Do Producers Gain from Selling Milk?

An Economic Assessment of Dairy Farming in Contemporary India

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Primary field-level information collected shows that producing milk for sale is not always profitable and suggests that despite the white revolution, milk production still remains largely a subsistence activity. There are, however, large variations in milk price, animal stock, and profit among regions; urbanisation levels of districts; and main occupations of producers. The results also reveal that the producer's remuneration varies with the uses of different marketing channels. While informal traders still dominate the market, the sign of entry of private corporate buyers is also clear. The findings raise serious concerns about the commercial prospects of dairy farmers, especially in the eastern region and among the labouring classes and others who practise dairy as a subsidiary economic activity.

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Hailed as one of the most remarkable successes of independent India, the Operation Flood brought farmers together to market their milk at reasonable prices and also transformed India from being a minuscule milk producer to the world's largest one. The movement, however, persisted more as a tool to mitigate poverty than to build a strong and sustainable sector, and a milk producer remained a typically poor farmer with a few animals (GoI 2013a; IUF 2011; Birthal et al 2013). Whether the price the producer receives is gainful given the cost of production is in urgent need of examination in the context of multinationals and Indian corporate giants jumping into the market and the milk prices being determined by the forces of demand and supply as markets open up. Although forecasts suggest that milk prices will recover from their low levels by 2018 internationally (OECD/FAO 2015; USDEC 2016), going by recent experiences, uncertainty and volatility can hardly be ruled out.

Objective

Food price management is known to be double-edged in nature—a higher price is a gain and an incentive to the producer, while a low price is a relief to the consumer. The government's task is to facilitate efficient working of the market while ensuring that accrued gains are distributed equitably among income classes, communities, gender, and regions. Hardly anyone can deny that the alleviation of farmers' distress has to be a political priority. Milk is another farm product which is deemed nearly essential in the diet for its nutrient value (Satija et al 2013).

Marketing today has become a powerful tool for agricultural development and farmers' well-being, and hence the price that the actual producer gets is a subject of major query (Acharya and Agrawal 2004; Bardhan 1980; Ghosh 2013). With the milk market being highly fragmented and sensitive to urbanisation, the answer is likely to be varied across space and context. Hence comprehensive as well as differentiated estimates of producer prices may be useful in assessing the viability of the sector in the national and global markets. Further, regardless of the price, costs and technology also vary. So a similar insight into returns from commercial milk production is useful for planning strategy and policy for the dairy sector and poverty alleviation.

There is no official protocol for reporting producer prices regularly in India. Like for other agro-products, wholesale price data for milk is collected and reported with regularity in

Agricultural Prices in India (API), a publication of the Government of India (MoAb various), though the wholesale market is only one of the many possible links in the milk supply chain. Retail milk prices in a number of markets across the country are also reported in the Ministry of Agriculture website (MoAc nd), but these have not been published regularly. Improvements in statistical protocols are underway at present.

We require some field level insights to understand certain aspects of the dairy sector because secondary data collected with uniformity under current public protocols does not suffice. Though literature based on primary surveys does indicate economic viability of milk production (Cheema et al 2015; Kaur and Kaur 2014; Kumar et al 2011), it appears rather selective, covering largely the north-western parts of India, especially where cooperative movements have been successful. This is despite the fact that cooperatives have put up a weak performance in most parts of the country (Shah et al 1992) and sale to traditional traders and direct sales still remain popular, especially in eastern India (Kumar et al 2011).

Under the ongoing economic reforms, new profit-driven organised entities are also entering the market as milk purchasers. Their innovative models in the primary dairy market (Gandhi and Jain 2011; Birthal et al 2013), may bring significant new dimensions to an inquiry into producer gains. In this paper, using primary data collected from milk producing households, we try to find out the prices and returns fetched by typical milk producers in a few villages in northern and eastern India.

Methods

Primary data and field level insights from select study regions in Bihar, West Bengal, Uttar Pradesh (UP) and Delhi have been collected by the Institute of Economic Growth (IEG) and collaborating teams. The districts were chosen purposively (Appendix 2B, p 96) for not only getting the estimated producer price and returns but also for gathering insights and perceptions disaggregated by the level of urbanisation in the surveyed region and the occupational profiles of the people.

The households in the samples are selected randomly from a frame constituted of milk producers cum sellers. All surveys were conducted between October 2014 and April 2015, the reference study period. Local interactions in all the surveyed regions indicated that the average milch animal produced milk for 28 days in a month for only eight months in a year. This finding was utilised while arriving at annual household production. Tabular presentation of averages and statistical methods, including t-tests, are, used for comparison. Limited validation of the producer price arrived at from the survey data is attempted using all India annual averages of the wholesale price and retail price for a contemporary period when continuous data is accessible from the government sources (MoAb various and MoAc nd) and treating the annual wholesale price as the anchor.

Bihar, West Bengal and northern region: The first of the three sample surveys was conducted by the FASAL[1]–IEG team in Khagaria district of Bihar in 2015; the second survey was conducted by the West Bengal State University (WBSU) team in Haringhata region, encompassing North 24 Parganas and Nadia districts in West Bengal in 2014–15; and a third survey was made by the IEG team in the northern region of the country in the two neighbouring states of UP and Delhi. The survey was done in Muzaffarnagar and Faizabad districts in UP and an urban village, Chandrawal, in Central Delhi. Both Chandrawal and Muzaffarnagar fall within the National Capital Region (NCR).

The surveyed districts have been classified as (i) peri-urban (PURB) if the farmers can possibly cater to a notable urban clientele in the vicinity—for example, farmers in Muzaffarnagar cater to Delhi and North 24 Parganas farmers to Kolkata; (ii) urbanising (UBZ) if it has the characteristics of a town as defined by the Census of India while retaining some rural attributes; (iii) urban (URB) or (iv) rural (RUR) if the district is urban or rural respectively as defined by the census, and supported by other observable social attributes. The occupational profiles have been specified as (i) cultivation, (ii) dairy business, (iii) housewife, (iv) trade and small business, (v) farm labour and (vi) other casual labour, and were based on what the households themselves reported as their main occupation. Caste and religion reported were as declared by the respondents.

Demography and socio-economic profiles: In the sample selection, greater emphasis has been attached to the rural character, greater dependence on crop cultivation, and the extent of poverty. Thus the Khagaria district's share in the grand total of sample size being 32%, far higher than its 5% share in the census population, is a mark of the added weight attached to this relatively rural and economically backward region. Compared to 64% and 30% shares in the census population, the selected districts in West Bengal and the northern region respectively represent only 45% and 22% of the total sample size. In contrast to the sampled district of Bihar, the sample districts in West Bengal, UP, and Delhi are more urbanised, with lower extents of poverty. However, the latter districts differ from one another in the urbanisation level of their hinterland markets that they serve. The sustained growth of the NCR, noted for its industrialisation, information technology parks, and consumer affluence, makes the sampled northern region stand out for its market potential.

The districts from the northern region are, however, rather heterogeneous, with urbanisation being 100% in Chandrawal village in Delhi and only 13% in Faizabad in UP. Urbanisation is also different in the two surveyed districts in West Bengal—Nadia being more rural and agriculture-based, while North 24 Parganas, which is closer to Kolkata, being relatively urban in character. Compared to the districts covered in the northern region, the population density is also higher in Bihar and West Bengal sampled districs. Table 1 (p 90) shows that while households belonging to nearly all categories of urbanisation are present in the surveyed areas from the northern region, the sampled districts from West Bengal are more inclusive in occupation. The surveyed district from Bihar is the least varied (Table 1).

The samples showed variety in the household profiles and ways of marketing milk. In Faizabad, the sample consisted of one Muslim and two Hindu households. Out of the three households, two sold milk directly from home. Only one of the three households was engaged in crop cultivation, one was engaged in small business, and the third was dependent on the remittance from a migrant member in the Gulf.

Table 1: Regional Features and Number of Sampled Households in Categories in the Sample Regions

States	Northern Region (Uttar Pradesh and Delhi)	Bihar	West Bengal	Total
Districts	Muzaffarnagar, Faizabad, and Central Delhi	Khagaria District	North 24 Pargana and Nadia Districts	
Urbanisation* %	29.2	6.0	43.1	36.7
Population density** (km^2)	894	1,106	1,028	969
Poverty** %	28.4	34.0	20.3	28.1
Occupation (number of households)				
Cultivator	5	11	2	18
Housewife	1	–	2	3
Trader-petty business	1	–	3	4
Agri-labour	–	4	4	8
Other labour	–	1	10	11
Dairy business	5	1	3	9
Urbanisation (number of households)				
Rural	–	17	14	31
Peri-urban	5	–	10	15
Urbanising	3		–	3
Urban	4	–	–	4
Total	12	17	24	53

* Relates to sample region (districts) only, ** relates to state.
Source: Planning Commission (2013), Census, 2011 and computed from survey data.

All subjects in the Muzaffarnagar sample were Hindu Jat farmers who reported crop cultivation and milk production as their primary and traditional occupation. They all sold to an agent who in turn sold to a private dairy company producing milk and ghee (see Appendix 2c, p 96). The agent, also interviewed by the team, collected milk from 50 producers twice daily and sold it to a dairy company. The milk was picked up from the agent by a van and taken to a centre with a refrigeration facility. The milk price was dependent on its fat content in all cases.

Faizabad and Muzaffarnagar are both in UP, but the latter, which has been included in the NCR, is an affluent district and is experiencing rapid urbanisation and increased connectivity. Faizabad, which is situtated further from the capital, is on the other hand demographically diverse and more agriculture-based.

The residents of Chandrawal village in Delhi are mostly descendants of the farming castes such as Gujjars and Yadavs, who traditionally specialised in dairy farming in the area and are now also engaged in the service sector. The village is also inhabited by a large group of poor migrants, mostly from Bihar, who live on rent and earn their livelihood in the surrounding urban landscape as domestic helpers, rickshaw pullers, and construction workers. Chandrawal is a rural pocket (*gaon)* in an otherwise urban city.

All the sampled households of Chandrawal practised Hinduism, and belonged to caste groups traditionally associated with the specific occupation of animal rearing for milk except one upper caste household. All of them owned residential buildings, but only one of them had rented out his premises for supplemeting his income. In general, different households reported owning motorbikes, shop premises which they had rented, and rickshaws which were hired out for additional income. Only one respondent, who was primarily a security guard by profession and had lost his job taking care of his sick son, reported milk production as his main livelihood.

Drained by the rivers Kosi, Ganga, and their tributaries, Khagaria in Bihar is highly flood prone and poor.[2] Food security is a critical issue in the area because growing monsoon rice is deemed risky. The district is, however, well known for maize cultivation and is also recognised for the advantages it can offer to the dairy sector (NDDB 2008). Farming is the main occupation. The district is 169 km from Patna, 491 km from Kolkata, and 1,241 km from New Delhi.

The socio-economic character of the sample is least varied in Khagaria, with all households engaged in cultivation, with own or leased land, or as agricultural labour. The majority of the respondents were Yadavs or Kurmis, who fell in the category of Other Backward Classes, but a few Brahmins and Muslims were also among the respondents. Though farmers largely sold their milk to a cooperative society collection centre and a private dairy firm (see Appendix 2c), they also sold to traders from their own farms and directly to consumers in the market. They also delivered milk to customers' doorsteps.

North 24 Parganas and also a part of the Nadia district in West Bengal are satellite regions of the state capital Kolkata. The Nadia district is low-lying and agrarian in character, while North 24 Parganas, being more industrialised, combines both rural and urban features. The sample in West Bengal was quite varied in comparison to the sample from Bihar. Some households in the Nadia district were engaged in agriculture either as cultivators or farm labourers, some solely practised dairy farming, some were housewives who took up dairy farming additonally, and others were small business owners and non-farm labourers. Selling to the cooperatives was not reported, and traders were the most dominant purchasers of milk. Sweet shops too constituted possible buyers.

Animal feed is a major component of the cost of milk production in addition to the medical cost, a large part of which is incurred on artificial insemination, often requiring a number of trials. Dry fodder or *bhussa* and *choker* are purchased, and green fodder such as bajra, jowar, gram, *dhaicha*, and *jai* is cultivated in rural areas. Milch cattle owners in a urban village like Chandrawal had to purchase both dry and green fodder. The utensils and sheds are fixed inputs, but expense on these are nominal. Much of the livestock is home grown and raised by producers, but young animals are also purchased and sold in market and local fairs. Operation Flood had been active in all states under study but its success has been unequal in extent and pace (Appendix 2d, p 96).

Sampling and estimation: Only village households possessing milch animals for the purpose of producing and selling milk were included in the sample. The households were asked to respond to questionnaires soliciting information on the

number and value of milch animals in stock; the proportion of the produce that was held back for home consumption, cost of feed, price fetched from selling milk and returns from milk production, calculated as the difference between the cash revenue received from selling milk (price into the actual quantity sold); and the total paid cost on feed and medical services. The fixed cost incurred on animals was not included in cost. Similarly, proceeds from sale of young or old animals were not taken as a part of the revenue.

The results are represented by simple averages of the sample and subgroups categorised by urbanisation and occupation profile within the samples in Table 1. The sample means of the categories are compared, accounting for the possible heterogeneity of variances treating one category as a base. This has been done with F-test and a Levene test. The Levene test and the simple F-test yielded similar results in nearly all cases, but the Levene test was used as superior measure for assessing the homogeneity of variances when estimating the t-statistics.

The Levene test statistic, F , is defined as follows:

$$F_{\text{Levene}} = \frac{(N-K)}{(k-1)} \frac{\sum_{i=1}^{k} N_i (\bar{Z}_{i.} - \bar{Z}_{..})^2}{\sum_{i=1}^{k} \sum_{j=1}^{N_i} (Z_{ij} - \bar{Z}_{..})^2}$$

distributed as F_{Levene}.

Where,

K is the number of different groups to which the sampled cases belong,

N is the total number of cases in all groups,

N_i is the number of cases in the ith group,

Y_{ij} is the value of the measured variable for the jth case from the ith group,

$Z_{ij} = |Y_{ij} - \overline{Y_i}|$, $\overline{Y_i}$ is a mean opf i – th group

Dairy Sector at Crossroads

At the time of independence, milk production was low, though the number of animals was very large. Operation Flood, implemented by the National Dairy Development Board (NDDB) in the late 1960s, is celebrated for its success in instituting a cooperative movement across India. It epitomises the creation of a three-tier national cooperative structure. It also resulted in the phenomenal increase of milk production and the hybridisation of Indian cattle, with more productive exotic varieties largely responsible for the revolution. Bridging the gap between the rural producer and urban consumer was also a challenge that Operation Flood successfully addressed. Though efforts to spread the cooperative movement have continued through initiatives such as the National Dairy Plan (NDP) and Intensive Dairy Development Programme (IDDP) post Operation Flood, market reforms have enabled the entry of profit-oriented private enterprise into the sector.

The compounded pressure on land to produce more food to achieve food security, urbanisation, industrial growth, and environmental conservation is making access to improved feed increasingly challenging. In this situation, the poor farmer, who cannot afford to feed his/her cattle adequately, lets cattle loose to graze. The excessive use of artificial insemination has led to the genetic dilution of the local breeds that are more adapted to Indian weather conditions and feed availability and are resistant to many deadly diseases (Hegde 2001)[3] as compared to the hybrid varieties. Market reforms[4] have introduced competition from importers (of processed and powdered milk), and the prospect of reaching out to export markets is becoming alluring. The emergent need to reduce the cost and the price of milk production raises serious contradictions in a relatively protected market.

Milk pricing by cooperatives is critiqued as unscientific and not being auction determined (Shah et al 1992). The fat content in the milk, measured by a lactometer, is a common determinant of price, though a 2-axes formula is held to be superior for giving weightage also to non-fat solids in milk for price determination. In the past, the central government has denied its role in influencing milk prices, and the NDDB chairperson has denied that large players such as Amul and Mother Dairy have formed cartels, manipulating the price of milk (Singh 2014; Kulkarni 2014). The lowering of prices is not an easy task and has lead to serious protests by farmers, while high prices have been stridently opposed by more vocal urban consumers. Models like contract farming, producer companies, mutually aided cooperative societies (MACS), dairy hubs (Rajeshwaran et al 2014; Kolekar and Meena 2013; and Kolekar et al 2013) are being tried out to bring small producers together for negotiating prices with more powerful buyers. The cooperative movement, though seen to be an "ethical" practice is clearly under challenge (Abbott and Panwar 2014) and transition.

Findings and Ground-level Insights

Taking the total stacked sample from the three study regions, the grand averages have been worked out (Table 2). The average number of animals per farm was 2.8 and were worth over ₹60,000. Production per farm was over 14 litres per day, and the yield per animal was five litres per day. The household sold 71% of the produce at a price of ₹27.40 per litre and earned ₹12,000 per year. However, the coefficients of variation show

Table 2: Performance Statistics—Grand Mean of Total of Samples in All Study Regions

	Animals		Production per Day		Marketing		
Category	No	Value (₹'000)	Yield per Animal (litre)	Production (litre)	Price (₹/kg)	Annual Income (₹'000)	Surplus (%)
Mean	2.8	61.5	5.0	14.5	27.40	11.7	71.1
CV (%)	66.6	135.4	83.0	149.2	27.10	684.9	27.6

Mean is simple artithmetic mean; CV is coefficient of variation.
Source: Computed from survey data.

Table 3: Pearson Correlation Coefficients among Variables across Meta-data of Samples

	Animal Value	Productivity	Price	Income
Animal value	1	.602**	.469**	.858**
Productivity	.602**	1	.531**	.604**
Price	.469**	.531**	1	.491**
Income	.858**	.604**	.491**	1

**Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed).
Source: Computed from survey data.

that the overall sample averages hide a great deal of variation, especially with respect to incomes earned. Subsequent discussions bring out the differences among the three surveyed regions (Table 3, p 91), where we found that the production of milk for sale was not even earning positive economic returns in some cases. However, what is common in all cases is that the produced milk provided nutrition to the farmer households who also earned from selling calves.

Results from West Bengal: In the two districts sampled in West Bengal, the average farm owned 2.8 animals (cows and buffaloes) worth a little over ₹26,000. The milk yield was three litres per day per animal and it was sold at ₹22 per litre, thereby incurring a financial loss of ₹17,000 in the period under study. The households, however, held back 27% of the produce for home consumption. When compared to the producers in North 24 Parganas (not shown in table), the surveyed households in the Nadia district owned a larger stock in size and value, obtained higher productivity despite the lower average price of animals, and retained a lower share of milk for home consumption but incurred larger monetary losses. Over 90% farmers in both districts sold bulk of their milk to traders (Appendix Table A1, p 96) while 10% and 7% of farmers in North 24 Parganas and Nadia respectively delivered milk to sweet shops. The average sample farm holding of a cultivator household was less than one hectare.

Results from Bihar: The average size of the landholding among the sampled households in Bihar was found to be a little more than a hectare, much of which was sharecropped, but a large number of households did not own land. The major crop maize was grown in the rabi season, supplemented by wheat and banana. Though cultivation of rice was avoided due to the persistent threat of floods, farmers took the risk of growing kharif fodder such as grass, bajra, and jai even by leasing in land, which is suggestive of the significance attached to dairy. The households surveyed were generally below the poverty line (BPL) and nearly all obtained foodgrains at cheap rates from ration shops. At the time of survey, no Mahatma Gandhi National Rural Employment Gurantee programmes were operational in the area. Members of many households migrated periodically under economic compulsions. Most of the households owned milch animals, identified, though uncertainly, as Jersey cattle. Farmers bought dry fodder, leased in green fodder land for grazing, and procured pulses for the nourishment of breeding animals, all of which along with artificial insemination constituted paid cost.

The sample average household owned 2.3 animals each, worth over ₹22,000 to obtain a milk yield of four litres per day per animal. The price of milk was ₹29 per litre, higher than that in West Bengal. The annual loss was also lower at ₹1,778 per capita, but the average family size of 9.3 was larger than 6.5 in West Bengal as joint families persist widely in the area. A few milk producers sold to the village cooperative society at its collection centre, but 12% of respondents also reported selling to a private dairy. However, 47% of milk producers still relied on middlemen. A fairly large share (35%) of farmers sold directly in the market or to their neighbours. The cooperative society paid a relatively lower price for the milk. The paid out cost of milk production worked out to ₹3,947 per month. The production of cow-dung and sale of calves at the local periodic fairs besides retaining 37% of the produce for home consumtion justified the business with visible returns.

Results from the northern region: The household in the northern region owned 3.5 animals on an average, produced 10 litres of milk per day per animal, obtained ₹37 per litre and earned ₹99,000 per year (₹22,000 per capita) while also consuming 21% of the produce. Chandrawal, the urban village, lead in all aspects—size of stock, value of stock, production, milk price, and income. Muzaffarnagar had the smallest average sock size but the value of stock was higher than that in Faizabad, owing to higher priced animals in stock. Productivity of animals, household milk production, and income from milk sale were also higher in Muzaffarnagar. The average household in Faizabad owned more animals than those in Muzaffarnagar but productivity was only half. The dairy farmer in Chandrawal, operating at the largest scale, obtained lower productivity than in Muzaffarnagar. All the surveyed farmers in Muzaffarnagar sold to a private processing company, while all the farmers in Chandrawal and Faizabad sold directly to consumers. In Faizabad, only 33% of the farmers delivered milk to households in neighbouring towns.

Comparing regions and categories: Our surveys found that the grand mean of all household incomes was less than ₹12,000 per year with a remarkable variation but a high level (29%) of retention for home use, suggesting motivations other than selling milk in the market (Table 2). The average stock was 2.8 animals, valued at ₹61,000 per farm. The variation across farms shown by the coefficient of variation was large. An analysis of the meta-data from all three study regions showed that the variables measuring herd value, milk yield, producer price and income from milk sale were all correlated to one another positively (Table 4). Though statistically significant, the correlation coefficient was low between stock value and milk price and also between milk price and income but was highest (at 86%) between stock value and income, suggesting, perhaps, the critical significance of scale and investment regardless of the price received.

Table 4: Performance Statistics (Mean) of the Three Surveyed Regions and Mean of Region Means

Place	Animals	Production per Day	Marketing		
	Value (₹ '000)	Yield per Animal (litre)	Price ₹/kg)	Annual Income (₹'000)	Surplus (%)
Northern region	150.6	10.0	37.0	99.3	79.0
West Bengal	26.6	3.0	22.0	-17.4	73.0
Bihar	47.9	4.0	29.0	-9.0	63.0
Mean	75.0	5.7	29.3	24.3	71.7
CV (%)	88.4	66.8	25.6	268.1	11.3

Mean is simple artithmetic mean, CV is coefficient of variation.
Source: Computed from survey data.

For comparing the categories, the means of different business indicators, namely, the stock value of animals, milk

yield per day, annual income from milk sale, and price at which milk is sold have been presented in Table 4 by regions and in Tables 5 and 6 by the two categories—occupation and

Table 5: Performance Statistics of Surveyed Households by Occupations

Occupation	Animals	Production per Day	Marketing	
	Value (₹'000)	Yield per Animal (litre)	Price (₹/litre)	Annual Income (₹'000)
Cultivation (CLTV)	61.6	6.6	31.2	3.6
Dairy business (DB)	139.8	7.6	31.6	100.5
Housewife (HWF)	46.7	5.3	30.3	29.0
Farm labour (FLB)	26.5	2.4	23.6	-20.7
Non-farm labour (NFLB)	24.3	1.9	21.5	-20.4
Small trader and business (TRDB)	68.3	5.0	23.3	-11.4
Mean	61.2	4.8	26.9	13.4
CV (%)	69.4	47.0	17.1	346.9

Mean is simple artithmetic mean, CV is coefficient of variation. Average farm size of those in cultivation is 0.44 in West Bengal, 2.07 in Bihar and 1.36 in northern region.
Source: Computed from survey data.

Table 6: Performance Statistics of Surveyed Households by Levels of Regional Urbanisation

Region	Animals	Production per Day	Marketing	
	Value (₹000)	Yield per Animal (litre)	Price (₹/litre)	Annual Income (₹'000)
Urban (URB)	263.0	11.3	38.3	227.4
Peri urban PURB)	42.8	5.1	25.5	1.6
Urbanising (URBZ)	90.0	6.3	37.3	30.9
Rural (RUR)	41.8	3.9	26.0	-13.1
Mean	109.4	6.7	31.8	61.7
CV (%)	95.8	48.2	21.9	181.5

Mean is simple artithmetic mean, CV is coefficient of variation.
Source: Computed from survey data.

urbanisation levels—respectively. The t-statistics with reference to a base category, comprehensibly the leading one, have been also provided in Table 7 to assess the significance of the differences in the means. When ranked by the three sample regions, the northern region came first followed by Bihar and then West Bengal in all the indicators and the differences were statistically significant.

Among the six occupational categories, dairy business lead in all indicators of business; non-farm labour registers the lowest stock value, yield, and milk price; while farm labour had the lowest income among all the categories. The cultivation category stands second in terms of price, yield, and income; and the housewife category followed in all cases except stock value in which the small trader and small business category came second, to be followed by cultivation (Table 5). However, the differences between dairy business and cultivation and dairy business and housewife categories were not statistically significant in all cases. The labour class fell back with significantly lower stock value of animals, milk yield, milk price, and income.

Among the four urbanisation categories, urban, urbanising, peri-urban, and rural is the descending order observed for stock value, yield, and income. Milk price obtained by farmers in peri-urban and rural areas was significantly lower relative to base urban while there was no significant difference between the base and urbanising areas. In yield, urban had an edge over the other categories significantly, and in income the differences were significant at 5% or 10% level.

Analysis of Metadata

Combining all the data collected, traders and milkmen were found to corner milk from about 57% of the sampled producers (Table 8). The selling of milk through traders was confined mostly to West Bengal and partly to Bihar (Table A1), while direct selling was common in the northern region. Direct sales to consumers ranked second as reported by 24% of the producers. Sales to private dairy firms were also considerable, standing at 24% in the meta-sample, while cooperatives had the lowest

Table 7: Tests of Equality of Variance and Mean across Category

	Value (₹)	Yield per Animal (litre)	Price (₹/litre)	Annual Income (₹)
Northern Region		Base Study region		
West Bengal	123.9 (2.7**)	8 (4.2***)	15 (4.1***)	116.7 (2.8**)
Bihar	102.7 (3.3***)	6 (5.7***)	8 (10.3***)	108.3 (3.1**)
F-test	13.7***	31.7***	53.1***	13.9***
Levene test	10.6***	3.2**	8.1***	13.4***
Urban (URB)		Base urbanisation category		
Rural	221.2 (2.5*)	7 (11.8***)	12 (7.9***)	240.4 (2.9*)
Peri-urban (PURB)	220.2 (2.5**)	6 (3.7***)	13 (5.2***)	225.7 (2.8*)
Urbanising (URBZ)	173.0 (1.9)	5 (4.9**)	1 (0.2)	196.4 (2.4*)
F-test	16.7***	4.7***	7.2***	26.9***
Levene test	18.1***	7.1***	2.8**	10.2***
Dairy business (DB)		Base occupation category		
Farm labour (FLB)	113.3 (2.1*)	5.2 (3.6***)	7.9 (2.3**)	121.2 (2.3**)
Non-farm labour (NFLB)	115.5 (2.1*)	5.6 (4.3***)	10.1 (3.4***)	120.9 (2.3*)
Trader (TRDPB)	71.5 (1.2)	2.6 (1.6)	8.3 (2.2**)	111.8 (2.1*)
Cultivation (CLTV)	78.1 (1.4)	0.9 (0.5)	0.4 (0.1)	96.9 (1.8)
Housewife (HWF)	93.1 (1.5)	2.2 (1.1)	1.2 (0.2)	71.5 (1.3)
F-test	2.7**	4.1***	5.1***	3.7***
Levene test	7.8***	2.8**	5.3***	9.7***

***, ** and * denotes the level of significance at 1%, 5% and 10% respectively. Values of indicators for categories are mean difference from base and figures in the parenthesis are t-statistics for equality of mean relative to base. F-statistics and Levene statistics test the hypothesis of unequal variance across various category.
Source: Computed from Survey data.

Table 8: Marketing Channels in Surveyed Districts

District	Trader/ Milkman	Sweet Shops	Cooperatives	Direct Sales	Private Dairy	Home Pickup
Average Price (₹/litre)	23.1	23.0	23.0	35.1	33.7	26.6
Annual income (₹'000)	-11.1	-31.9	-17.9	66.1	25.0	12.5
Animal (no)	2.8	3.0	2.0	3.2	2.0	2.98
Animal value ('000)	35.6	25.0	70.0	111.0	87.9	58.3
Farmers selling (%)	56.6	3.8	1.9	24.5	13.2	79.2

Mean is simple artithmetic mean, CV is coefficient of variation.
Source: Computed from survey data.

share in procuring milk from producers, meagre even when compared to purchases made by sweet shops. Thus the households surveyed in the present study relied only marginally on the cooperative system for marketing their produce. Also, a distinct preference for marketing from home, which saves time and trouble of carrying the milk to the selling point, was seen.

The price fetched was highest in direct sales followed by sales to private dairy, while sale to traders, cooperatives, and sweet shops fetched a considerably lower price. Selling to private dairy firms and direct sales were associated with gains for producers and their stock value was higher though not necessarily due to a larger number of animals in stock. Table A1 shows that among the surveyed districts the price fetched was higher in districts surveyed in the northern region, the highest being in Chandrawal, and among the eastern region the price was higher in districts in Bihar than in West Bengal. Stock value and milk yield per animal were also relatively lower in the East, with lowest in North 24 Paraganas, and milk production was a loss-making exercise in the eastern regions.

The producer price varies from ₹23 to ₹35 per litre across channels and is ₹26.60 for milk picked up at home (Table 8). As an average of all sample households, the producer price is ₹27.40 (Table 2). Averaged across occupations, the producer price is lower at ₹26.90. Due to higher price in the northern region, the regional average is higher at ₹29 (Table 3) and it is nearly ₹32 when averaged across levels of urbanisation. A simple validation of the sample average producer price is attempted using two indicative price ratios, one observed from secondary data and the other reported by experts.

In the period 2001–02 to 2011–12, when the monthly retail price was officially reported with consistency and continuity, the wholesale price as a proportion of the corresponding retail price, both taken from official secondary data, was found to vary between 0.93 and 1.12 but the average ratio exceeded unity at 1.035. Using the monthly wholesale price as benchmarks and the observed ratio between wholesale price and retail price over the period, a representative average for the reference study period can be calculated.

The National Commission on Farmers (NCF) reported that milk producers in the Anand cooperative model got, net of intermediation, about 60% of the final price (NCF website), but given the spatial and qualitative variations this figure was only indicative. A 2014 estimate of 75% to 85% of consumer rupee going to the farmer has also been reported (Kulkarni 2014). These ratios from expert sources help in further deriving the producer price from the retail price estimated as explained above.

With the wholesale price of milk officially reported at ₹35.89/litre as of April 2015 used as an anchor, the producer price of milk for the same period was estimated to be ₹20.81 using the official NCF information and ₹27.74 using the average Kulkarni (2014) estimate of intermediation margin. The average producer price (grand mean) obtained from our surveys in all these three regions at ₹27.40 per litre is relatively closer to the estimate that uses the Kulkarni (2014) ratio, which therefore deserves greater confidence. Considering the variation in the observed ratio between the wholesale price and retail price, the estimated producer price using the Kulkarni estimate would lie between ₹25.64 and ₹30.87 per litre, while the price obtained from our survey was lower at about ₹23 in certain marketing channels, involving cooperatives and traders, and for occupation groups such as labour and small traders but higher up to ₹35 in direct sales. For further validation, the estimated retail price and producer price are also compared with consumer prices in urban and rural sectors imputed from the National Sample Survey Office (NSSO) data from 2004 and 2009.[5] The use of NCF ratio would lead to much lower estimates compared to what the NSSO data and our survey estimates would suggest.

Though pursuing a loss-making occupation can be arguably explained by unobserved peripheral transactions not taken into account in this study such as sale of calves and cowdung, the subsistence motivation can also justify the choice. Considering the milk production in a household computed at the annual level and the derived retention (Tables 3, 4 and 5), the imputed cost of home consumption valued at the estimated national level retail price was ₹26,000 in Bihar and ₹18,000 in West Bengal sampled districts, and the corresponding annual losses were computed as ₹9,000 and ₹17,000 respectively.

The analysis suggests gains from a subsistence perspective because the imputed consumption prices of producing households was less than the prices at which they would have hypothetically purchased in the market. On the contrary, in the northern region, the imputed cost of consumption in a sample household at ₹57,000 was a clear supplement to the income of ₹99,000.

Conclusions

On the whole, the study did not find milk production commercially profitable in many cases. Subsistence or family nutrition still persists as a strong justification for pursuit of the dairy occupation, which appears economically even less gainful in the eastern region, where traders are more dominant, than the northern region. The price of milk, animal stock size, yield, and income from milk sale varied according to occupation groups, the level of urbanisation of the area and the marketing channels used for reaching urban consumers. Sellers to private dairies access higher producer prices, but direct sale to consumers seemed most lucrative. The investment and scale of business appeared important for commercial success.

The global dairy market faced serious disruptions in recent times owing to landmark policy changes in the United States (US) and the European Union (EU), erratic demand arising in China, and complexities created by contaminations and geopolitical events. The prices are likely to be volatile and even decline (Sally 2014; Sheehan 2014) in the near future[6] but might firm up later; however, the uncertainties of market cannot be ruled out (Zohra 2007; Zohra et al 2009; OECD 2015; Sally 2014; Sheehan 2014; Shelton 2014; and St-Piere 2014). In the 21st century, as the markets open up, consumers in a food rich world appear to be interested in food produced in a sustainable way. So just producing higher volumes may not be enough for sutainable livelihoods in dairy. If India has to face global competition with respect to processed dairy products, efficiency, ethics, safety and profit would merit emphasis. The country faces a contradiction between protecting the interests of subsistence motivated small producers and strengthening the dairy sector more for facing competition than poverty mitigation.

NOTES

1 Forecasting Agricultural output using Space, Agro-meteorology and Land (FASAL) is a central scheme for supporting the statistical system for estimating agricultural production.

2 Khagaria is designated as one of the 250 most backward districts by the Ministry of Panchayati Raj.

3 The implementation of the Rashtriya Gokul Mission (RGM) and the establishment of two National Kamdhenu Breeding Centres (NKBC) are indicators of primacy given to conservation and development of indigenous genetic groups.

4 Enactment of Milk and Milk Product Order (MMPO) in 1992 initiated the process.

5 The estimated retail price is matched with imputed purchase price based on NSSO's quinquennial consumer survey data published in *Agricultural Statistics at a Glance* (MOAa, various) to gain confidence. Consumer prices of milk were from NSSO data in 2004–05 are ₹12.22 and ₹16.30 for the rural and urban sectors respectively compared to the producer price and retail price of fresh milk at ₹12.98 and ₹16.23 that we derive using wholesale price as an anchor and the indicative ratios. Similarly, in 2009 the estimates for retail price and producer price are ₹23.35 and ₹18.68 compared to urban and rural consumer prices of ₹25.60 and ₹19.55 from the NSSO data. This exercise presumes that rural consumer price would not differ much from producer price and retail price is approximately the urban price.

6 The outlook appears competitive as exporting countries revamp their management strategies and technologies to bring down cost of production in the run-up to the US Farm Bill 2014, EU's emergence from the quota regime in 2015 and dairy stock build-up in China which had been perceived as an import destination. These nations also enjoy advantage of cold weather as opposed to most regions within India.

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Appendix 1

Table A1: Performance Statistics (Simple Means) of Surveyed Households by Survey Districts

Districts	Animals		Marketing		Sold to Traders (%)
	Stock (₹'000)	Yield per Animal per Day (litre)	Price (₹/litre)	Annual Income (₹'000)	
Muzaffarnagar	97.0 (1.8)	12.20	35.80	37.91	0.0
Chandrawal	263.0 (6.5)	11.25	38.25	227.35	0.0
Faizabad	90.0 (2.3)	6.33	37.33	30.85	0.0
North 24 Praganas	15.7 (2.2)	1.60	20.40	-16.48	90.0
Nadia	34.4 (3.3)	3.36	22.43	-18.08	92.9
Khagaria	47.8 (2.3)	4.41	28.94	-9.05	47.1

Figures in parentheses are numbers.
Source: Computed from survey data.

Appendix 2

2A—Secondary data sources: National Sample Survey Office (NSSO), Ministry of Agriculture (MoA), National Dairy Development Board (NDDB), state government websites, and Food and Agriculture Organization (FAO) of the UN.

2B—Primary data collection: The survey in Khagaria district of Bihar state was conducted by the FASAL–IEG team in April 2015 as part of a larger study funded by ICIMOD, Kathmandu in Koshi–Ganga region. The surveys in North 24 Parganas and Nadia districts in West Bengal were conducted by West Bengal State University, Barasat (WBSU) team in Haringhata region in 2014–15 as part of students' curricular commitment. In the northern region, primary surveys were conducted in the two neighbouring states Uttar Pradesh and Delhi by the FASAL–IEG team. The households in the northern region were drawn from districts Muzaffarnagar and Faizabad in UP and from an urban village Chandrawal in Central Delhi.

2C—Private sector dairy firms: Madhusudan is a private dairy firm to which all the surveyed farmers in Muzaffarnagar sold their milk to. The firm has its factory in Burthana, and it sells milk and ghee in a branded packaged form. The agent interviewed collected milk from 50 producers twice daily, adding up to 520 litres, and sold it to the dairy company Madhusudan which delivered it to a centre with refrigeration facility.

In Khagaria, Bihar a private dairy called Ganga Dairy Limited (GDL or Ganga) competes with the Sudha brand cooperative for procuring milk from farmers. GDL specialises in the manufacture and storage of milk products. Situated 1,020 km from Patna on the railway route from Delhi to Guwahati on NH31, GDL was established in 1997 with a capacity of processing 10,000 litres of liquid milk per day. It also entered the milk powder business in 2006 and gradually began to produce many milk products, selling them to neighbouring states and to bulk consuming institutions. GDL maintains a relationship with farmers, has a cold chain infrastructure, and controls quality with the latest technology. Over time its plant capacity has been expanded and upgraded.

2D—Cooperatives in states under study: UP has the oldest model of cooperative in milk sales under the brand name Parag, which was established in 1917. A union was formed in Lucknow in 1938 followed by a federation for technical consultancy in 1962, and it later became an implementing agency of Operation Flood. In 1976, the state government set up the dairy development department. The UP cooperative federation (Pradeshik) set up processing and distribution units in several cities, a Jersey cow breeding unit, and an extensive network of offices.

In Delhi, though consumers are served by various cooperatives promoted under Operation Flood such as Parag (UP), Vita (Haryana), Paras (Rajasthan), the celebrated Amul brand of Gujarat and the Mother Dairy (National Capital Region) are probably more popular. Recently private brands like Nestle and Danone are also becoming popular.

In West Bengal, the state government had set up a dairy plant at Haringhata in 1950. A cooperative producers' federation, formed in 1983 with a three-tier Anand pattern, later took over extension and other developmental activities. When the Operation Flood was implemented, the directorate of dairy was dealing with chilled raw milk collection from unions, processing it in plants, and selling pasteurised and homogenised milk and milk products through its network of booths, but the state government was confronted with reduced demand. The distribution was subsequently handed over to milk federation/unions for management. Although socities and members of cooperatives are large in number, the state dairy enterprises have become loss-making and some have stopped operations.

In Bihar, the state government sanctioned a separate directorate for dairy development in 1981. In 1985, the dairy sector came under the Bihar State Milk Co-Operative Federation Ltd (COMFED), established in 1983 as part of Operation Flood. Progress was slow to start with but picked up as strategies changed in 1993–94.