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Economic Effect of COVID-19 Pandemic on Member and Non-member Farmers of Dairy Cooperative Societies in West Bengal State, India

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ABSTRACT

Background: The COVID-19 pandemic has brought an unprecedented threat to the dairy sector and it faced disruptions primarily due to the perishable nature of dairy products and the breakdown of the supply chain. In this study, an attempt was made to quantify the economic losses faced by the members and non-members of the Dairy cooperative societies (DCS).

Methods: The study was conducted in Howrah, Nadia and N-24 Parganas districts of West Bengal, India. A multistage sampling scheme was employed to select dairy farmers from each district. A total of 90 DCS member and 90 non-member dairy farmers were studied. The data collected from the farmers covered the three periods of the first wave of the COVID-19 pandemic *i.e.* pre-lockdown (January 01 2020 to March 23 2020), lockdown (March 24 2020 to May 31 2020) and post-lockdown period (June 01 2020 to December 31 2020).

Result: The total cost of milk production increased significantly by around 1 to 3% for DCS members and around 1 to 5% for non-members. The net returns from dairying were reduced significantly for both DCS members and non-members but it was more for non-members (lockdown: 80 to 90%, post-lockdown: 32 to 60%) than the DCS members (lockdown: 10 to 18%, post-lockdown: 7 to 15%).

Key words: Cost of milk production, Farm gate milk price, Lockdown, Post-lockdown, Pre-lockdown.

INTRODUCTION

Dairy farming has been an integral part of the agricultural landscape for thousands of years. In India, where over 70% of the population resides in villages, livestock farming plays a crucial role in the socio-economic life of the country. India is not only one of the world's leading milk producers, with a production of 198.4 million tonnes in 2019-20 and also the largest consumer of milk and milk products, with a per capita availability of 406 gm/day (DAHDF, 2019). The dairy sector in India contributes approximately 67% to the total livestock Gross Value Added (GVA) and about 5% to the national economy (Suthar *et al.*, 2019). The dairy sector employs approximately 80 million farmers in India (Drishti, 2022).

The Coronavirus, initially identified in Wuhan, China, rapidly spread across the globe, causing severe damage to various sectors of the economy. The dairy sector was particularly hard hit during the pandemic. Over the past two years, approximately 44 million people in India (including 2 million in West Bengal) were infected by COVID-19, resulting in half a million deaths (including 20 thousand in West Bengal) (GoI, 2022). In response to the spread of the virus, the Government of India (GoI) implemented strict measures, including a nationwide lockdown starting on March 24, 2020. Subsequently, a phased unlocking of social and economic activities began on June 1, 2020, with strict lockdowns still enforced in containment zones (GoI, 2020). Due to a massive vaccination drive, a significant portion of India's population became immune to the disease, leading the GoI to lift all COVID-19 restrictions in late 2021.

The lockdown imposed during the COVID-19 pandemic severely impacted dairy farmers (Goe *et al.*, 2023). Milk, being a highly perishable product, requires

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immediate transportation to consumers or other stakeholders after milking (Goe *et al.*, 2023; Gulsia, 2022). However, due to the lockdown restrictions, dairy farmers were unable to supply milk and suffered substantial losses (Das *et al.*, 2021).

The Dairy Cooperative Societies (DCSs) represent an organized structure within the milk supply chain, operated by the state governments of India. DCSs play a major role in procuring milk from their members, providing subsidized concentrate cattle feed and offering training in dairying. During the COVID-19 pandemic, DCSs implemented several relief measures to support their member dairy farmers and mitigate losses. These DCSs cover approximately 190,516 villages in India, with a combined membership of around 17 million dairy farmers. The average daily milk procurement through DCSs was 50.77 million kg (NDDB, 2019). Although the involvement of DCSs in the milk supply chain appears promising, the reality is that only 20% of milk is sold to the organized sector, such as DCSs, while 34% is sold to the unorganized sector, including milk vendors, private dairies and sweet makers. The remaining 46% is consumed locally (Mahida *et al.,* 2022). Hence, it is crucial to assess the economic setbacks experienced by both members and non-member (who supply milk to the unorganized sector) farmers of DCS. This evaluation is necessary because the operational modes of these two distinct types of dairy farmers differ, leading to varying degrees of economic losses. The research findings will enable researchers, extension personnel, policymakers, planners and administrators to make rational decisions that can positively impact the welfare of dairy farmers during pandemics or other challenging situations in the future.

MATERIALS AND METHODS

Study area and data sources

The present study was conducted in Howrah (22.5604°N, 88.0510°E, Coastal and Saline agro-climatic zone), Nadia (23.4710°N, 88.5565°E, New alluvial agro-climatic zone) and N-24 Parganas (22.6168°N, 88.4029°E, New alluvial agro-climatic zone) districts of West Bengal (22.9868°N, 87.8550°E), India (Fig 1).

A multistage sampling technique was employed to select the dairy farmers from each district. Three milk unions, namely Howrah Cooperative Milk Union Ltd., Howrah; Kishan Cooperative Milk Union Ltd., Nadia; and Ichhamati Cooperative Milk Union Ltd., N-24 Parganas, are working actively in the study districts. From each milk union, six DCSs were selected randomly. A total sample of 180 dairy farmers (DCS members-90; non-members-90) were selected randomly from 18 villages under the selected DCSs of the study districts. Primary data from dairy farmers were collected using a standard interview schedule. The study covers three periods of the first wave of the COVID-19 pandemic, *i.e.* pre-lockdown (January 01, 2020 to March 23, 2020), lockdown (March 24, 2020 to May 31, 2020) and post-lockdown periods (June 01, 2020 to December 31, 2020).

Analytical tools

Trends in dairying inputs and milk farm gate prices

The trends in prices of feed and fodder and milk farm gate prices during COVID-19 were analysed separately for DCS members and non-members using the box plot technique. Due to skewness in price data, median prices were considered for the comparison.

Gap in marketed surplus

A marketed surplus of milk indicates the actual quantity of milk sold to the market after household consumption.

Marketed Surplus = Milk production-Milk consumption

The gap in marketed surplus per day was estimated using the following formula and compared across three periods (pre-lockdown vs lockdown period and pre-lockdown vs post-lockdown period).

Gap in marketed surplus (%) =

$$\left[\frac{(\text{MS during period t})-\{\text{MS during period (t-1)}\}}{\text{MS during period (t-1)}}\right] \times 100$$

t = Lockdown or post-lockdown period.
t-1 = Pre-lockdown period.

Estimation of cost and net returns of milk production

The total cost of milk production and net return per litre of milk per day was estimated for pre-lockdown, lockdown and post-lockdown periods of the COVID-19 pandemic using standard methodology.

Fixed costs

These costs do not vary with the output level and remain unchanged in the short run. These costs include costs due to depreciation and interest on fixed capital. Annual depreciation of animals, buildings, machinery and equipment used in dairy farming practices was included for calculation using Capital Recovery Cost (CRC) method (Singh and Datta, 2016).

$$R = Z\left[\frac{(1+r)^n r}{(1+r)^n-1}\right]$$

Where:
R= Capital recovery cost.
Z= Initial value of the capital asset.
r= Interest rate.
n= Useful life of the assets.

Variable costs

Variable costs are those costs that vary with the output level and can be altered in the short run. Variable costs include costs of green fodder, dry fodder, concentrate feed, labour cost and miscellaneous expenditures.

Gross cost = Total variable cost + Total fixed cost

Net cost = Gross cost - Value of dung

Gross returns = Quantity of milk × Procurement prices of milk

Net returns = Gross returns - Net cost

Wilcoxon signed-rank test was used to test the significant differences in the prices of dairying inputs and farm gate prices of raw milk, marketed surplus of milk and total cost of milk production during the lockdown and post-lockdown periods as compared to the pre-lockdown period. The level of statistical significance was fixed at 5.00% (P≤0.05).

RESULTS AND DISCUSSION

The detailed estimated cost and returns of milk production for the pre-lockdown, lockdown and post-lockdown periods of the COVID-19 pandemic are presented in Table 1, 2 and 3 for Howrah, Nadia and N-24 Parganas district respectively. For brevity in presentation, the cost and returns of milk production were firstly compared between pre-lockdown and lockdown periods followed by pre-lockdown and post-lockdown periods of the COVID-19 pandemic.

(a) Pre-lockdown vs lockdown period

The total cost of milk production consists of total fixed cost (TFC) and total variable cost (TVC). During the lockdown period, the share of TFC in the total cost of milk production was about 36 to 37% for DCS members and about 30 to 35% for non-members (Table 1, 2 and 3). The fixed cost was considered to be the same across lockdown and post-lockdown periods given the short time duration.

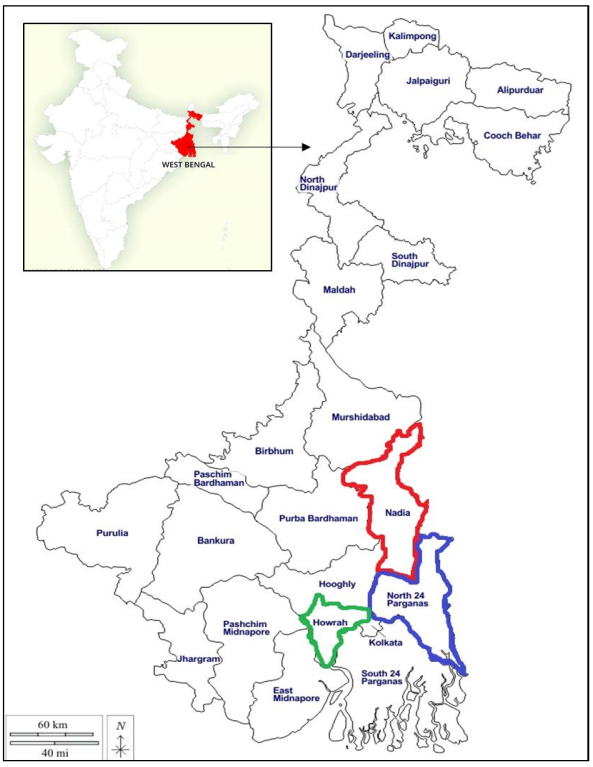

Fig 1: Physical map of West Bengal showing Nadia (red border), N-24 Parganas (blue border) and Howrah (green border) districts.

Table 1: Cost and returns of milk production for crossbred cows during the pre-lockdown, lockdown and post-lockdown periods of the COVID-19 pandemic in Howra (Rs./animal/day).

Particulars	Members			Non-Members		
	PRLD	LD	POLD	PRLD	LD	POLD
Variable cost						
Green fodder (A)	25.41	27.82	28.59	25.57	27.63	29.23
Dry fodder (B)	39.86	41.80	43.73	46.76	47.46	48.05
Concentrate feed (C)	18.55	18.81	18.18	29.94	30.26	31.23
Feed and fodder cost (D=A+B+C)	83.82	88.43	90.50	102.27	105.35	108.51
Labour cost (E)	19.39	16.07	18.16	23.43	22.01	22.85
Miscellaneous cost (F)	4.32	5.22	5.98	3.92	4.02	4.88
Total variable cost (TVC=D+E+F)	107.53	109.72	114.64	129.62	131.38	136.24
Total fixed cost (TFC)	65.94	65.94	65.94	55.94	55.94	55.94
Total cost (TC=TFC+TVC)	173.46	175.66	180.58	185.56	187.32	192.19
		(1.27)**	(4.10)**		(0.94)***	(3.57)***
Value of dung (G)	13.89	15.26	15.78	15.72	16.01	15.98
Net cost (NC=TC-G)	159.57	160.39	164.80	169.78	171.54	176.40
Milk yield (MY) (Litre/ Milch animal)	6.75	6.69	6.70	6.29	6.09	6.19
Farm gate milk price (MP) (Rs./Litre)	28.83	28.97	29.41	32.21	30.69	31.45
Gross return (GR=MY*MP)	194.64	193.64	196.96	202.47	186.76	194.77
Net return (NR=GR-NC)	35.07	33.24	32.17	32.69	15.22	18.36
Cost of milk production/Litre (NC/MY)	23.63	23.99	24.61	27.01	28.19	28.48
Net return/Litre (NR/MY) (Rs./Litre)	5.19	4.97	4.80	5.20	2.50	2.97
BC ratio (GR/TC)	1.12	1.10	1.09	1.09	1.00	1.01

Figures within parentheses indicate the percentage difference in total cost with respect to the pre-lockdown period.
Statistically significant at **P<0.01, ***P<0.001; PRLD- Pre-lockdown, LD- Lockdown, POLD- Post-lockdown.

TVC (green fodder, dry fodder, concentrate feed, labour and miscellaneous cost) contributes the most part of the total cost of milk production and significantly increased during the lockdown period as compared to the pre-lockdown period in all the study districts. In all the study districts, TVC was found to increase significantly during the lockdown period. Due to the increase in TVC, the total cost of milk production increased by 0.88% for DCS members and 2.54% for non-members (Table 1,2,3). In Howrah and N-24 Parganas districts the growth in total cost was significant for both members and non-members. Among the different components of TVC, feed and fodder costs were the major contributors to the TVC. Its share ranges from 76 to 79% for both DCS members and non-members across different study districts. Therefore, the trends in feed and fodder costs during the lockdown period are discussed elaborately in each district (Fig 2).

Fig 2(a) reveals that the variation in green fodder price was very minimal across the different COVD-19 pandemic periods for both DCS members and non-members. The range of price per kilogram of green fodder was Rs.2.8 to Rs.3.5. In 2020. Bhandari and Lal (2020) observed a 20-30% surge in green fodder prices during the lockdown period, a trend supported by the FAO (2020) in its global findings. Rude (2020) highlighted the double blow to dairy farmers, as elevated fodder costs coincided with reduced milk demand. Workie *et al.* (2020) noted a diminished access to green fodder during this period, while Das *et al.* (2021) in their meta-analysis identified escalating green fodder prices as a significant concern among dairy farmers grappling with the lockdown's economic impact.

As dry fodder can be stored for a longer duration, the dairy farmers purchased an excess quantity of dry fodder at the beginning of the lockdown period and stored it for future use. Due to panic buying, the demand for dry fodder for both DCS members and non-members surged during the lockdown period in all the study districts and this ultimately led to a rise in dry fodder prices. In Howrah district, dry fodder prices for DCS members increased from Rs.8 per kg during the pre-lockdown period to Rs.8.2 per kg ($P<0.05$) during the lockdown period. DCS non-members also faced a similar price hike. In Nadia district, the dry fodder price was lesser compared to the other two districts. In N-24 Parganas district also prices of dry fodder increased from Rs.7.5 per kg (pre-lockdown) to Rs.8 per kg (lockdown) for DCS members and Rs.8 per kg (pre-lockdown) to Rs.9 per kg (lockdown) for non-members (Fig 2b). During the lockdown period, Bhandari and Ravishankar (2020) noted a decrease in the availability of dry fodder, leading to a surge in prices. Singh (2020) identified various constraints during the lockdown, with the scarcity of dry fodder being a significant issue.

Table 2: Cost and returns of milk production for crossbred cows during the pre-lockdown, lockdown and post-lockdown periods of the COVID-19 pandemic in Nadia (Rs./animal/day).

Particulars	Members			Non-members		
	PRLD	LD	POLD	PRLD	LD	POLD
Variable cost						
Green fodder (A)	24.06	26.05	27.09	25.81	28.46	29.58
Dry fodder (B)	42.77	44.99	44.69	43.08	43.10	44.49
Concentrate feed (C)	16.77	16.98	17.82	30.03	31.12	31.40
Feed and fodder cost (D=A+B+C)	83.61	88.02	89.60	98.91	102.68	105.47
Labour cost (E)	17.53	12.08	16.94	20.19	17.47	19.86
Miscellaneous cost (F)	4.50	6.85	6.89	4.20	4.78	5.20
Total variable cost (TVC=D+E+F)	105.63	106.95	113.43	123.31	124.93	130.52
Total fixed cost (TFC)	60.48	60.48	60.48	65.80	65.80	65.80
Total cost (TC=TFC+TVC)	166.11	167.42	173.91	189.11	190.74	196.33
		(0.78)	(4.70)**		(0.86)***	(3.82)***
Value of dung (G)	12.56	12.88	13.02	10.89	10.95	11.23
Net cost (NC=TC-G)	153.55	154.54	160.89	178.22	179.79	185.10
Milk yield (MY) (Litre/Milch animal)	6.82	6.71	6.66	6.75	6.31	6.44
Farm gate milk price (MP) (Rs./Litre)	29.20	29.63	29.80	32.87	29.03	31.36
Gross return (GR=MY*MP)	199.16	198.85	198.53	221.85	183.27	201.85
Net return (NR=GR-NC)	45.61	44.31	37.64	43.63	3.48	16.76
Cost of milk production/Litre (NC/MY)	22.51	23.03	24.15	26.40	28.48	28.75
Net return/Litre (NR/MY) (Rs./Litre)	6.69	6.60	5.65	6.46	0.55	2.60
BC ratio (GR/TC)	1.20	1.19	1.14	1.17	0.96	1.03

Figures within parentheses indicate the percentage difference in total cost with respect to the pre-lockdown period.
Statistically significant at **P<0.01, ***P<0.001; PRLD- Pre-lockdown, LD- Lockdown, POLD- Post-lockdown.

Das *et al.* (2021) also reported the unavailability and increased prices of dry fodder during this period.

In all the study districts, the concentrate feed prices were significantly lower for member dairy farmers compared to non-member dairy farmers. The reason is that DCS members were receiving concentrate feed at a subsidized rate, whereas non-members purchased in the open market at the market rate. In Howrah district, the price of concentrate feed for DCS members remained stable during the lockdown period (Rs.13.5 per kg) [Fig 2(c)]. However, for non-members, it was found to increase from Rs.16 per kg (pre-lockdown) to Rs.16.2 per kg (lockdown). In Nadia district, concentrate feed prices remained stable for both DCS members (Rs.13.1 per kg) and non-members (Rs.16 per kg) during the lockdown period. In N-24 Parganas district, the concentrate feed price increased from Rs.13.9 per kg (pre-lockdown) to Rs.14 per kg (lockdown) for DCS members and from Rs.16.6 per kg (pre-lockdown) to Rs.16.7 (lockdown) for non-members. During the lockdown period, Chandel *et al.* (2020) observed a 40 to 50% surge in feed prices. This surge had cascading effects, as reported by Dadas (2020) impacting dairy farmers who struggled to provide an adequate quantity of feed to their livestock. Jhajhria *et al.* (2020) highlighted a significant rise in the cost of milk production due to escalated feed prices during the same period. Haritha (2021) further emphasized that the increased prices of concentrate feed adversely affected the profitability of dairy farmers. Thejesh *et al.* (2022) corroborated these findings, noting a 33% decrease in net return per litre of milk, with elevated concentrate feed prices being identified as a major contributing factor.

Labour cost per animal was found to decrease during the lockdown period in all the study districts. The reason behind this is that during the lockdown period dairy farmers hired fewer labourers to reduce the cost of milk production and to minimise the risk of COVID-19 infection. The present results aligned with the findings of Haritha (2021). Dairy farmers adopted serval precautionary measures (masks, sanitizer, sanitization process) against Coronavirus disease to keep their dairy farms in working condition. Therefore, miscellaneous costs (per animal per day) increased during the lockdown period as compared to the pre-lockdown period for both DCS members and non-members in all the study districts.

The gross return from dairy farming is worked out by multiplying milk yield with milk farm gate price. The trends in these variables are presented below.

During the lockdown period, milk yield was found to decline (Nzeyimana *et al.*, 2022) for both the category of dairy farmers in all the study districts. However, due to better feed and fodder management, the rate of decline was lesser for DCS members (1 to 6%) as compared to non-members (3 to 8%) (Table 1, 2 and 3).

Table 3: Cost and returns of milk production for crossbred cows during the pre-lockdown, lockdown and post-lockdown periods of the COVID-19 pandemic in N-24 Parganas (Rs./animal/day).

Particulars	Members			Non-members		
	PRLD	LD	POLD	PRLD	LD	POLD
Variable cost						
Green fodder (A)	26.23	26.37	28.36	26.55	28.10	27.66
Dry fodder (B)	37.47	38.37	38.37	36.25	41.18	38.61
Concentrate feed (C)	17.20	17.65	19.23	32.16	34.63	33.46
Feed and fodder cost (D=A+B+C)	80.90	82.39	85.95	94.97	103.91	99.73
Labour cost (E)	19.33	17.81	18.47	22.00	23.37	21.04
Miscellaneous cost (F)	5.25	6.22	6.78	5.98	6.44	6.39
Total variable cost (TVC=D+E+F)	105.49	106.41	111.21	122.95	133.72	127.16
Total fixed cost (TFC)	61.46	61.46	61.46	59.24	59.24	59.24
Total cost (TC=TFC+TVC)	166.95	167.88	172.67	182.19	192.96	186.40
		(0.56)**	(3.43)***		(5.91)***	(2.31)***
Value of dung (G)	14.14	15.58	15.94	15.04	16.54	16.43
Net cost (NC=TC-G)	152.80	152.30	156.72	167.15	176.42	169.97
Milk yield (MY) (Litre/Milch animal)	6.88	6.42	6.42	7.08	6.92	6.47
Farm gate milk price (MP) (Rs./Litre)	28.60	29.13	29.17	27.05	25.74	28.59
Gross return (GR=MY*MP)	196.74	187.07	187.36	191.55	178.19	184.93
Net return (NR=GR-NC)	43.93	34.77	30.63	24.40	1.77	14.96
Cost of milk production/ Litre (NC/MY)	22.21	23.72	24.40	23.60	25.48	26.28
Net return/ Litre (NR/MY) (Rs./ Litre)	6.39	5.41	4.77	3.44	0.26	2.31
BC ratio (GR/TC)	1.18	1.11	1.09	1.05	0.92	0.99

Figures within parentheses indicate the percentage difference in total cost with respect to the pre-lockdown period.
Statistically significant at ***P<0.001; PRLD- Pre-lockdown, LD- Lockdown, POLD- Post-lockdown.

DCS members mostly sell milk to DCSs and non-members mostly supply milk to milk vendors, private dairies and local consumers. In all the districts, the marketed surplus of milk for non-members reduced significantly by 6.7 to 100% and received lesser farm gate prices from private players (milk vendors and private dairies) during the lockdown period as compared to the pre-lockdown period (Fig 3). In contrast, marketed surplus of members sold milk to DCS increased significantly by 1.96 to 9% (Table 4) and received a stable farm gate price (Fig 3). The main reason is that the private players could not procure milk due to lockdown restrictions. The non-members who could not sell milk to private players sold milk to local village consumers in surplus quantity (Table 4) with a lesser price.

To estimate the gross returns from milk production, the average prices received from different players were considered. DCS members of Howrah, Nadia and N-24 Parganas districts received around 0.48%, 1.47% and 1.85% higher farm gate prices during the lockdown period as compared to the pre-lockdown period. On the contrary, during the same period milk farm gate prices received by non-members decreased by 4.71%, 11.68% and 3.51% in Howrah, Nadia and N-24 Parganas districts respectively (Table 1, 2 and 3).

The net return per litre of milk for both DCS members and non-members declined during the lockdown period compared to the pre-lockdown period in all the study districts due to the higher cost of milk production and reduction in milk yield and milk prices. However, the rate of reduction was substantially more for non-members (78%) compared to DCS members (7%) (Table 1,2,3).

(b) Pre-lockdown Vs Post-lockdown period

As indicated earlier the fixed cost of milk production remained the same during the lockdown and post-lockdown periods, but the share of TFC to the total cost of milk production was found to decrease (34 to 36% for DCS members and 29 to 33% for non-members) because during the post-lockdown period the share of TVC increased.

During the post-lockdown period also TVC was found to increase but the rate of increase was higher when compared to the rate of increase during the lockdown period. Due to the higher rate of increase in TVC, the total cost of milk production also increased for both DCS members (4.07%) and non-members (3.24%).

In Howrah district, green fodder prices showed a similar trend as shown in the lockdown period. In contrast, DCS non-members paid an equal price (Rs.3 per kg) during the post-lockdown period as compared to the pre-lockdown (Rs.3 per kg) period. In Nadia district, the green fodder prices surged from Rs.3 per kg to Rs.3.5 per kg for both member and non-member dairy farmers. In N-24 Parganas district the price hiked to Rs.3.5 per kg during the post-lockdown period from Rs.3 per kg during the pre-lockdown period for DCS members, however, the price remained stable for non-members (Rs.3 per kg) (Fig 2a).

In Howrah district, dry fodder prices for DCS members increased from Rs.8 per kg during the pre-lockdown period to Rs.8.5 per kg ($P<0.05$) during the post-lockdown. DCS non-members also faced a similar price hike. In Nadia district, dry fodder prices ranged from Rs.6.5 per kg during the pre-lockdown to Rs.6.8 per kg during the post-lockdown for DCS members. For DCS non-members, the price ranged from Rs.7 (pre-lockdown) to Rs.7.8 per kg (post-lockdown). In N-24 Parganas district also prices of dry fodder increased from Rs.7.5 per kg (pre-lockdown) to Rs.8 per kg (post-lockdown) for DCS members and Rs.8 per kg (pre-lockdown) to Rs.9 per kg (post-lockdown) for non-members (Fig 2b).

Table 4: Gap analysis of marketed surplus of milk by DCS members and non-members. (ΔMS%)

District	Period	Membership	Marketed surplus (ΔMS%)			
			DCS	Private dairy	Milk Vendor	Local village consumer
Howrah	PRLD Vs LD	M	1.96	-	-	-
		NM	-	-100	-6.7	21.79**
	PRLD Vs POLD	M	3.52**	-	-100	-
		NM	-	-35.65**	-5.51	24.36
Nadia	PRLD Vs LD	M	8.11*	-100	-100	-
		NM	-	-100	-26.19*	68.35**
	PRLD Vs POLD	M	7.29	-100	-66.67	-
		NM	-	-41.32*	-22	71.43**
N-24 Parganas	PRLD Vs LD	M	9	-	-83.33	-
		NM	-	-100	-20.48*	31.25**
	PRLD Vs POLD	M	9.06*	-	-70.83	-
		NM	-	-25	-19.82	8.33

Statistically significant at *P<0.05; **P<0.01, ***P<0.001.

PRLD- Pre-lockdown, LD- Lockdown, POLD- Post-lockdown, M- Member, NM- Non-member.

In Howrah district, the price range of concentrate feed per kg for DCS members was from Rs.13.5 during the pre-lockdown period to Rs.13.8 during the post-lockdown period (Fig 2c). However, it was Rs.16 to Rs.16.5 for non-member dairy farmers. In Nadia district, concentrate feed price increased from Rs.13.1 (pre-lockdown) to Rs.13.9 (post-lockdown) for DCS members and from Rs.16 (pre-lockdown) to Rs.16.3 (post-lockdown) for non-members. The price in N-24 Parganas was Rs.14.1 and Rs.17.5 per kg for DCS members and non-members, respectively. Our findings are consistent with the earlier literature. Chandel *et al.* (2020) and Das *et al.* (2021) documented that the escalated feed prices observed during the lockdown period persisted into the post-lockdown period as well.

In all the study districts, the labour cost during the post-lockdown period was found to move towards the level of the pre-lockdown period due to the relaxation of travel restrictions during that period. Miscellaneous costs showed an increasing trend during the post-lockdown period as well, because the dairy farmers still needed to purchase masks and sanitizers and they also needed to adopt other precautionary measures against Coronavirus to run their dairy farms safely.

As mentioned earlier gross return depends on milk yield and milk farm gate price. The trends in milk yield and milk farm gate prices are presented below.

Milk yield was also found to decline during the post-lockdown period as compared to the pre-lockdown level, but the rate of reduction was less when compared to the lockdown period. During the post-lockdown period, the decreasing trend of milk farm gate prices and marketed surplus of milk (Table 4, -5.51 to -41.32%) continued for non-members pouring milk to milk vendors and private dairies in Howrah and Nadia districts. However, in N-24 Parganas district, farm gate prices improved. For DCS members the increasing trend of farm gate prices and marketed surplus of milk (Table 4, 3.52 to 9.06%) continued in the post-lockdown period as well (Fig 3).

During the post-lockdown period, the milk farm gate prices showed a similar trend as shown in the lockdown period in all the study districts. For DCS members farm gate prices increased by around 2 to 3% and for non-members, it decreased by around 2 to 5% across different study districts (Table 1, 2 and 3).

The net returns per litre of milk also showed a declining trend during the post-lockdown period as compared to the pre-lockdown period for both DCS members (17%) and non-members (48%).

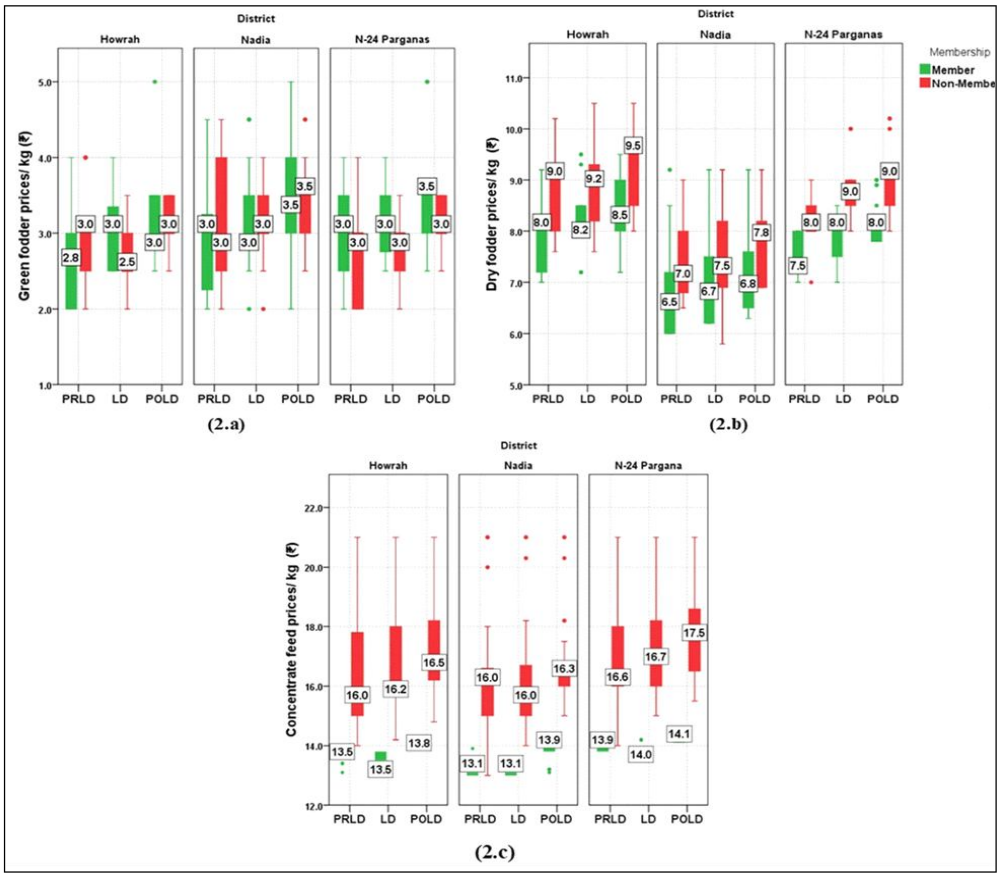

Fig 2: Trends in prices of (a) green fodder, (b) dry fodder and (c) concentrate feed during the COVID-19 pandemic.

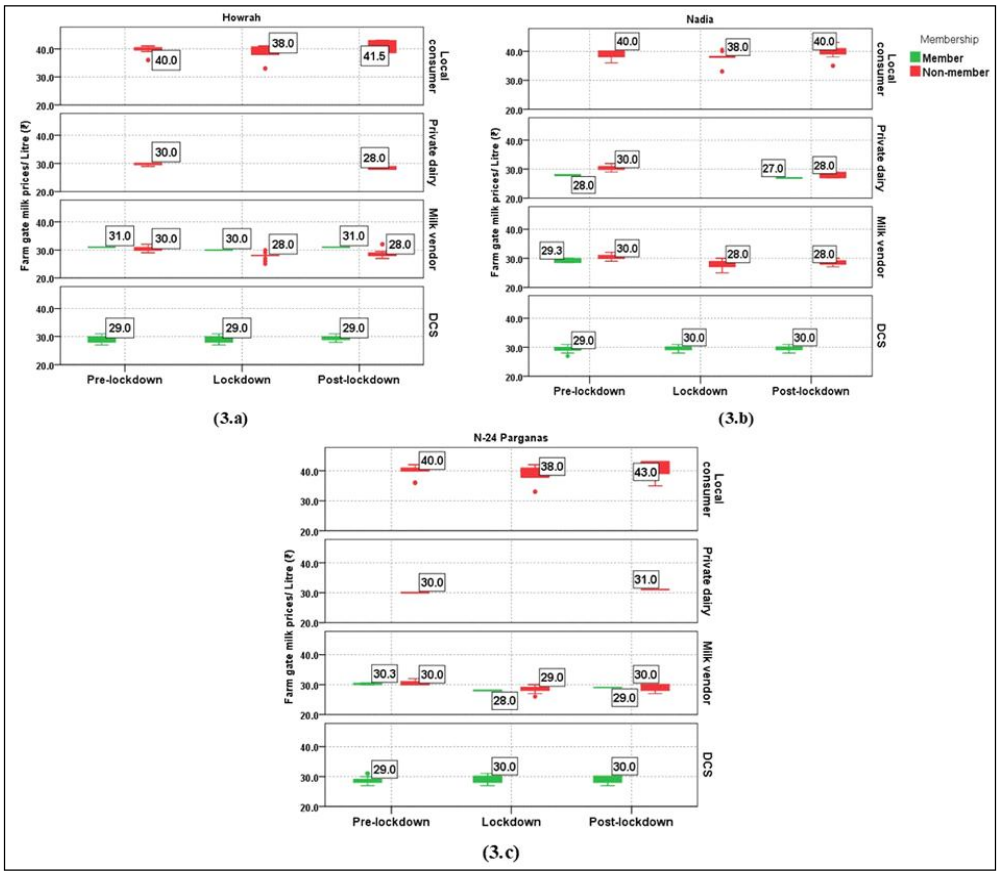

Fig 3: Trends in farm gate milk prices during the COVID-19 pandemic in (a) Howrah, (b) Nadia and (c) N-24 Parganas district.

CONCLUSION

The prices of dairying inputs were higher for DCS non-members than the members during both the lockdown and post-lockdown periods of the COVID-19 pandemic. The cost of milk production was also higher for non-members than the members. Net returns also contracted substantially more for non-members than the DCS members during the lockdown period. Therefore, DCS non-member dairy farmers should be made aware of the benefits of joining organized structures such as DCSs and FPOs (Farmer producer organization) to realize more economic benefits even during such a crisis. Milk unions should increase their area of operation so that a greater number of dairy farmers could be benefited from the dairy farmers' welfare policies of the government. During such a pandemic or any other calamities, the government may also adopt an inclusive approach by including non-members in their policies and programmes so that their grievances are also addressed.

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Conflict of interest

All authors declared that there is no conflict of interest.

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