presence is an indicator of the many human and zoonotic pathogens spread via the faecal-oral route (bacteria, viruses, intestinal parasites etc.).
 - Action: Further bacteriological testing is needed to identify the origin of coliforms (human or animal) and identify critical control points for coliforms.
- Pathway analysis suggested that problems of raw milk quality could be attributed to two main causes: poor hygiene along the chain and delays between production and consumption.
 - Action: Interventions and training packages should address both hygiene and distribution systems.
- Adulteration with milk is widespread and appears to be the standard among some actors. Some pathways are free of adulteration, but not the predominant private sector model. However, adulteration with water does not seem to represent a major health risk in terms of adding bacteria.

- Consumers are very poor judges of adulteration and have unfounded confidence in their ability to judge milk quality, creating a market failure in the provision of pure milk. The same applies to bacteriological quality, which was often poor, but indiscernible to consumers. Customer willingness to pay for quality is obviously contingent on ability to detect quality. Some systems seem to be better at self-regulation (e.g. co-operative and “Gosala” model) but not the traditional private sector model that predominates.
 - Action 1: Consumers need to be better informed about the quality problems of milk, both raw and pasteurized, and their own lack of ability to assess these.
 - Action 2: Simple tests for quality and institutional mechanisms for their adoption need to be developed and disseminated.

- Manufacture of milk sweets can be an effective way of reducing the risk associated with poor quality raw milk, but only if sweet-shop hygiene is adequate. Quality of milk sweets correlates strongly with hygienic practices. However, this study was small (10 shops) and non-random and looked at only one type of sweet.
 - Action: The study has identified the specific practices that lead to higher quality in milk sweets. The check lists developed for this study are a tool for improving quality and monitoring change. These should be incorporated into training programs specifically aimed at traditional processors and sweetshop keepers.

Highlights of milk production systems in Assam

This section describes the key findings of a comprehensive survey of rural production systems across the eight AACP districts and the North Cachar Hills. The study comprised a random survey of 3,006 rural households in these locations and thus portrays a representative picture of agricultural and livestock systems and their associated livelihoods. Of the households surveyed, 1,910 (64%) kept cattle, 126 (4%) buffalo and 65 (3.4 %) cross-bred cattle. In Assam, cattle are an integral part of the livelihoods of most rural households. There is an emerging dairy industry based on milk produced by low-yielding local (*desi*) cattle and increasingly by high-yielding dairy cross-breeds, which are currently managed by only a few cattle-keeping households. In response to the increasing demand for milk in Assam, expanding the dairy cross-bred herd, improving the productivity of local dairy cows and putting in place good access to input and output markets are the major challenges for sustainable pro-poor dairy development in the state.

Overview of dairy production systems

The majority of agricultural households in the surveyed districts kept cattle. About 82 % of agricultural households in Assam kept cattle (79%) or buffalo (5%) mainly in Cachar and North Cachar Hills districts. Cattle are used traditionally as draught power and this explains the importance of the species in the rural communities, with milk production being supplementary to the provision of draught power. Mixed farming (crops and livestock) is the main form of livelihood in rural Assam. Figure 29 shows the average herd size (in tropical livestock units) by district. Herd sizes are larger in North Cachar Hills, although results for this district should be taken with caution due to the small sample size.

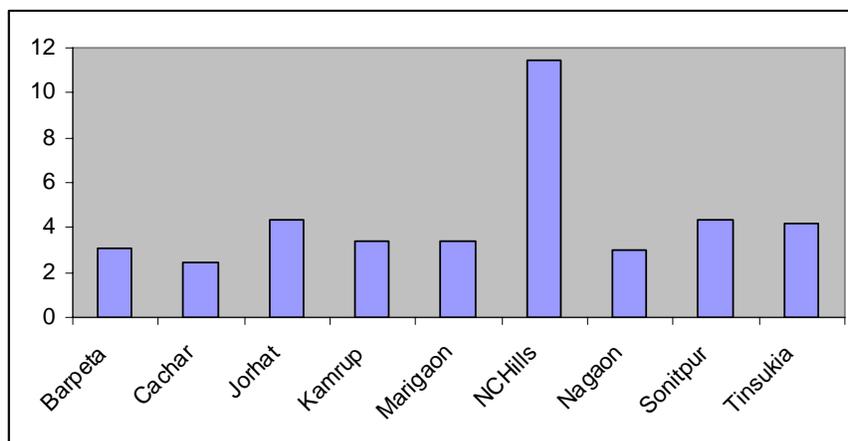


Figure 29: Average herd size (cattle and buffalo) in tropical livestock units (1 local cow=0.7), by district

Milk productivity and production are low

Milk production is low with an average of one litre per day of lactation for local breeds (nondescript cattle), 1.6 litres for buffalo and 3.6 litres for dairy cross-bred cattle. Among the surveyed districts, the average yield per day for local breed cows ranged from 0.8 litres per lactation day in Jorhat district to 1.4 litres in both Barpeta and North Cachar Hills.

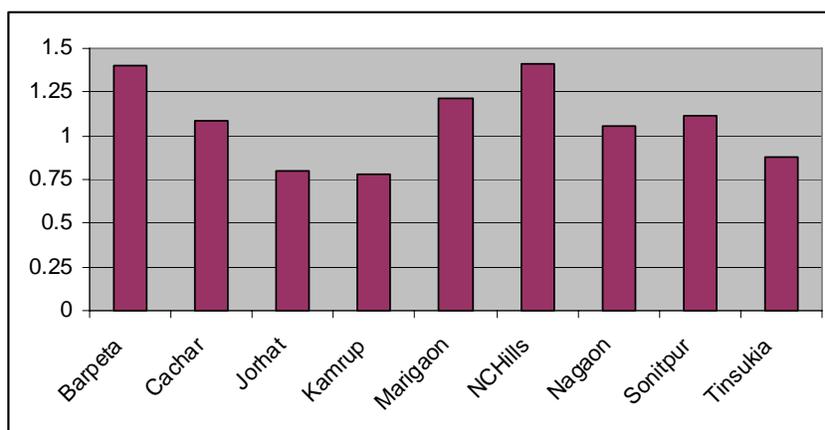


Figure 30: Average milk production (kg per day) for local breed cows, by district

Not only is milk productivity per cow low, but about one quarter of cattle/buffalo owners did not keep any cows. In fact, on average, only one animal in three is a cow. The percentage of cows in total herd (cattle/buffalo TLU) was slightly higher in Cachar and Kamrup districts (40%).

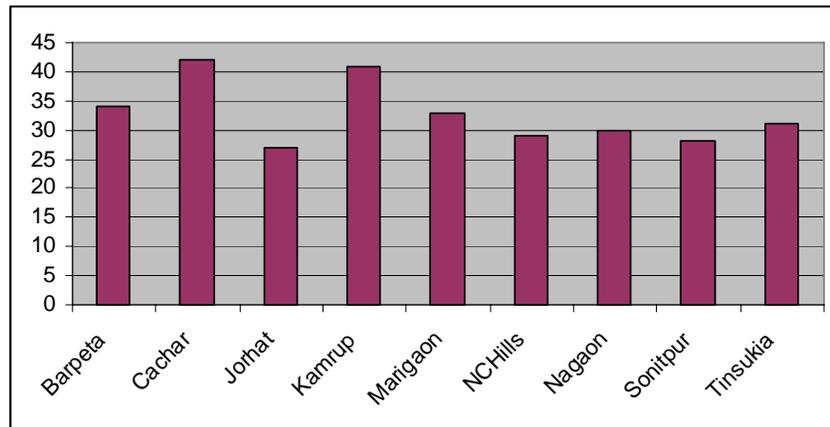


Figure 31: Percentage of cows in the herd, by district

Household average milk production is therefore low, given the low milk yields and the limited number of milking animals kept on farm. On average, households with cattle and buffalo produce 1.9 litres of milk per day. There are important differences between areas, as Figure 32 shows, with relatively high levels near the capital city Guwahati and in the southern parts of the state, i.e. milk clusters with good market access to inputs and for milk marketing is the way forward.

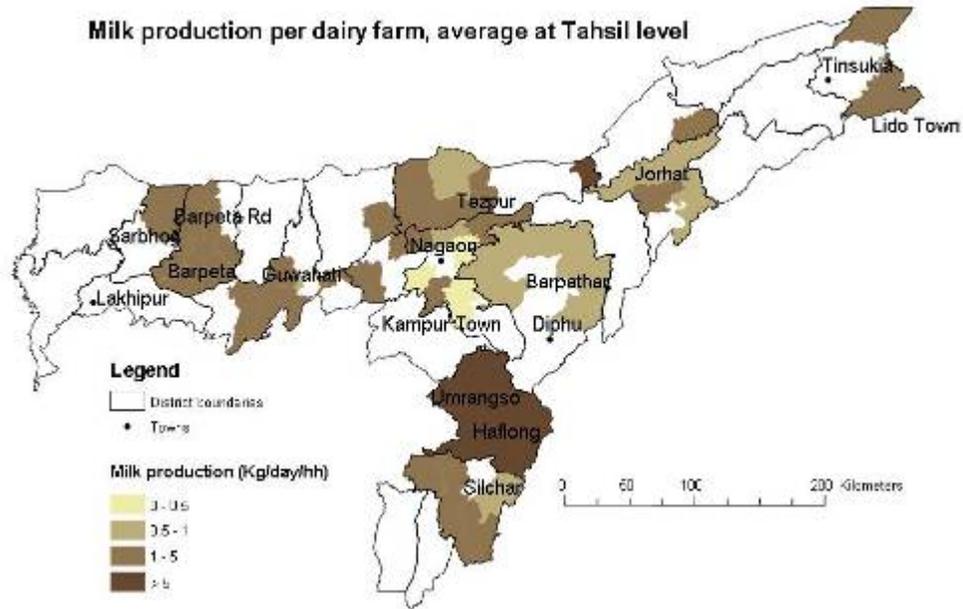
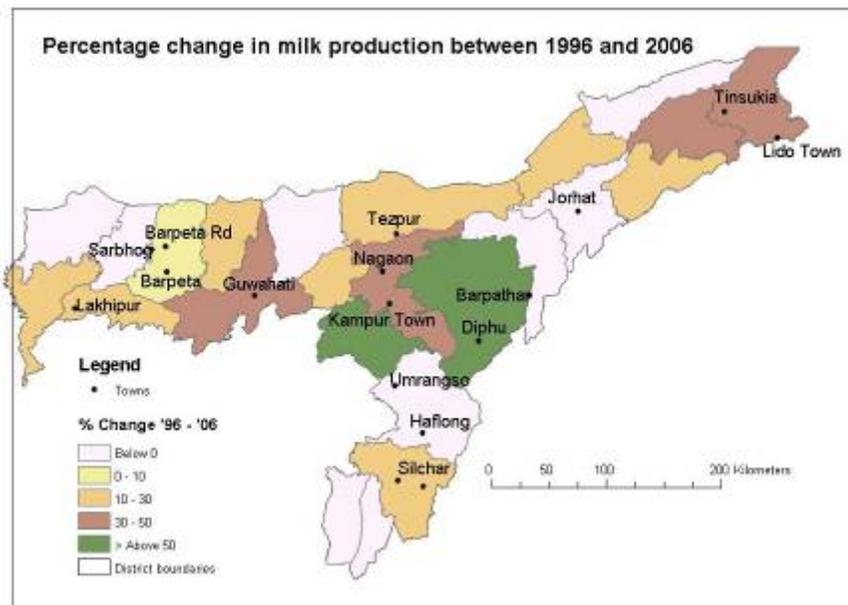


Figure 32: Average household milk production (kg/day/household)



Source: NSSO, Government of India

Figure 33: Percentage change in milk production between 1996 and 2006

Despite low milk production, according to government figures, milk production has increased significantly in percentage terms in some districts of Assam, although from a very low base (Figure 33). In several districts, including Kamrup, growth in milk production between 1996 and 2006 exceeded 30%. While this points to some progress as a result of government interventions to stimulate milk production, it still only represents an annual growth rate of 3.4% annually, and only in selected districts. In other districts, such as Jorhat, there has been no apparent growth at all in that 10-year period. Even in Barpeta, a focus area for public investment in dairy development, there has been only minimal growth, less than 3% over the period.

The key route to achieving high milk production is through crossbreeding. Currently, only about 3.4% of the surveyed cattle owners keep cross-bred cattle, and are located in specific areas as seen in Figure 34. However, even among these cross-bred herds, the average number of cows is only about 1.6. Total milk production per day on these farms is about 7.8 litres (inclusive of milk from local cows), in comparison with an average of 1.7 for households with only local cattle. The average milk productivity of cross-bred cows is 3.5 litres per lactation day (median =3 litres). Further, it is interesting to note that the top 10% producers have daily milk production above 6.5 litres, which is more than six times the daily production of local breed cows. This significantly higher level of production in some cases shows that there is potential to substantially increase milk production in Assam through cross-breeding.

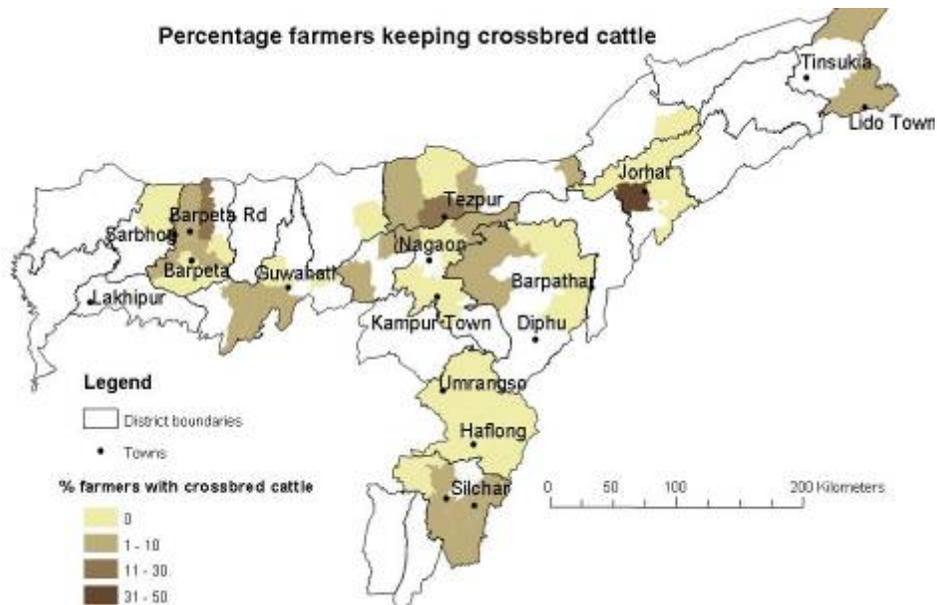


Figure 34: Percentage of farmers keeping cross-bred cattle

One way to better understand the low rate of adoption of cross-bred cows is to compare households who currently have cross-bred cattle with those who do not. Households with cross-bred cattle are older, which may indicate that experience is needed. As expected with a technology that requires some level of expertise, those with cross-bred cattle are slightly more educated; they also have more family members, suggesting that labour availability may be a constraint to the uptake of grade cattle. Also, adopters have better market access (in terms of being closer to urban centres), but distance to the nearest dairy cooperative society does not differ significantly between the two groups of farmers. Less than one percent of the surveyed farmers were member of a dairy cooperative, although farmers can deliver milk to cooperatives, even if they are not members. This result shows that good market access is a key factor for farmers to increase milk production, but it also shows that cooperatives do not create enough incentives to do so. This partly explains the fact that most of the milk does not go through the organized (formal) sector.

Farmers with cross-bred animals had larger land size and a higher percentage lived in permanent houses (68% versus 35%). At this stage, it is not possible to conclude whether farmers who succeeded in acquiring cross-bred animals were able to increase their living conditions through sale of milk; or whether those who are better off are also those able to start cross-bred dairying.

Feeding systems

Most farmers practised extensive grazing as the majority of the farmers either only or mainly grazed cattle. This was particularly the case for local breed cattle where only about 23% of the farmers mainly or only stall-fed their cattle during the rainy season and only 7% did so during the dry season (Figure 35). A higher percentage of farmers stall-feed cross breed cattle: 64% during the dry season and 43% during the rainy season (Figure 36).

Types of feeding systems are good indicators of dairy intensification: in fact, farmers who either mainly or only stall-feed cattle market a higher percentage of their milk (for example 52% for households who stall feed local breed cattle during the rainy season versus 22% for those who practise grazing). Moreover, farmers who stall feed cross-bred cows during the rainy season have higher household milk production (12.8 litres) than those who graze (2.8) and they market a significantly higher percentage of their milk (59% versus 25%).

This suggests that an increase in milk production can be achieved by providing farmers with the appropriate set of technologies, particularly those related to intensification of feeding systems.

The predominance of grazing suggests that currently there is still available land for pasture, giving farmers a variety of options for feeding strategies to suit their resource availability, particularly labour. While the results suggest that grass is often available, farmers report that there is a trend of decreasing availability of quality green grass, a primary fodder, and are substituting straw, which in itself is increasing in price. While grazing and collection of grass remains an important feed resource for many producers, intensification through greater use of specialized fodder production will be necessary for market-oriented producers. Also, only about half of the households regularly fed their cows on concentrates. This may explain the low level of milk production per cow. All cross-bred cattle keepers fed concentrates, while slightly less than half of farmers with local breed cattle fed concentrates.)

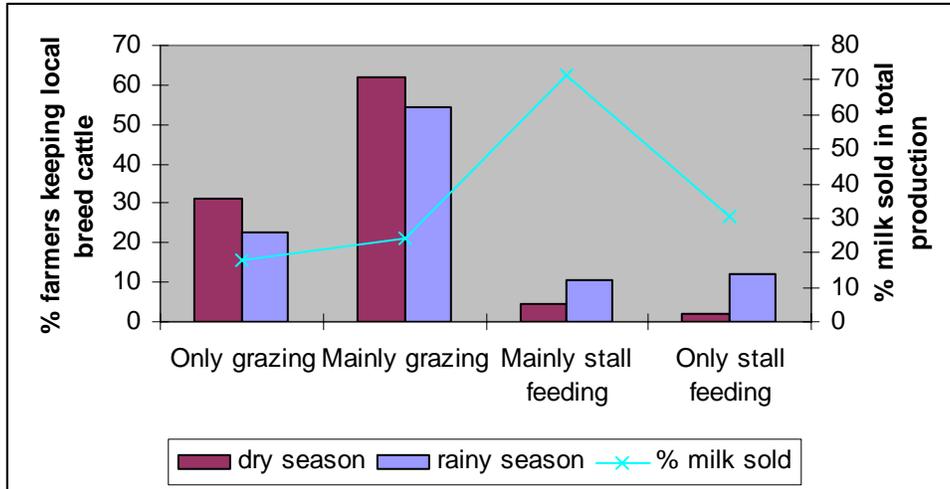


Figure 35: Feeding systems and market orientation for farmers keeping local breed cattle

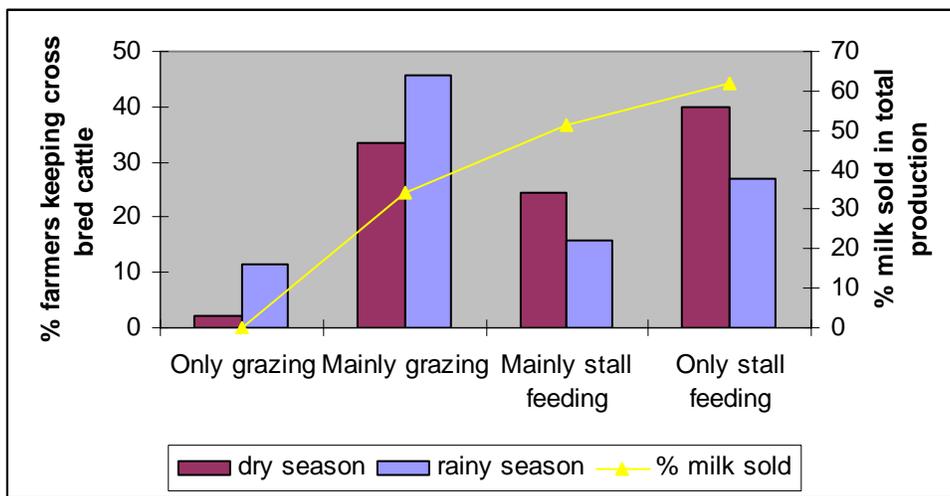


Figure 36: Feeding systems and market orientation for farmers keeping cross-bred cattle

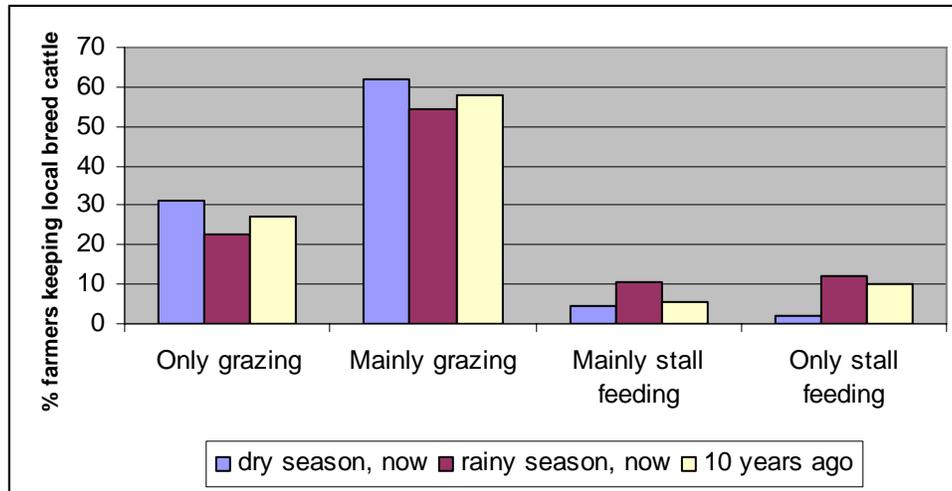


Figure 37: Reported feeding systems now and 10 years ago

As reflected in Figure 37, feeding systems do not appear to be intensifying rapidly, at least among farmers with local cattle (results from farmers with cross-breeds show similar lack of change). In general, farmers report similar strategies of grazing versus stall feeding now as compared to 10 years ago. This suggests that there is little current pressure for increased intensification, but the high level of reliance on grazing also indicates that opportunities for intensification exist.

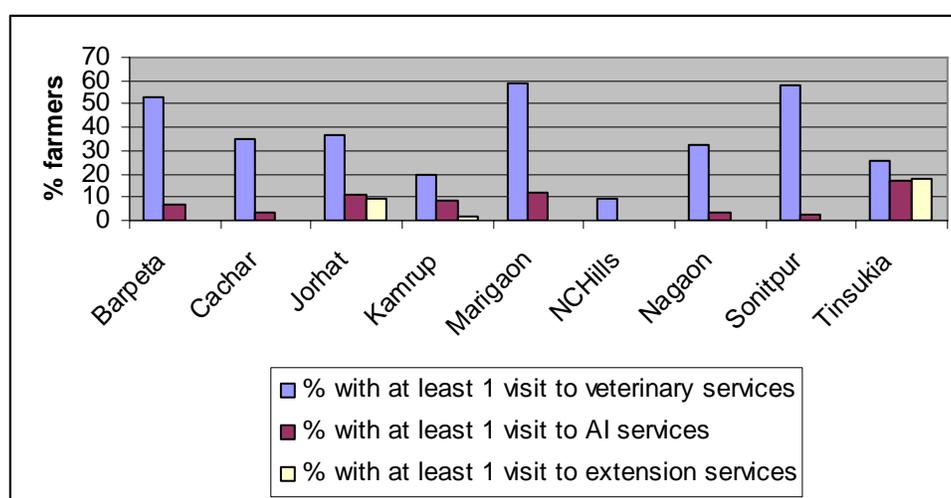
Access to livestock services

Access to livestock services emerged as a major constraint to dairy producers in Assam (Table 4). Although most (60%) of the farmers reported availability of and access to artificial insemination (AI) and veterinary services, only 7% and 38%, respectively, used these services in the 12 months leading up to the survey. Despite the relatively high availability of AI services, only about 11% of the farmers reported having used AI as the source of the last service. There seemed to be greater utilization of available veterinary services, with most of those reporting availability also reporting at least one visit to or by a veterinary officer in the previous 12 months.

Extension services were practically non-existent, with only some 8% of farmers reporting that extension services were available, and only 3% reporting at least one extension visit in the previous 12 months. Assam has no separate livestock extension service (e.g. crop extension) and veterinary officers provide livestock extension advice as well.

Table 4: Access to livestock services

Type of livestock service	% farmers reporting access to services	% farmers with at least one visit in the previous 12 months	Average no. of visits for those with at least one visit
Artificial insemination	61	7	2.3
Extension	8	3	1.5
Veterinary	61	38	2.5

**Figure 38: Percentages of farmers with at least one visit to different services in the previous 12 months, by district**

Access to livestock services varied considerably across the districts surveyed. AI services were more frequently accessed in Jorhat, Kamrup, Marigaon and Tinsukia. Within the latter case nearly 20% of livestock farmers reported at least one visit to AI in the past 12 months. This suggests that under some local circumstances, utilization of AI can be promoted successfully. More generally, however, farmers reported that there was inadequate supply of semen straws, especially for the higher potential stall fed system of dairy production. Moreover the quality of semen provided by the State Veterinary and Animal Husbandry Department was perceived to be of inferior quality, with high incidence of “repeat breeding” and inferior quality calves born, at least as perceived by farmers. Particularly in the stall-fed setting, producers had to buy quality semen at a higher price from private agents which are inaccessible to most producers. Further, government AI providers supply

Jersey semen. While that is likely to be very suitable in many rural settings, particularly given demand for high fat milk, peri-urban systems closer to urban areas, Holstein Friesian crosses are likely to be more economic due to higher milk volume. However, semen of that breed is not available.

Farmers reported that the main source of service for cows was other farmer’s bull, with over 80% of the service provided. Government AI was the second most important source of services, followed by own bull and private AI. In the case of buffaloes, 40% of farmers kept bulls while the rest relied on bulls of other farmers. In terms of animal health issues, farmers cited diarrhoea, foot and mouth disease (FMD) and hemorrhagic septicaemia (HS) as the top three diseases (Figure 39).

Table 5: Source of last service for cows, as reported by survey farmers

Source of last service for cows	Frequency	Percent
Own bull	96	5.6
Other farmer's bull	1,423	82.5
Government AI	170	9.9
Private AI	35	2.0
Total	1,724	100

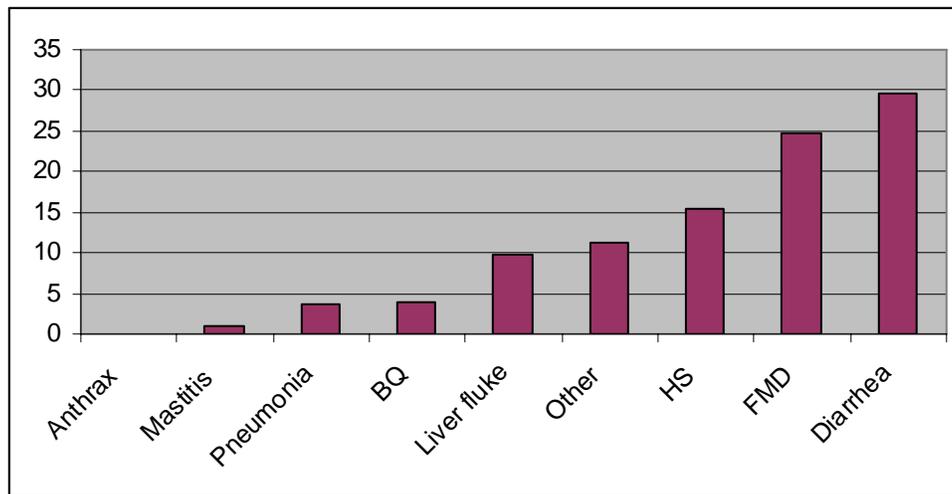


Figure 39: Percentage of farmers citing diseases as one of the top three most important health problems

The main source of veterinary services was the government with about 26% of the cattle/buffalo keepers having used these services at least once in the previous 12 months (Table 6). No farmer mentioned using services from cooperative unions as they do not provide such service. Improving the scope of activities, services and effectiveness of these mainly public services will be central to the proposed interventions to support more and sustainable crossbreeding and the better management of feeding and health.

Table 6: Main source of reported veterinary services in the previous 12 months

Variable	% of cattle/buffalo keepers
Government vet services were used	25.7
Private vet services were used	16.3
Other vet services were used	1.5

Milk marketing by producers

About 65% of the surveyed farmers did not sell milk at any time of the year. Moreover, less than a quarter of the farmers who sold milk did so for six or more months per year. The main constraint does not seem to be availability of milk marketing outlets since only 6% declared having difficulties selling their milk and almost half of them recently searched new buyers. The major issue seems to be the low marketable surplus of milk produced on farm, although it is likely to be site specific. Figure 40 shows milk sold as a percentage of total production, with higher levels near Guwahati, but also in other parts of the State, such as in Barpeta. The geographical spread resembles that of household milk production (Figure 32), suggesting that low milk availability on farm is the major constraint to sales.

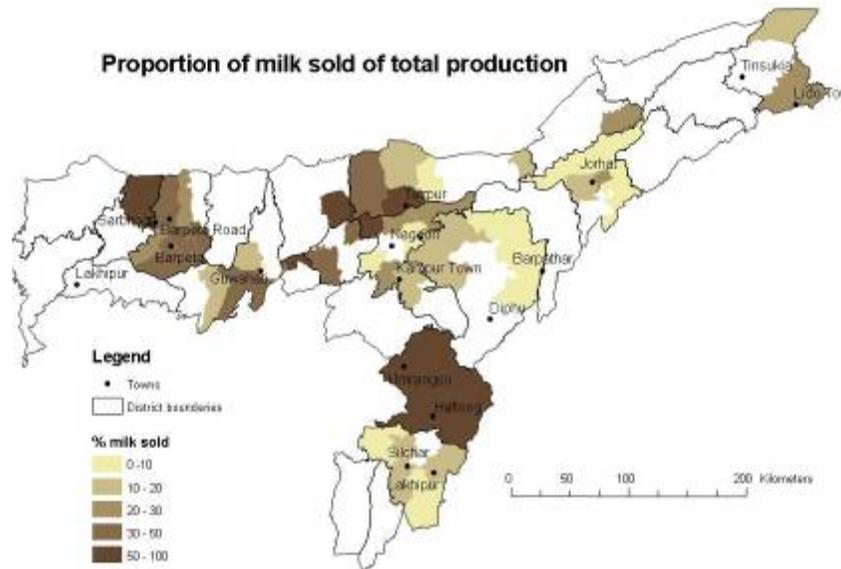


Figure 40: Milk sold as a percentage of total production

The fact that about 65% of livestock producers did not sell any milk points to the continued predominance of subsistence dairy production for home consumption, using local breed cattle. The average overall percentage of total production of milk sold was 17%, although with huge variability by district as Figure 41 shows.

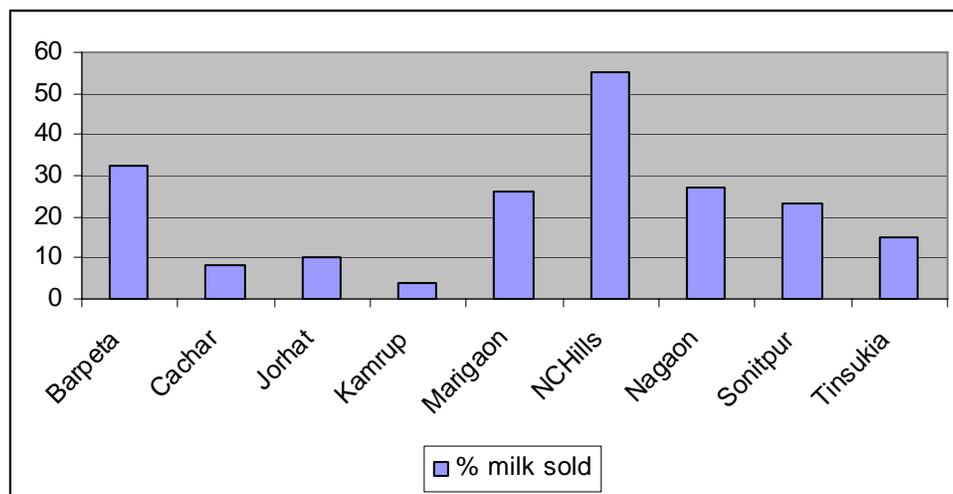


Figure 41: Milk sold as a percentage of total production, by district

In terms of farmer choice of milk market outlets, as in other developing country dairy systems, most milk sales are directly from producer to consumers, with 64% of producers selling their milk to individual customers (Figure 42). About 31% sold to traders while less

than 3% of the surveyed producers sold to organized dairy cooperatives. Some 9% of cross-bred cattle keepers sold to cooperatives. Figure 43 shows the geographical variation in the proportion of milk sold by producers to traders. Of note is the fact that cross-bred cattle keepers sold more frequently to traders than to individual customers, certainly because of the higher milk volumes they produce. This suggests that as milk production expands, marketing arrangements other than producer to final consumer type will need to be used, with required changes in contractual arrangements.

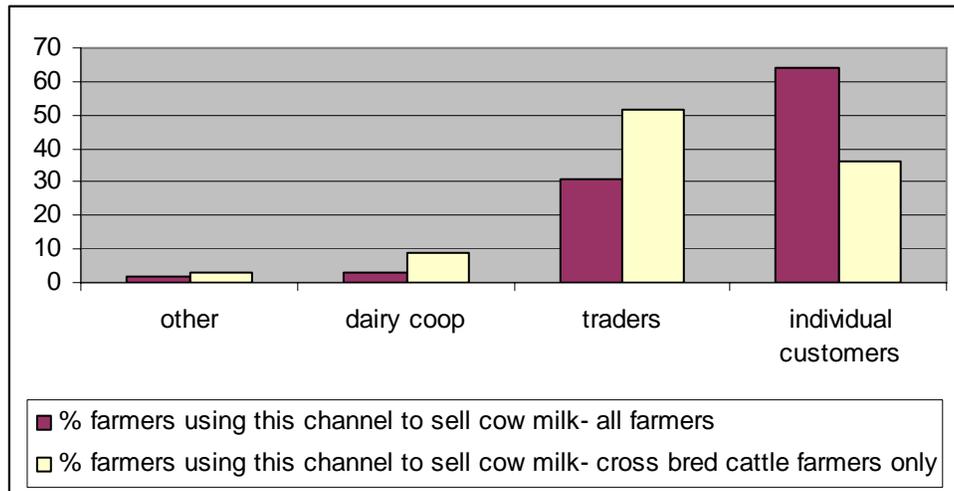


Figure 42: Percentage of farmers selling cow milk, by market outlet and type of producer

Table 7: Cattle- and buffalo-keeping by community group (among agricultural households)

Community group	Number	% of keeping cattle	% of keeping buffalo
Assamese	1,479	79	4
Bengali	500	78	10
Nepali	170	92	0
Other	267	75	6

In the context of livelihoods, a good indicator of household wealth was the type of house. About 64% of the surveyed cattle/buffalo keepers lived in a *kachha* house and could be described as poor households (as opposed to a *pucca* or semi-*pucca* house, or non-poor households). Total milk production per household did not differ significantly between poor and non-poor households. Conversely, poor households sold a significantly lower proportion of the milk produced (23%) compared to non-poor households (31%). Also, a 34% of non-poor people (34%) sold milk during at least six months in a year compared to 21% of poor people. While the causality in relation to poverty and milk sales is yet to be fully analyzed, these results suggest that market-oriented dairy is a way to lift people out of poverty.

Key action-oriented implications of the dairy producer survey

- There is demonstrated strong potential and incentive for increased milk production across rural areas of Assam, although with significant spatial variation. Many farmers reported a desire to increase marketed milk production and indicated that market opportunities were not the most critical of their constraints. Thus at a basic level, the outlook for investment in dairy production is positive.
- Dairy production was demonstrated to be a feasible option for increased income and improved livelihoods across Assam's communities.
- Access to improved dairy cattle, mainly cross-bred, was the primary barrier to increasing the marketed milk surplus on smallholder farms. Farmers with cross-bred cattle demonstrated were able to generate much higher levels of milk sales. However, there was systematic under-utilization of AI. Farmers also reported limited access to credit to procure improved cattle. Improving access to improved cattle must be a primary aim in the dairy development plan. More in-depth analysis of semen

production and AI delivery systems will be required to identify bottlenecks to effective services.

- Selection of best performing local breed cows is another route to increase milk productivity, especially in areas where there is high demand for dual purpose cattle.
- While feeding systems did not appear to present major constraints, there was a trend towards scarcity of grazing and grass from common areas. Interventions will need to focus on enhancing producer ability to intensify fodder production.
- Milk markets may not be a major constraint in many areas, except in pockets where milk production is high or where the road network to urban markets is still poor. However, cooperatives and SHGs currently play a small role and, alone, are unlikely to be able to serve all needs in the medium term. Thus alternative milk collection and marketing options should be explored, including links to private market agents.

Action plan for dairy development in Assam

Recent dairy development strategies in Assam have focused on two main tracks: (a) increasing productivity through providing improved cattle under government-run semen production and AI schemes and (b) increasing milk collection through dairy cooperative societies and SHGs, mainly linked to formal processing channels. This study has shown that these efforts have met with limited success, although in some dairy pockets there has been some clear positive impact. It is apparent that dairy systems in Assam may be too diverse to have a singular policy thrust. We need to recognize such diversities of the system and place them within pro-poor dairy intervention designs and enable poor households to take part in the process.

The real challenges are as follows:

- To increase the intensity of smallholder dairy activity at the poor household level by providing access to improved production means and associated support systems centered around improved cattle, though not exclusively.
- To bring the low level surplus generated by the poor households to the market.
- To boost to the demand for milk through improved hygiene and quality of local products and diversified dairy products that made from local milk production.

Further, while designing programs, it must be kept in mind that many small actors (e.g. milk collectors) are already playing a decisive role by creating vital links in the value chain. The idea is not to have a parallel competitive system to the traditional one, but it would be more effective to recognize the traditional system and built a more modern and professional system around it.

Therefore, the proposed action plan suggests and covers the key areas where the analysis has identified constraints and opportunities to development of the dairy industry in Assam. These key areas are: consumption, marketing of milk, quality control and production. The action plan is based on the pillars of Business Development Services (BDS) and the Cluster Development (CD) approach, which emphasize process development and coordination among different actors to ensure sustainability of the dairy development initiatives. It has been empirically established that BDS and CD approaches are a very important means of

supporting the development of micro-, small- and medium-sized enterprises. These enterprises have potential to create employment, generate income and contribute to overall economic development and growth. India has successful cases of BDS and CDs in other sectors.

A. *Generic promotion of milk consumption and quality awareness*

Issue: Low demand for dairy products. As shown in the consumer survey information, the current level of per capita consumption of milk (i.e., less than one litre per week) is still way below the national average of about 1.57 litres per capita per week (National Household Survey, Government of India, 2004-2005). On the other hand, there are indications of strong demand, e.g. the majority of respondents in both urban and rural areas indicated preference for milk as part of their daily diets and this is also bolstered by the indication that the majority of respondents in both urban and rural areas are aware of the health and nutritional benefits of milk consumption. The analysis has also shown clearly that consumers are not able to judge milk quality accurately.

Recommendation: Invest in specific steps to increase demand for fresh milk and dairy products derived from local production, in a State-level campaign.

Action: Conduct a generic public information campaign, through multiple media, for increasing consumption of fresh milk and for awareness of quality, in partnership with private and cooperative sectors. The campaign should also establish Assam milk loyalty through state-level branding and certification.

Target location: State-wide

Specific steps

1. Recruit a proficient advertising firm with expertise in generic food campaigns.
2. Establish a coalition of public, private and cooperative partners involved in dairy processing and marketing, to guide the campaign design and also to make supplementary investment in public awareness.
3. Design a State dairy identity or brand, to be used on all Assam dairy products.

4. Conduct the milk awareness and dairy promotion campaign over a 2 year period, using a variety of media outlets. Focus should be on a) quality and nutrition awareness, including school milk programme as improving child nutrition is a key way to improve welfare of many poor families and b) livelihood awareness in that dairy development contributes to overall rural development in Assam.

B. Improving the performance of the milk market, both formal and traditional

The study has identified a number of weaknesses throughout the marketing channels serving the State dairy industry, both in the dominant traditional sector, and in the smaller formal sector. These include unreliable quality and inappropriate product mix in formal markets, adulteration, and poor hygiene and constraints to scaling up in the traditional sector.

Issue: Support to improving the milk quality and product mix in formal milk processing. Based on information from the consumer survey, nearly half of urban consumers and about one-fourth of rural consumers are generally not satisfied with the present level of hygiene and quality of milk available in the market. There was also some indication that consumers were not attracted to the “toned” milk supplied by processors, favouring instead whole fresh milk. The milk quality analysis demonstrated very clearly that locally processed milk was the main problem area and was generally of inferior quality to milk and dairy products from sources outside the State. This is a clearly an obstacle to consumer acceptance and increased consumption of local milk and dairy products. Without increased consumption of locally-produced products, dairy development in Assam will continue to be constrained.

Recommendation: Support local dairy processors to improve quality and product mix. This is a critical step to increasing demand for local dairy products, which currently are regarded as inferior to imported products by consumers.

Action: Design and implement a program of support and training to local dairy processors (private and cooperative) in product quality control and product targeting.

Target location: Kamrup, Barpeta, Sonitpur, Jorhat and Cachar and then extended to other districts

Specific steps

1. Recruit a reputable firm with private-sector expertise in dairy processing, quality control, product design, and application of HAACP methods. Also recruit one or more local firms that could develop the same capacity.
2. In consultation with local processors and dairy regulators, design a training program for processor managers and technical staff to address quality control and product design.
3. Conduct the training locally, combined with visits to model dairies in nearby States, over a 1 year period.
4. Conduct follow-up regular monitoring and support to ensure quality control is maintained, over a 3 year period.
5. Design and conduct training program for local service firms and local dairy regulators to better enable them to support and monitor local dairy product quality.

Issue: Variable and generally low quality and performance of traditional small-scale milk market agents. The testing of milk quality in the traditional sector indicated that the milk marketed had a high level of adulteration with water and low bacteriological quality, i.e., average water added in raw milk was about 19%. These results suggest the need to improve the practices, as well as the monitoring of those practices, of the small-scale milk agents who currently dominate raw milk trading and indeed to dairy industry overall, to ensure better quality and hygienic milk for sale. Moreover, there are indications that urban consumers are willing to pay a premium for milk that is guaranteed to be safe and hygienic, so this presents opportunities for market agents who can deliver what these consumers require. Priority should be given to the majority of informal milk agents who have been shown to lack appropriate training in milk handling based on the market agent survey; i.e., some 99% of informal milk agent respondents indicated not having any training in milk processing and handling.

In order to ensure better compliance with quality and hygiene standards of milk and milk products, there also needs to first agree on appropriate standards and monitoring process to

maintain quality control among small-scale milk agents, and then capacity enhancement on the part of the regulatory agencies tasked with monitoring food quality and safeguarding the public health interest. Specifically this should be targeted to key people tasked with developing and implementing dairy development projects, as well as those personnel who are directly involved in the actual monitoring of compliance with milk quality standards in order to enforce them properly, including not only public regulatory agencies, but also milk trader associations etc.

Recommendation: It has been demonstrated in other regions and countries (East Africa region, and Kenya in particular) that a program to address small scale traditional milk market agents through a combination of training in hygiene and small enterprise skills leading to certification, combined with development and enforcement of appropriate standards, can improve milk quality and market performance. It is recommended that this approach is tested and applied in Assam.

Action: Develop and implement a program of TCM (training, certification and monitoring) for traditional milk market agents, in consultation with public regulators and stakeholders, tailored to specific channels where opportunities are greatest.

Target locations: Initially in the districts where small-scale milk agents play the largest role in general (Figure 43): Barpeta, Sonitpur, Kamrup, North Chachar, Chachar, during first two years. The program will later be implemented in the remaining districts.

Specific steps

1. Identify and recruit a reputable lead NGO with experience in capacity building and training of informal sector market actors. Identify local NGOs or firms with capacity and interest in supporting training and certification of traders, following a business development services (BDS) approach.
2. Establish and conduct a consultation process among State and local quality regulators, dairy development agencies, private sector and small scale market agents and their associations, and other stakeholders, to agree on appropriate standards, certification process and monitoring procedure, including sampling regime.

3. Develop the training materials with focus on quality concepts, hygienic milk handling, and small business skills, in consultation with local stakeholders. Also develop the monitoring regime and tools.
4. Train local firms/NGOs to provide the training of market agents, and local regulator in the certification and monitoring practices.
5. Conduct the market agent training in target sites.
6. Establish and implement the certification and monitoring procedure.
7. After 2 years, review progress and changes in milk quality, and revise the program as required, based on stakeholder feedback.

Issue: Capturing opportunities in traditional value addition (processing)

Based on the consumer survey information, there appears to be increasing demand for local traditional sweets, e.g., households in urban areas spend on average some three rupees for every 10 rupees spent on milk, and this is about 25% higher than what rural consumers spend on milk based sweets. Rising demand for these products will generate new employment opportunities. However, the dairy product quality analysis showed that in some cases sweets producers and vendors did not follow good hygiene practices, and that very simple changes would improve product quality.

Recommendation: To design and implement a program of basic training in hygiene and processing for traditional sweet and product manufacturers and vendors. Attention should also be given to innovation in product packaging and presentation to increase preservation, quality and consumer satisfaction. This would increase product quality, and potentially increase consumption of local dairy products.

Action: Design and implement a program of basic training in hygiene and processing for traditional sweet and product manufacturers and vendors.

Target location: All major urban areas in the target districts.

Specific steps

1. Identify and recruit a reputable lead NGO with experience in capacity building and training of informal sector market actors. This may be the same organization enlisted to develop training for milk market agents above.
2. Develop the training materials with focus on quality concepts, hygienic practices, and small business skills, in consultation with local stakeholders.
3. Train local firms/NGOs to provide the training of local sweet and dairy product processors and agents.
4. Conduct the training in target sites, over a period of 2 years.

Issue: Lack of clear coordinating and information gathering and sharing mechanisms in the Assam dairy industry to support private sector investment. The existing set up of involvement of multiple departments/agencies/organizations in dairy development is complex and thus is not effective in harnessing the complementarities. During the course of the study, and the during the process of engagement with local partners, it became apparent that while there were many players in Assam dairy industry, both small and large, there did not exist an effective coordinating mechanism for dairy development, nor a central repository of information on the dairy industry, or a mechanism for regularly updating that information. The coordinating agencies are focused on public and cooperative actors, with less attention to the private sector who will be critical in driving dairy development in the State. Small scale agents have little voice, and have no clear support to reach required services, such as micro-credit and other business support services.

Recommendation: Invest in the resources and organizational mechanisms required to support greater information sharing and private sector investment in Assam dairy.

Action: Establish a Facilitation Centre for Dairy Development (FCDD).

Target location: Dairy Development Department, Khanapara, or other suitable location if agreed by stakeholders.

Specific steps

1. Consult with stakeholders to agree the terms and structure for the proposed FCDD. Priority should be given to the needs of private sector investors and agents, and also cooperative and NGO agencies. Agree a simple steering committee or other mechanism to backstop and guide the FCDD, and the staffing structure. The FCDD could be linked to a new Assam Dairy Development Board (ADDDB), with voluntary dues-paying membership, if desired by stakeholders.
2. Recruit a dynamic individual with experience in business development services, and in public awareness principles and practices. Recruit support staff with expertise in information materials, databases, etc.
3. Develop a database of dairy stakeholders and enterprises, and dairy development activities, and a procedure for regular updating.
4. Develop a database of potential dairy business support services providers, such as credit and finance agencies, dairy technology and quality support providers, animal health and genetics services providers, cattle traders, business skills providers, marketing and advertising agencies, etc, and a procedure for regular updating of the same.
5. Identify the regular market information needs of dairy stakeholders, and a procedure for collecting and disseminating that information. That is likely to include information on a regular basis across key locations in the State on milk and dairy product prices, feed and fodder prices, prices of dairy cattle and buffaloes, veterinary drugs, etc, as well as information on quantities of milk volume traded and processed, and results of milk and product quality analysis, etc.
6. Maintain the FCDD for a period of 5 years, with a mid-term review of progress. Towards the end of the 5 year period, identify mechanisms to continue long-term support to the FCDD.

C. Supporting pro-poor smallholder dairy production systems

The analysis has identified a range of constraints to the increased development of smallholder dairy production systems, and to their improved productivity and scaling up. The areas identified as priorities for support to pro-poor dairy development, which the Action Plan will ensure are addressed, include:

- improved access to milk markets;
- the availability of more dairy cross-bred cows;
- the increased capacity of milk producers to manage the breeding, feeding and health of their dairy cows; and
- public and private support services that are better equipped to satisfy the needs of their clients, small-scale dairy producers.

The most appropriate approach to tackling these needs is to employ a cluster approach to new smallholder dairy farmer development, integrating breed improvement, feed and management skills development and new market development. Site-specific targeted development of new dairy farmer clusters serving traditional milk markets, particularly in regions where the formal market is not yet a viable option. However, these should be linked to on-going existing dairy cooperative development efforts.

Key development partners

A key ingredient for success for all of the recommended activities below is the presence and active participation of a key national NGO with significant experience in smallholder dairy development. The experience in Assam suggests that interventions driven only by public agencies are unlikely to achieve the desired outcomes, and so an experienced NGO with experience from other parts of India will be required to be the lead agency in all the cluster development efforts described below. If it is not possible to identify a single NGO with expertise in the different fields, a consortium of NGOs will be put in place, with a pre-defined coordination structure.

Targeting: Locating the action plan

While the consumer and market oriented interventions described above can be relatively easily targeted to specific locations, largely aimed at urban market areas, the targeting of producer interventions must consider a wider range of variables across the districts. These may include access to market and to livestock services, availability of grazing and fodder resources, the agro-climate and elevation, among other factors. In the section, a

preliminary targeting is done to begin to best locate suggested interventions. However, more stakeholder consultation will be required to fine-tune the strategy for final locations.

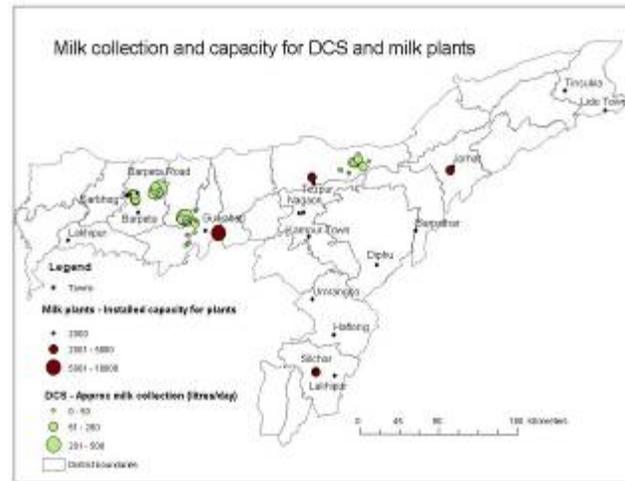


Figure 45: Current DCS and milk plant activity and capacity

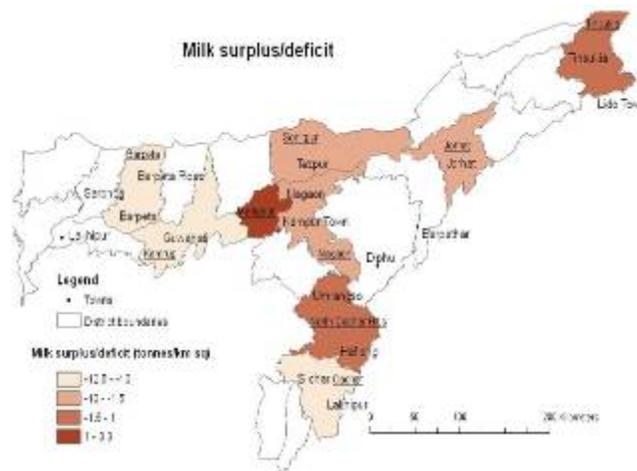


Figure 46: Local milk surplus and deficit based on projected production and consumption

Some of the important types of spatial information need to target the dairy development interventions will be the current locations and level of activity of DCSs and dairy processing plants (Figure 45) and the current availability of surplus milk (Figure 46). Detailed suggestions for targeting the interventions are presented at the end of this report.

Issue: Ensuring a client-oriented and needs-based action plan

A pre-condition for the successful implementation of the production-based points 2, 3 and 4, will be the participation of the cluster communities in the decision-making processes for the design and the implementation of the plans to make more dairy cows available to the communities and for improving the dairy management skills of each community. The participation of the current and potential small-scale dairy producers in the design and implementation of the schemes will ensure that the action plan is client-oriented and needs-based.

Recommendation: In each identified cluster having good potential for pro-poor dairy development the participation of the community will be integral to the planning and implementation of the schemes to increase the availability of dairy cows and to improve the capacity of individuals within the community to manage the cows to achieve and sustain profitable performance.

Action: Implement a series of activities to build capacity for client-oriented dairy cluster development.

Specific steps

1. Train the staff in the dairy and rural development departments, their NGO counterparts and partners and the community leaders in the identified clusters in the participatory processes and methods appropriate to pro-poor dairy development.
2. The training will precede the engagement with the cluster communities and will continue during the participatory design of the community-based development plans.
3. Implement further training during the implementation of the plans to ensure the capacity of all partners to recognize and act on the needs of each cluster community and its members, particularly the poorer households.

Issue: Increasing the availability of dairy cross-bred cows

Given the current small population of dairy cross-bred cows and the constraints to their adoption, the key intervention for successful pro-poor dairy production (where there is a secure market with a reasonable farm-gate price for milk), will be increasing the availability of dairy cross-bred cows.

Recommendation: Because local circumstances, needs, and resources will differ, several alternative strategies for increasing availability of cross-bred cows will be required. Simple crosses of dairy breeds (Jersey or Holstein-Friesian) with local desi cattle are recommended, as opposed to more complex mixes involving a third breed, which has sometimes been proposed. The organizational requirement for delivering in a sustained manner 3-way cross breeds are high, and may be beyond the capacity of existing services.

Action: Provide target cluster communities with alternative means to increase access to improved cows, and the required support services.

Cluster communities will be advised to consider and assisted in putting in place one or more of three complementary pathways to increasing the availability of dairy cows:

1. Dairy bull breeding services through purchased or loaned bulls kept and managed by a nominated “breeder” experienced in cattle-keeping or by a progressive dairy farmer;
2. Artificial insemination (AI) as a component of an integrated veterinary service provided by technicians employed by a large cluster or a group of neighbouring smaller clusters or by an entrepreneur; the AI service fees and other fees for veterinary treatments will represent a major part of the technicians’ income, supplementing a low base salary;
3. Hand-on-the-Gift (HoG) schemes in which the cluster community identifies the most-needy recipients of in-calf dairy heifers and cows to be donated to the community by the programme. In the programme each recipient retains the cow or heifer for their own market-oriented dairy production and its progeny is given

(handed on as a gift) to the next needy households on the list compiled by the community.

Specific steps

1. Drawing on their training in participatory methods, staff in the dairy and rural development departments, their NGO counterparts and partners and the community leaders in the identified clusters, will consult with the community about the options for making available more dairy cows;
2. Given the low rate of success of the majority of publicly-funded AI/breeding and veterinary-service programs, a key part of the training will address how to involve entrepreneurs in the development of profitable service-delivery businesses;
3. Specific training in dairy breeding for the technical staff and the community leaders will be required. Options 1 and 2 (listed above in the second Recommendation) apply to upgrading desi cows through mating with dairy bulls (F_1 , three-quarter bred or pure-bred) or by AI (using three-quarter bred or pure-bred semen) and to the mating of the current dairy cross-bred cows. For the latter, F_1 or three-quarter bred bulls or semen are recommended. Given the hot, humid climate in Assam, the use of purebred dairy bulls and semen should be avoided and will not be supported by the programme.
4. For successful implementation, training in HoG schemes and the continuing inputs from NGOs experienced in this approach, will be required.
5. As the recipient families in the schemes will be poor households keeping dairy cattle for the first time, and possibly keeping any cattle or buffalo for the first time, it is particularly important that the technicians working with the communities to implement the HoG schemes are trained in all aspects of dairy management. Care of lactating cows and of calves will be especially important.
6. Support will need to be given to appropriate semen production, delivery services, liquid nitrogen supply, and upgrading provided where required, with emphasis on identifying and training private providers where possible.

These HoG schemes would also be the entry-point for participatory extension on feeding and health management and for the linkages to the input markets for feed supplements and veterinary supplies.

Issue: Equipping resource-poor producers to better manage their dairy animals.

Complementing the capacity building in community-based actions and service delivery for increasing the availability of dairy cows will be training designed to equip resource-poor milk producers to better manage the feeding and health of their dairy cows and progeny.

Recommendation: In each identified cluster with potential for pro-poor dairy development the staff in the dairy and rural development departments, their NGO counterparts and partners and the members of households interested in adopting dairy production, will work together to describe, analyze and improve current feeding and health management practices.

Specific steps

1. Drawing on the training in participatory methods, staff in the dairy and rural development departments, their NGO counterparts and partners and the current and potential dairy households in each cluster will carry out the participatory description, analysis and improvement of current feeding and health management practices.
2. For feeds, the aim will be to optimize the efficiency of use of local resources and of family labour through combining and supplementing feeds to meet the requirements for the profitable production of milk and of replacement stock, particularly heifers.
3. A key element will be ensuring an adequate year-round supply of good quality feed; integral to the process will be maximizing the utility of rice by-products and increasing the availability of cost-effective protein-rich supplements, e.g. from legume crops and forages.
4. Involving in the diagnostic process rice-millers, other processors of crop by-products, current feed suppliers and cropping system specialists will be critical to the success of increasing the quantity and quality of cost-effective feeds that are available to dairy producers.

5. Parallel with the capacity building for improved feed management will be the participatory description, analysis and improvement of current health management practices.
6. Emphasis will be given to improving preventative medicine practices, including vaccination against FMD and other endemic diseases, and implementing programs to reduce the risk of, and to treat, manage diseases, especially mastitis. (The latter will be run in conjunction with the milk hygiene programs described above).
7. Local private veterinary service providers and agro-vet drugs supplier will be solicited to work with cluster groups to provide services on fee-paying basis, and will be supported to provide additional extension services.

Implementing these recommendations will increase the availability of dairy cows, improve the capacity of individuals within the community to manage the cows for profitable milk production and increase the capacity of public and private sector services to support Assam's emerging dairy industry and specifically its small-scale producers.

Issue: Supporting small-scale milk market development.

Many producers report that they have few problems marketing their milk. However, this may be related to lack of significant marketable surplus of production. As production increases, markets for milk will be critically important. The options for organizing milk marketing are numerous, and are likely to depend on local circumstances, and the preferences of communities. A key point is that because the formal processed milk market is so small, for the medium term the largest opportunities are likely to occur in traditional markets serving urban areas and even small rural market centres, both in the form of milk and value added traditional products.

Within the producer clusters being developed, alternative market strategies can be explored, which might include at organizational level:

- dairy cooperative societies or self-help groups
- dairy producer companies, or partnership firm

- individual producer sales to designated agents serving traditional or formal markets.

The marketing strategy could be one or several of the following options:

- raw milk sales to local or distant market centres, targeting institutional or individual customers, either directly by producer group or through selected market agents
- milk sales to commissioned agents of formal processors, cooperative processors
- sales to local traditional processors – sweet makers, channa makers, etc.
- Producer group value addition of their own milk output, in the form of traditional products or simple new products such as yoghurt

Individual sales to individual market agents, with no form of producer collective action, may be a lower priority given the risk of reduced bargaining position for smallholder producers.

Recommendation: Given the numerous market development possibilities, each cluster group should explore the best option for their own need.

Specific steps

1. Cluster groups to be provided with training and oriented in basics of market opportunity analysis, and market organization and group governance, by lead NGO.
2. With support of the lead NGO, cluster groups to explore local market options and identify which strategies work best for their needs, with an emphasis on a) simplicity of governance and financial management, b) lowest cost of organization and delivery of milk and c) most reliability of payment and milk collection, including possibility of scaling up milk output.

Detailed targeting of producer interventions

Among the intervention strategies above, there are two main targeting aims that can be considered in these early stages of planning. These are selection of zones for (1) initial development of producer clusters and (2) targeting higher grade dairy cattle.

Targeting initial development of producer clusters

This aims to identify the areas within the survey districts that have the attributes that are favourable to initial dairy development efforts. Based on prior research and development experience, several key variables related to success of initial smallholder dairy development efforts are:

Market access: This is critical to the development of successful group marketing efforts of any of the types mention above. Figure 47 shows a map of a GIS based projection of a common market access measure, travel time along the road network from any given rural point to the nearest large urban centre⁵. As can be seen, there is considerable variability in market access across the target districts.

Access to veterinary services: This is another important variable which is needed to support smallholder dairy development, particularly using improved animals. Veterinary services are likely to be linked not only to support to animal health, but also AI and animal husbandry support. Rather than use the locations of existing veterinary clinics, some of which may not be functioning effectively and which may not include private veterinary services, we used instead farmer-reported availability of vet services, based on the survey of over 3,000 rural households (Figure 48).

Milk market orientation: Development interventions towards milk production for sale are most likely to be successful if there is within the zone already some orientation towards selling of milk. Thus we include a variable related to the percentage of milk that livestock keepers actually sell, based on the survey (Figure 49). Again, there is considerable variation.

⁵ Travel time is based on the assumption of speeds of 80 km/hour on main roads, 55 on secondary and 30 on other types of roads. Large urban centres are those with pop above 50,000 but at least 1 in each district.

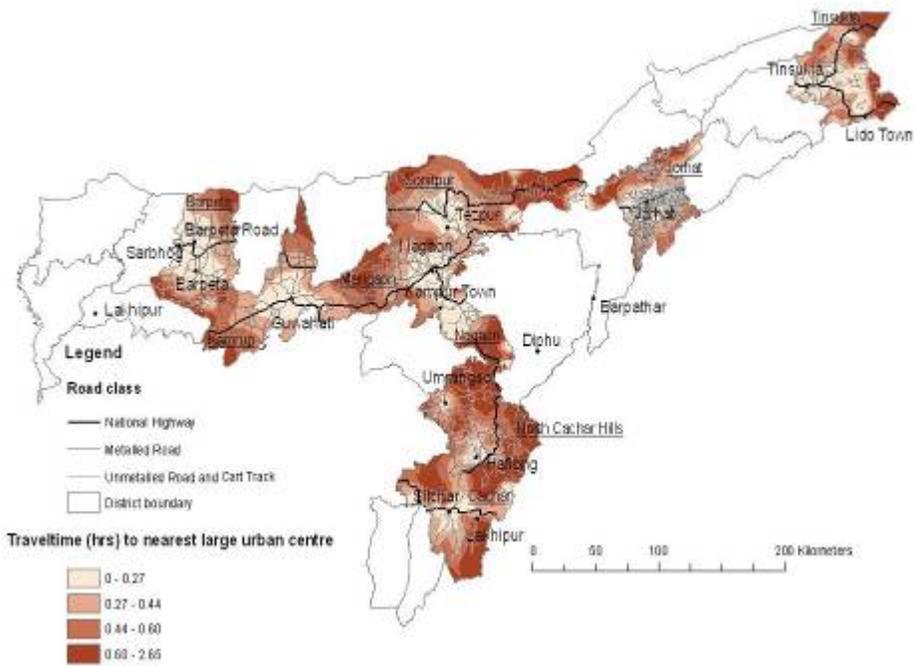


Figure 47: Estimated travel time to nearest large urban centre

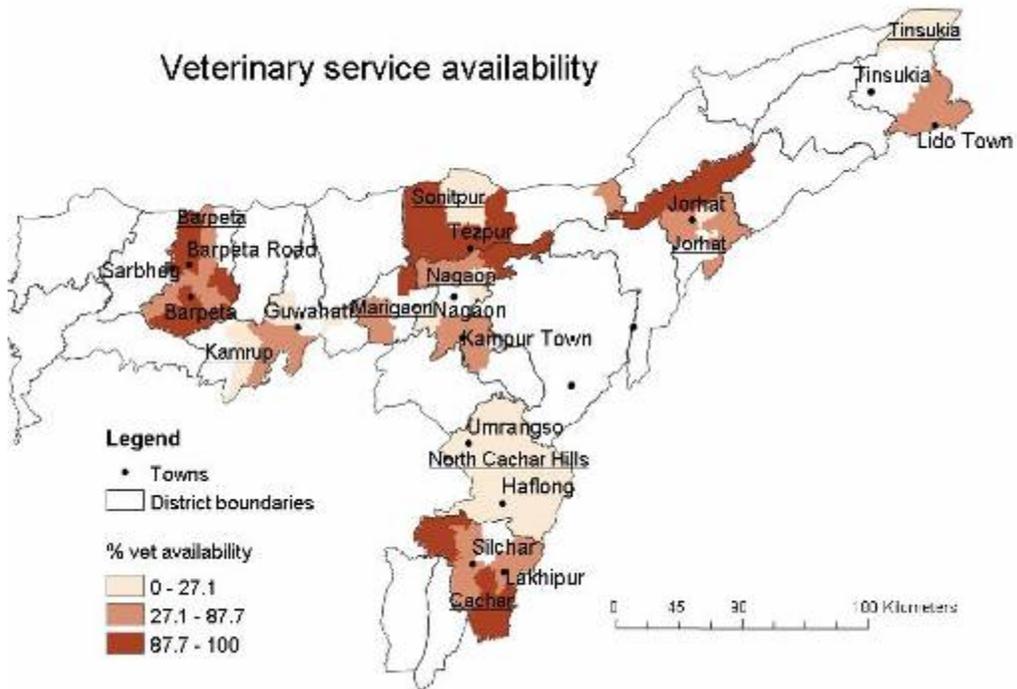


Figure 48: Percentage of farmer-reported local availability of veterinary services

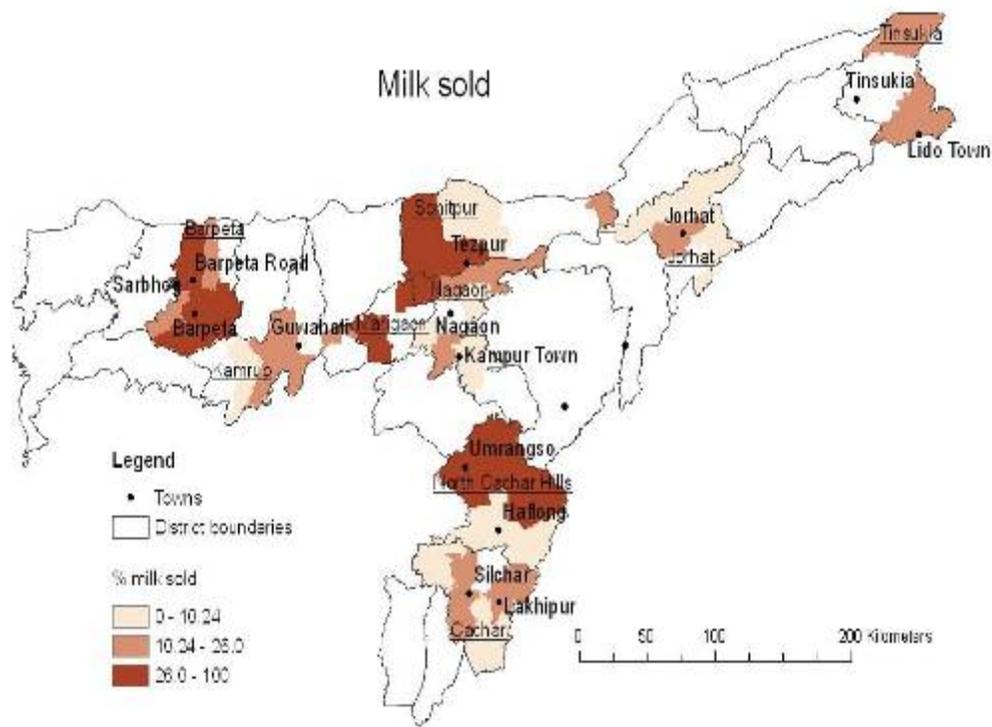


Figure 49: Percentage of milk sold by cattle and buffalo keepers

Integrated recommendation domains for initial cluster efforts

When we combine the three GIS domains for market access, veterinary services and milk sales, we get a clear definition of the most likely zones for initial farmer cluster development efforts. As seen in Figure 50, these include selected zones of Barpeta, Kamrup, Marigoan, Sonitpur, Nagaon, Jorhat, Tinsukia and Cachar districts. All parts of these districts are not included in the recommendation domains. The precise recommended tahsils can be extracted from the GIS for consideration by stakeholders.

These form the zones for initial farmer cluster development, which would then be extended into the other parts of each district following success in these initial zones.

Recommendation domains based on market access,
veterinary services availability and milk sold

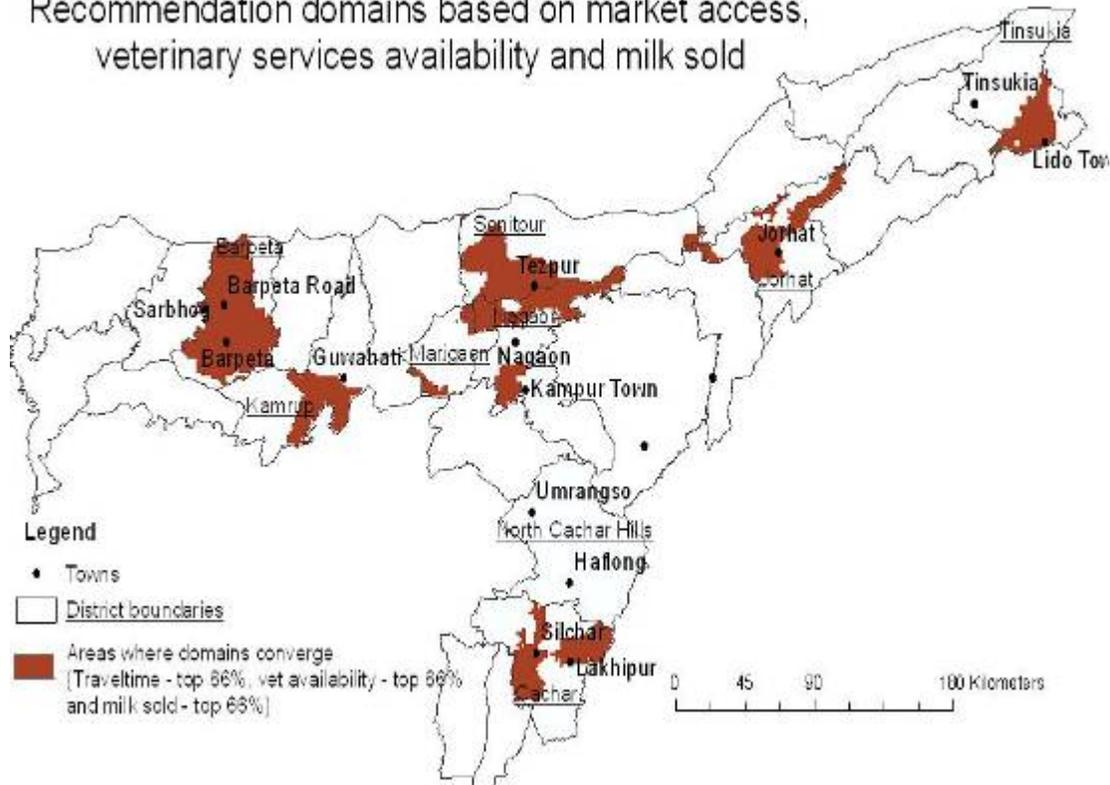


Figure 50: Recommended domains for initial farmer cluster development interventions

Targeting higher grade dairy cattle

The other key intervention that requires careful targeting is the higher grade dairy cattle, particularly the three-quarter dairy cattle described in the interventions above. Again, several important variables need to be considered to know where best to first locate these animals. In this case, while the livestock service environment is important, the climate and land resource environment is also important.

Access to veterinary services: This is an important variable, particularly for the support of higher grade improved animals (Figure 48).

Land and labour resources: Higher grade animals are best sustained in stall-fed systems, where their exposure to animal disease risks and their feed/fodder supply can be more easily managed. Although it may seem counter-intuitive, ILRI research across 15 countries in Asia, Africa and Latin America shows clearly that stall-fed systems are most sustained

when land resources are relatively scarce, and labour is relatively more available. A good measure of scarce land and surplus labour is human population density (Figure 51).

Favourable climate: Higher grade dairy cows are known and demonstrated to perform better in areas with less hot environmental conditions. Thus we include a map for elevation, which is closely related to mean surface temperature throughout the year.

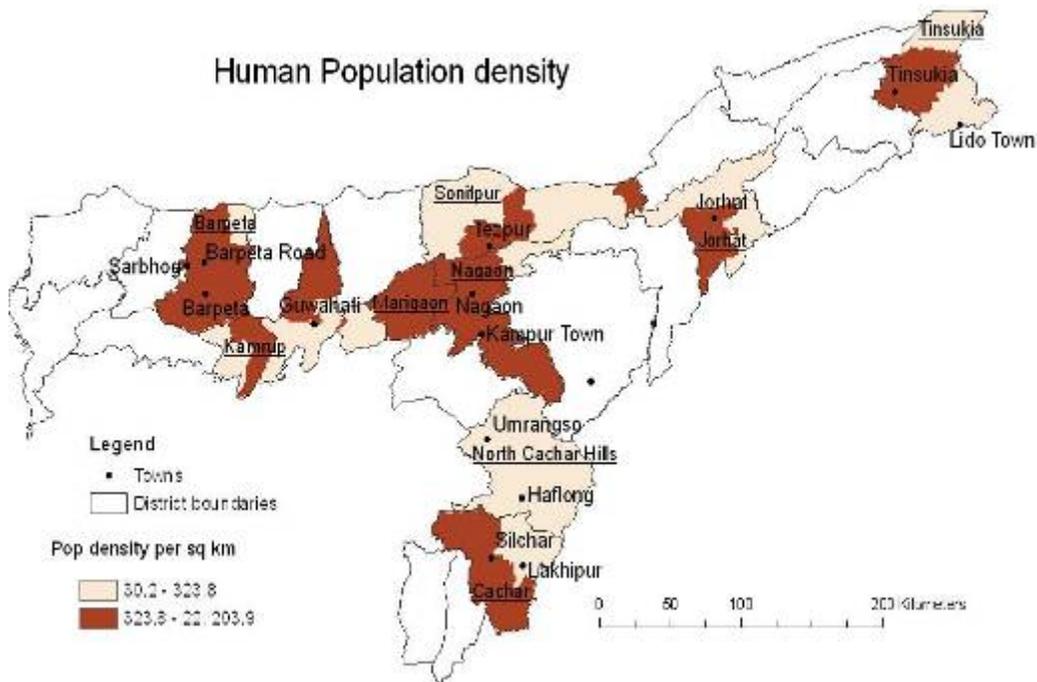


Figure 51: Human population density

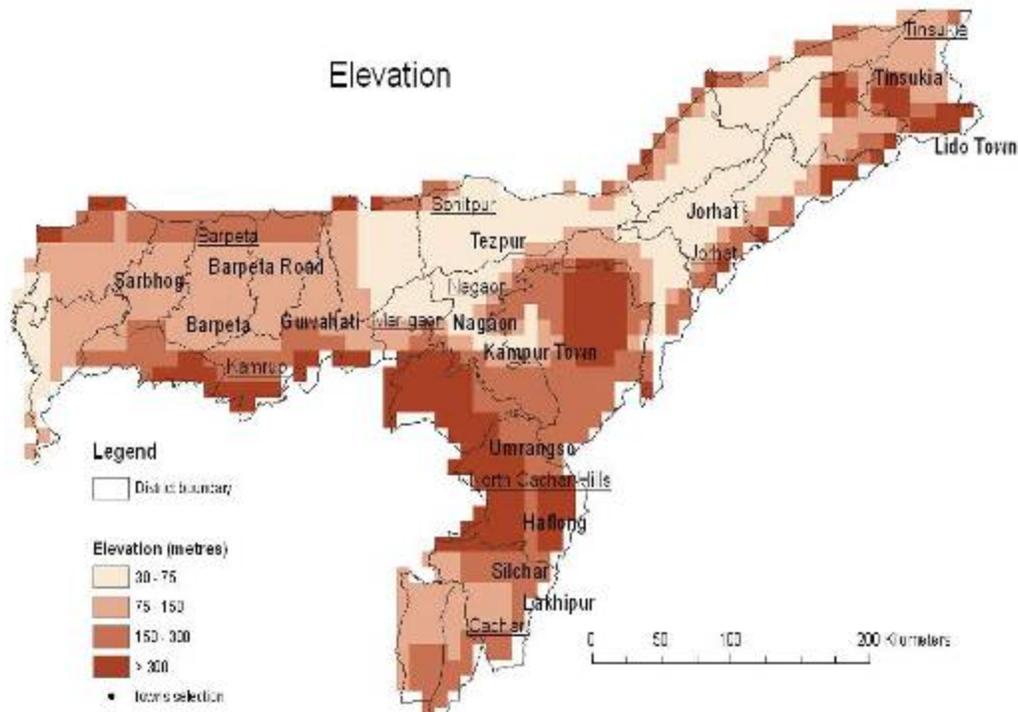


Figure 52: Elevation (metres above sea level)

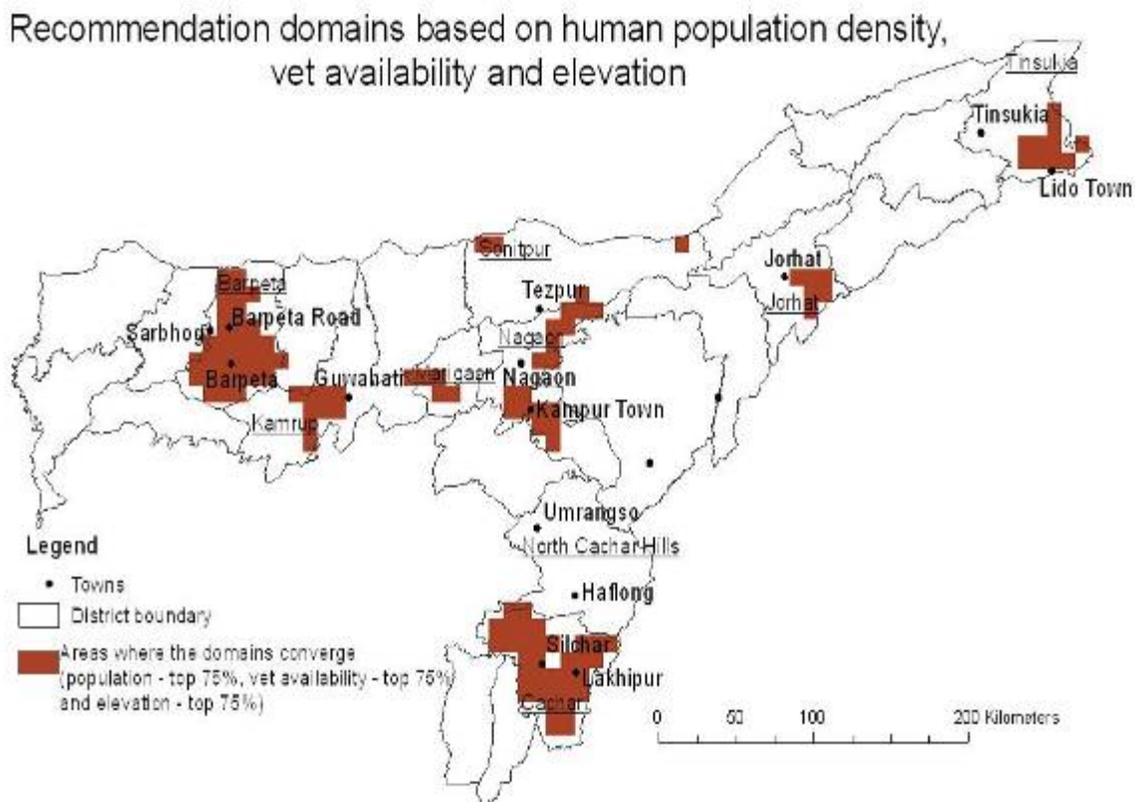


Figure 53: Recommended domains for targeting of higher grade dairy cattle

Integrated recommendation domains for higher grade dairy cattle

When we combine the three GIS domains for veterinary services, human population density and elevation, we get a clear definition of the most likely zones for initial higher grade cattle targeting efforts. As seen in Figure 53, these include selected zones of Barpeta, Kamrup, Marigoan, Sonitpur, Nagaon, Jorhat, Tinsukia and Cachar districts, and in some cases they may overlap with target zones for cluster development. All parts of these districts are not included in the recommendation domains. The precise recommended tahsils can be extracted from the GIS for consideration by stakeholders. These form the zones for higher grade cattle development. In other zones where conditions are less favourable, the objective would be focused on F1 crosses.

Table 8 provides a summary of the tahsils and blocks for initial targeting of the farmer cluster development interventions and higher grade cattle interventions. Consultations with key stakeholders were conducted to ground-truth the selection of the target areas, as well as ranking the blocks for interventions. Some blocks (e.g. Mandia in Barpeta district) are selected for both interventions while other blocks (e.g. Jorhat in Jorhat district) were selected for only one intervention (in this case cluster development). In Cachar and N.C. Hills districts, no specific blocks were selected.

Table 8: List of target tahsils and blocks for farmer cluster development interventions and higher grade cattle interventions

District	Tahsil	Block	Rank for cluster development	Rank for grade cattle
Barpeta	Baghbor	Mandia	1	1
Barpeta	Baghbor	Chenga	2	2
Barpeta	Baghbor	Gumafulbari	3	3
Barpeta	Barnagar	Gobardhana	1	1
Barpeta	Barnagar	Chakchaka	2	2
Barpeta	Barpeta	Bhabanipur	1	1
Barpeta	Barpeta	Pakabetbari	2	2
Barpeta	Barpeta	Changa	3	3
Barpeta	Barpeta	Gumafulbari	4	4

District	Tahsil	Block	Rank for cluster development	Rank for grade cattle
Barpeta	Kalgachia	Mandia	1	1
Barpeta	Kalgachia	Rupsi	2	2
Barpeta	Sarthebari	Pakabetbari	1	1
Barpeta	Sarthebari	Sarukhetri	2	2
Barpeta	Sarupeta	Bhabanipur	1	1
Barpeta	Sarupeta	Bajali	2	2
Barpeta	Sarupeta	Jalah	3	3
Cachar	Katigora			No specific block
Cachar	Lakhipur		No specific block	
Cachar	Silchar		No specific block	No specific block
Cachar	Sonai			No specific block
Jorhat	Jorhat East	Jorhat	1	
Jorhat	Jorhat East	Jorhat North West	2	
Jorhat	Jorhat East	Kaliapani	3	
Jorhat	Jorhat West	Jorhat	1	
Jorhat	Jorhat West	Jorhat North West	2	
Kamrup	Palasbari	Rampur	1	
Kamrup	Palasbari	Rani	2	
Kamrup	Palasbari	Chayani Barduar	3	
Marigaon	Mayong	Mayong	1	1
Nagaon	Dhing	Juria	1	
Nagaon	Dhing	Batadrawa	2	
Nagaon	Dhing	Mairabari	3	
Nagaon	Hojai	Jugijan		1
Nagaon	Hojai	Dhal Pukhuri		2
Nagaon	Hojai	Binnakandi		3
Nagaon	Kampur	Kathiatoli	1	1
Nagaon	Kampur	Kapili	2	2
Nagaon	Lanka	Dhal Pukhuri		1
Nagaon	Lanka	Binnakandi		2
Nagaon	Lanka	Lumding		3
Nagaon	Lanka	Udali		4
Nagaon	Rupahi	Juria	1	
Nagaon	Rupahi	Laokhowa	2	

District	Tahsil	Block	Rank for cluster development	Rank for grade cattle
Nagaon	Rupahi	Rupahi	3	
N.C Hills	Haflong			No specific block
Sonitpur	Dhekiajuli	Barchala	1	1
Sonitpur	Dhekiajuli	Dhekiajuli	2	2
Sonitpur	Dhekiajuli	Gabharu	3	3
Sonitpur	Gohpur	Pub Chaiduar	1	1
Sonitpur	Tezpur	Balipara	1	
Sonitpur	Tezpur	Bihaguri	2	
Sonitpur	Tezpur	Gabharu	3	
Tinsukia	Margherita	Kakapathar	1	
Tinsukia	Margherita	Margherita	2	

Indicative budget

This is a preliminary budget for implementing the action plan. Budget details are available from the Directorate of Dairy Development

	Year 1	Year 2	Year 3	Year 4	Year 5
A. Generic promotion of milk consumption and quality awareness	9135000	7245000	2520000	2520000	2520000
B. Improving the performance of the milk market, both formal and traditional.					
Support to improving the milk quality and product mix in formal milk processing.	6615000	14175000	3150000	3150000	3150000
Addressing low quality and performance of traditional small-scale milk market agents.	10080000	6300000	4725000	4725000	1575000
Supporting improved traditional value addition (processing)	1890000	4095000	3150000	0	0
Establishing Facilitation Centre for Dairy Development	22648500	26523000	12978000	9828000	7308000
C. Supporting pro-poor smallholder dairy production systems					
Developing capacity for a client-oriented and needs-based action plan	12600000	3150000	3150000	12600000	3150000
Increasing the availability of dairy cross-bred cows	28350000	14175000	14175000	28350000	14175000
Equipping resource-poor producers to better manage their dairy animals	12600000	5040000	5040000	12600000	5040000
Supporting small-scale milk market development.	12600000	5040000	5040000	12600000	5040000
Grand Total actions A, B and C	97933500	61173000	42903000	78498000	37233000
Grand total over 5-year period	31,7740500				