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RESEARCH ARTICLE

Estimation of feed costs and feed efficiency in typical dairy Farms of Bangladesh during Coronavirus (Covid-19) emergency: implications toward feed support policy

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Abstract: Feed cost is the highest cost item to the total costs of dairy farming all over the world including India, Pakistan and Bangladesh. Reducing feed costs and increasing feed efficiency-are two promising ways to decrease the cost of milk production and increase the competitiveness nationally and internationally (Hemme et al. 2014). Feed price in Bangladesh dairy farm is 51% higher than global feed price which has increased further due to the sudden infection of Coronavirus (Covid-19) (IDRN, 2020). Therefore, the objective of this paper is to estimate the impact of pandemic novel Coronavirus (COVID-19) prevalence on feed costs and feed efficiency in order to find a suitable feed supporting policy to the dairy farmers. The International Farm Comparison Network (IFCN) Feed Simulation Approach and Technology Impact Policy Impact Calculations (TIPICAL) model was used for estimating feed costs and feed efficiency of the dairy farm with and without Corona situation (This model is highly relevant to this study due to the fact that this model can produce results even with the scarcity of the data and it is highly scientific and produce the results that are simultaneously used both Academia (University and Research organization) and Industry (for business strategic decisions). The Integrated Dairy Research Network (IDRN) dairy sector and dairy farm database (January 2019 to March 2020) was used where 2019 is considered as without Corona (WOC) and March 2020 is considered as with Corona (WC). Two typical farms:2cow farm (BD-2) which is representative of 42% household farm (Household Farm (HF) is defined as one the income source for livelihoods, mainly consumed at household level and sells the surplus milk. The average size of the household farm (1-3 cows/farm) as per the International Farm Comparison Network (IFCN) methodology) and fourteen cow (BD-14) which is representative of 48% family farms in Bangladesh were selected. The share of feed cost to the total costs of milk production is increased by 9.5% and 8.9% for BD-2/19-WC and BD-14/20-WC, respectively. The purchased feed costs before corona was 22.1 USD/100 kg milk for BD-2/19-WOC and 32.2 USD/100 kg milk for BD-14/19-WOC which is increased to 23.8 USD/100 kg and 35.0 USD/100 kg for BD-2/20-WC and BD-14/20-WC, respectively (Author's own results). The purchased feed costs increased by 7.6% and 8.7% for BD-2/20-WC and BD-14/20-WC, respectively while for the homegrown feed, it is increased even higher which is 14.1% and 9.7%, respectively. The results revealed that decreasing milk price and increasing feed price has direct impact on increasing feed costs of 8.6% and decreasing margin over compound feed costs by 4.5% due to Coronavirus. As a result, an increase in feed cost, decrease in the margin over total feed cost and the feed efficiency (total, energy, and protein efficiency) was observed due to coronavirus (Covid-19) infection. The finding of this study revealed that for short-term and medium-term, farmers might need feed incentives either in the form of reduced feed price or liberalized concentrate feed input market. The outcome of this study is expected to be beneficial for policy makers, feed suppliers and farmers in Bangladesh and similar other countries like India, Pakistan, Sri Lanka and Nepal.

Keywords: Covid-19, Feed Cost, Feed efficiency, Feed Policy, South Asia

Introduction

The novel Coronavirus infection, since its first identification in Wuhan province in China during the end of December 2019, its subsequent infection globally were highly pandemic with four peak time (Covid-19 wave) with different variants, Covid-19, Delta and Omicron, in all over the world including Bangladesh. This has made tremendous challenge for general wellbeing and health risk for millions of dairy farmers in Bangladesh and lead the dairy farmers under financial stress (Uddin et al. 2020**).** Realizing the overall impact of Coronavirus on human health, the government of Bangladesh responded with an immediate action by taking all possible options and preventive measures for the safety of human

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health. However, there was an impact on dairy farm and its costs and profitability due to Covid-19 (Uddin et al. 2020). Within the total cost of the milk production, feed cost represents the highest cost item in milk production. Therefore, it is highly interesting and motivating to estimate the impact of the Covid-19 on the feed costs and feed efficiency in Bangladesh dairy farms.

Considering this, dairy farming activity was taken as unique as it required special attention for 24 hours in a day and 7 days in a week and it is not possible to stop suddenly. Therefore, the dairy farming, was quite challenging during Corona period not only in Bangladesh but also in the neighboring country (India, Pakistan, Nepal and Sri Lanka). Apart from the economic loss, the dairy farmers fall under other three-dimensional problems: i) taking safety measures for their own health against Coronavirus, ii) managing the dairy cattle and preventing them, and iii) selling their milk regularly with normal price. Against this, milk price has decreased substantially which was 17% lower than the previous month in one hand and on the other hand feed price was increased by 3.7% (IDRN, 2020). This had further been aggravated by distorting the regular milk market channel causing limited access to milk market for selling their milk. This had negative consequences on the demand for milk. This implies that Corona had not only affected the human health but was continued its effect in the short and long-run on the economics of the dairy sector.

Feed and feeding management cost are the highest cost items in the dairy farming ranging from 18 to 82% of the total costs globally wherein that is from 65-72% in Bangladesh (Hemme et al. 2014; Uddin et al. 2010). The Bangladesh feed price was 51% higher than global feed price in which was further increased to 68% in March 2020 (IDRN, 2020). Apart from this, feed is the top agenda both at farm level, supply chain level, policy as well as international level because feed is the major input for increasing productivity, influential drivers for environmental sustainability, greenhouse gas emission and water footprint estimation (Hagemann et al. 2011; Sultana et al. 2014; Uddin and Akter, 2019). Against this, the pandemic Coronavirus infection (Covid-19) had strong impacted on increasing the cost of milk production of typical dairy farms with an average increase by 15% due to Corona (Uddin et al. 2020). Therefore, it is of high interest how did Coronavirus (Covid-19) affect to the feed costs and feed efficiency, which in turn, might be helpful for defining the strategy for supporting the dairy farmers by developing a conducive feed policy addressing the corona.

Methodology

Selection of model

This study utilizes the concept of International Farm Comparison Network (IFCN) developed by Hemme (2000) which is further refined and validated each year to update the model and increase its ability to take the real time changes in the model (IFCN, 2019). This method consists of three pillars: i) Typical Farm Approach (TFA), ii) Technology Impact Policy Impact Calculations (TIPICAL) model and iii) the Concept of dairy networking. This method is based on the principle of Farm Level Income and Policy Simulation Model (FLIPSIM) which was developed Texas A&M (Richardson, 1986). The IFCN is superior in simulation the sector data (macro level) to produce the changes in the farm output (micro level). The data and results in IFCN method reflected the real time (most up to date) than the FLIPSIM (Uddin et al. 2020).

Selection of the simulation variables

For estimating the impact of Coronavirus (Covid-19), five simulating variables which are considered most influential on the simulation model are selected which are i) Milk yield (-3%), ii) ii) Milk price (-17%), iii) Marketable milk (-4%), iv) Milk wastage (-5%) and v) Feed price (+3.7%) where the (-) indicates decrease and (+) indicates increase. The effect of Corona on the selected variables were taken from the IDRN database where the changes were taken compared with 2019 (without corona) March 2020 (with Corona).

Selection of typical farms

The changes of simulating variables were applied to the typical farms. To do this, two typical farms using the TFA approach of IFCN (Uddin et al. 2010; Hemme et al. 2014 and Sultana et al. 2014) were selected. The first typical farm is BD-2 cow, that represents the mode farm (the most frequently occurring farm in a normal distribution curve) with hard size ranges from 1-3 cows. This is called household farm (small farm) and the second one BD-14 cow is the family farms (medium farms). The selection of BD-2 cow farm is based on the Transect survey of 616 dairy farms with herd size ranges from 1-3 and BD-14 is based on the transect survey of 723 dairy farms with herd size ranges from 4-16. The selected household farm for this study represents the 42% of the farm and family farm represents 48% of the total farms in Bangladesh (IDRN, 2020). For further analysis and interpretation easily, it is worth to mention that IFCN farm classification approach has defined three types of dairy farms: i) Household Farms, ii) Family Farms and iii) Business Farms were selected which were defined as below:

Household farm (HF) is defined as small farms, dairy is the one the income source for livelihoods, mainly consumed at household level and sell the surpluses milk. The herd size ranges from 1-3 cows (global standard: 1-30 cows).

Family farm (FF) is defined as the medium farm, work is done mainly by family members, with a herd size from 4-16 (global standard: 31-300 cows).

Business farm (BF) is defined as the large farm who operates their business-based Return on Investment (ROI) and work is

done by mainly hired employee. The herd size is >16 (global standard >300).

Based on this, our farms represent household and family farms which are described below:

BD-2 is typical household farm which has 2 lactating and dry cows with 0.4 ha of land (10% for dairy) with a milk production of 945 kg (natural content without any correction for fat and protein) -2.59 kg/day/cow with mostly family labour and no hired labour.

BD-14 is typical family farms which as 14 lactating and dry cows with 2.3 ha land (35% for dairy) with a milk production of 1227 kg (natural content without any correction for fat and protein) -3.47 kg/day/cow with combination of both family and hired labour.

Typical farm- a typical farm represents the most common farm production system which produce significant proportions of milk in a country or region.

In the cross-farm comparison, milk is standardized to Solid corrected milk (SCM) (IFCN 2019). The SCM is standardized to 4% fat and 3.3% protein which is calculated as

Estimation of output variables

The output variables are estimated as below:

1.Activity based costing for total feed costs in dairy farms (USD/ 100 kg SCM)

$$\boldsymbol{AB_c} = \sum(CF_p + CF_{hg} + F\&M_c + M_c + C_{ch} + Mn_c$$

Where,

AB_c = Activity Based Costing (USD/100 kg SCM)

CF_p = Cost for purchased feed (C/100 kg SCM), CF_{hg} =Cost for Home Grown Feed Production (USD/100 kg SCM), $F\&M_c$ =Feeding and Manure handling cost (USD/100 kg SCM), M_c = Milking Cost (USD/100 kg SCM), C_{ch} = Cow handling cost (USD/100 kg SCM), Mn_c = Management Cost (USD/100 kg SCM), In = Infrastructure (USD/100 kg SCM)

2.Cost for purchased feed (USD/100 kg SCM)

$$\boldsymbol{CF_p} = \frac{(PF_c \times \%C_d) + (PF_{nc} \times \%NC_d)}{MM_p}$$

Where,

CF_p = Cost for purchased feed (C/100 kg SCM)

PF_c = Purchased Feed Concentrate (USD/year), $\%C_d$ =% of concentrate feed used for dairy (%), PF_{nc} = Purchased Feed Non-Concentrate (USD/year), $\%NC_d$ = % of non-concentrate feed used for dairy (%)

3.Cost for Home Grown Feed Production (C/100 kg SCM)

This estimation is varied based on whether the pasture land and some part of arable land is used for dairy or not.

Home-grown cost: If the pasture and arable land is not used for dairy:

$$\boldsymbol{CF_{hg}} = \sum FC - CF_p$$

Home grown cost: In case, where pasture and arable land is used for dairy

$$\boldsymbol{CF_{hg}} = (OC_{a\&p} + RC_{a\&p}) + (\sum FC - CF_p)$$

Where,

CF_{hg} =Cost for Home Grown Feed Production (USD/100 kg SCM)

$\sum FC$ = Total feed cost (USD/100 kg SCM), CF_p =Cost for purchased feed (USD/100 kg SCM), $OC_{a\&p}$ = Opportunity cost for own arable land and pasture land (USD/100 kg SCM), $RC_{a\&p}$ =Cost of rented arable land and pasture land (USD/100 kg SCM)

4. Share of feed cost to the total costs (%)

$$\boldsymbol{FC_{s-TC}} = \frac{\sum FC}{\sum AB_c + \sum AC}$$

Where,

FC_{s-TC} = Share of feed cost on total cost (%)

$\sum FC$ = Sum of total feed cost (USD/100 kg SCM), $\sum AB_c$ = Sum of Activity based costing (USD/100 kg SCM), $\sum AC$ = Sum of additional Cost (USD/100 kg) where, Additional cost includes opportunity cost for own land, own land-alternative use, own labour, own capital and own quota

5. Margin over feed costs (USD/100 kg SCM)

$$\boldsymbol{Mo_{FC}} = MP - CF_p - CF_{hg}$$

Where,

Mo_{FC} = Margin Over Feed Cost (USD/100 kg SCM)

MP = Milk Price (USD/100 kg SCM), CF_p =Cost for purchased feed (C/100 kg SCM), CF_{hg} =Cost for Home Grown Feed Production (USD/100 kg SCM)

6. Total feed efficiency (kg SCM/kg DM intake)

$$FE_t = \frac{MP_{c\&d}}{DMI_t}$$

Where,
FE_t =Total Feed Efficiency (kg SCM/kg DM intake)

$MP_{c\&d}$ = Milk Production per cow and day in SCM (kg/cow/day), DMI_t = Total Dry Matter intake (kg/cow/day)

Data and analysis

The data was taken from five sources: i) IFCN dairy sector data, ii) IDRN dairy sector and dairy farm database, iii) DLS 2019 annual data on livestock) online source of worldometer.info. and v) Conversion factor for BDT to USD from Bangladesh Bank and adjusted from www.oanda.com (conversation date: March 31, 2020) Data was analyzed using MS Excel 365 and TIPICAL software version 5.6

Results and Discussions

Effect on milk and feed prices across the country due to Corona (Covid-19)

Effect on milk price and Feed Price

The monthly development for Bangladesh dairy market price for milk and feed is depicted in Table 1. The milk price is shown at three levels: National, farmgate and consumer level. National feed is the average of formal and informal milk price. The feed price is the weighted average of mostly used feed ingredients in dairy farms, wheat bran (35%), rice polish (20%), mustard oil cake (25%) and corn (20%) which is used as national feed indictor.

The average milk price was increasing compared to 2019 in January 2020 from 43.79 to 45.09 BDT/kg, respectively which is 3% higher. As the Corona started globally especially in China and started to spread widely, this has already started to make impact on Bangladesh price which is decreased by 3% in February and in first half of March 1-5% and second half of the March it is 10%. This implies that Coronavirus infection is negatively correlated with milk price.

At the same pace, the feed price is increased 3.7% which cause imbalance in farm accounting system. The larger farm who is dependent mostly on purchased concentrate has been affected mostly. However, the overall decrease in milk price by 17% can be exemplified with deeper analysis on the individual regional decrease which will show the reality than the aggregate decrease at national level. Out of 64 districts, we have analyzed 43 districts among which, milk price is decreased in 37 districts (86%) while the milk price is increased for 4 districts (9.3%) and stable for 2 districts (4.7%).

The dairy farmers fall in critical situation as the decrease in milk price is combined with main feed input price (feed price) is increased by 3.7% (IDRN, 2020). However, the price increase for the different feed ingredient is shown in Table 2. Among four important feed ingredients price, the price of the wheat bran and rice polish, which together is used 55% of the weighted average diet, are increased following by corn price.

Effect of Coronavirus (Covid-19) on feed costs in typical dairy farms

Effect of Corona on the total activity costs

The IFCN farm simulation model have three different types of costs: i) Cost of milk production only (COMPO) which is the unique aspect of cost calculation in dairy farms. The COMPO is the real costs which are explicitly described the cost only to produce kg milk which is possible to compare with milk price, ii) The total cost of the dairy enterprise and iii) Activity based costing (ABC) which shows the feed costs and feeding and manure handling costs. The major concern for this study is the cost for all types of feed costs used in the dairy ration. The ABC is depicted in Figure 1. The figure shows that total costs have been increased by 15.12% and 10.18% for BD-2/19-WOC and BD-14/20-WC, respectively. The higher cost is mainly arisen from higher feed price. The feed cost is also increased due to Coronavirus as the share of feed cost to the total costs increased by 9.5% and 8.9% for BD-2/19-WC and BD-14/20-WC, respectively.

The higher feed cost is associated with lower profit as the input cost directly depress the output (Uddin et al 2010). To be profitable

Table 1 Dairy market development in Bangladesh: 2019 to March-2020

Parameter		Without Corona			With Corona	
Milk price	Unit	2019	*Jan/20	*Feb/20	15-Mar/20	31-Mar/20
National milk price	BDT/kg	43.79	45.09	44.21	42.91	40.49
Farmgate Informal	BDT/kg	48.4	50.6	48.9	46.3	41.43
Formal	BDT/kg	39.17	39.55	39.55	39.55	39.55
Consumer (unpasteurized)	BDT/kg	59.40	59.27	55.72	54.50	47.35
Consumer (pasteurized)	BDT/kg	71.0	71.0	71.0	71.0	73.33
UHT milk price	BDT/kg	90	90	90	90	90

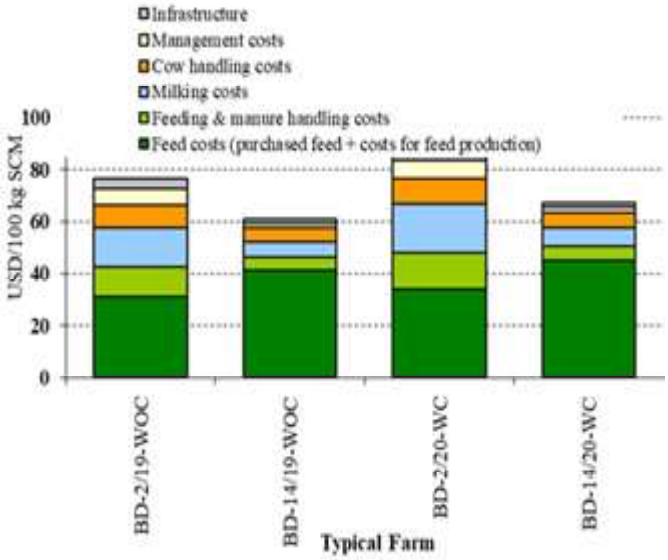

Fig. 1 Activity based costing (ABC) for dairy enterprise

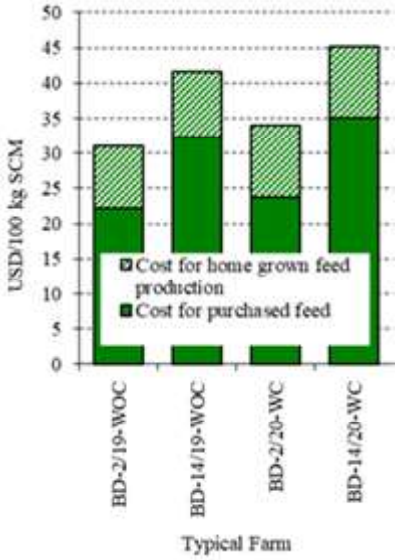

Fig. 2a Purchased and Home grown feed cost

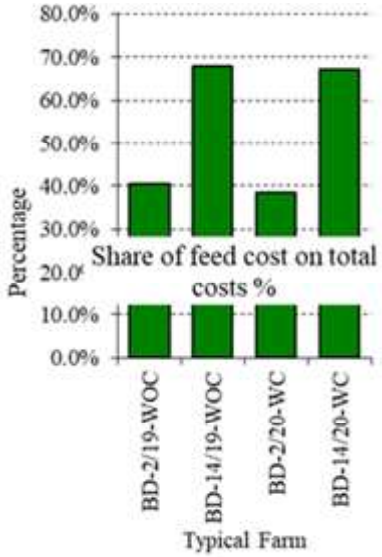

Fig. 2b Share of feed cost on total cost

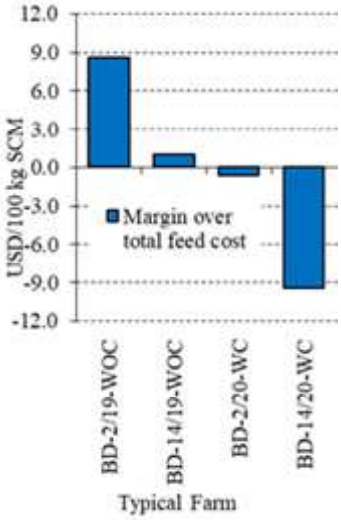

Fig. 2c Margin over total feed cost

Table 2 Feed Ingredient price development in Bangladesh: 2019 to March-2020

		Without Corona			With Corona	
Indicator	Unit	2019	*Jan/20	*Feb/20	15-Mar/20	31-Mar/20
Concentrate feed price	BDT/kg	27.17	28.39	29.45	29.16	30.05
Rice Straw: Basal feed for dairy	BDT/kg	8.04	7.47	7.29	7.46	7.91
Wheat Bran	BDT/kg	32.95	35.01	36.24	36.13	37.33
Mustard Oil cake	BDT/kg	34.19	35.33	36.13	36.12	36.15
Rice Polish	BDT/kg	12.46	12.65	13.35	13.05	13.86
Corn/Maize	BDT/kg	23.02	23.88	25.35	24.36	25.88
Milk price and feed /price ratio (MP:FP)		Ratio	1.61	1.59	1.50	1.47 1.35

Source: IDRN, 2020; Profitable dairy = Milk price and feed price ratio e" 1.5 (IFCN, 2019)

in dairy farming, it is necessary to decrease the costs. In order to decrease the feed costs, it is necessary to understand different share of the feed costs and its components.

Effect of Corona on the various cost components

The total cost of the typical dairy farm is composed of purchased

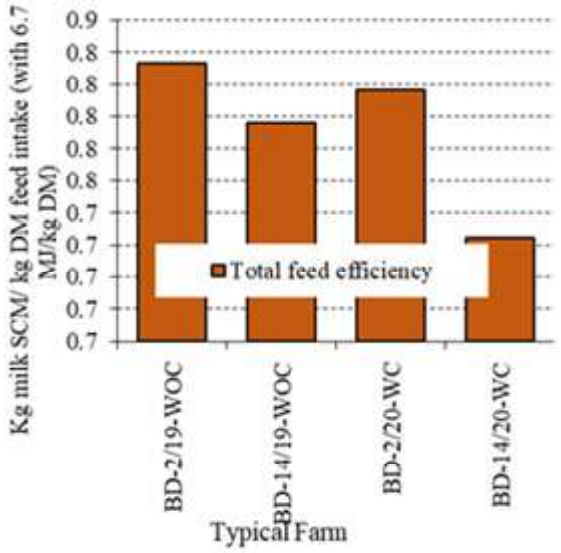

Fig. 3a Total feed efficiency

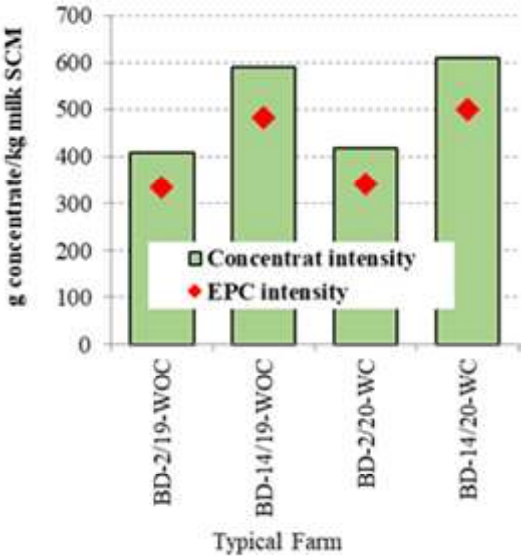

Fig. 3b Use of concentrate feed intensity

feed costs and home-grown feed costs which are depicted in Figure 4a. Both purchased feed costs and homegrown feeds are increased due to Corona. The purchased feed costs before corona was 22.1 USD/100 kg milk for BD-2/19-WOC and 32.2 USD/100 kg milk for BD-WOC which is increased to 23.8 USD/ 100 kg and 35.0 USD/100 kg for BD-2/20-WC and BD-14/20-WC, respectively. The purchased feed costs increased by 7.6% and 8.7% for BD-2/20-WC and BD-14/20-WC, respectively while for the homegrown feed, it is increased even higher which is 14.1% and 9.7%, respectively.

The higher purchased feed cost is due to the fact that increase in concentrate feed price which is the major share to the purchased feed. The higher home-grown might be due to the fact that the milk production is decreased which is reflected when the cost is expressed per 100 kg milk. However, interesting to note that share of the total feed costs the total costs remain stable which implies that farmers might have some adaptation to the cost reduction strategy where although the feed costs are increased but might take necessary precautions to control the other input costs.

The feed price increase as shown in Table 1 (methodological section) and also observed in the Figure 2a have negative impact on the margin over total feed costs which is depicted in Figure 2c. The higher feed cost influences the profit margin which is calculated as margin over total feed costs which is decreased substantially in larger farm (BD-14/20-WC) due to Corona mainly due to higher concentrate feed price. Before Corona infection started, the margin over total feed costs were 9 USD/100 kg milk and 0.98 USD/100 kg for BD-2/19-WOC and BD-14/19-WOC, respectively which is decreased to negative margin (0.6 USD/100 kg milk for BD-2/20-WC and -9.5 USD/100 kg milk for BD-14/20-WC). This implies that feeding management for the large farm is prior needs during corona and even after corona crisis. Since the larger farms have to rely more purchased feed and also use hired labour for operation the feeding, which together cause higher costs and now suffering from negative margin from the feed input. This signifies the immediate support from the government either by providing feed incentives or intervention on the feed market.

Effect of Corona on Total feed efficiency and concentrate feed intensity

The overall feed efficiency measured as total feed efficiency and concentrate feed intensity are used as the direct impact on profitability and costs of feed which are depicted in 3a and 3b. The figure 3a shows that total feed efficiency is decreased from 0.83 to 0.82 for small farms but substantial decrease in large farm which is from 0.80 to 0.72.

ncentrate feed intake (g/kg milk) is another useful indicator to improve the feeding management. Since the concentrate price or in other word, purchased feed is the highest cost item, increase in concentrate directly affect to increase the total cost of feed. The figure 3b shows that concentrate requirement per kg milk

production increases from 409 g to 417 g per kg milk production while for the large farm 592 g to 611 g. The benchmark for profitable dairy is considered as 300 g per kg milk production (IFCN, 2019) which is not found in any of the farm even before the corona infection. The corona infection has direct impact on increase the feed price, decrease the overall feed efficiency, and increase the cost of milk production leading decrease in profit.

Strategies toward feed support policy and replication to South Asian Countries

Dairy farming and milk production is the major source of income and livelihood of the most South Asian Countries (India, Pakistan, Bangladesh, Sri Lanka and Nepal) where these three countries are producing 29% of the global milk production which is shown in Table 3 (Uddin et al. 2011 and IFCN, 2019).

As shown in table 6 that unlike Bangladesh, India and Pakistan are the biggest contributor to the total global milk production raking first and 3rd in the global milk production. In contrast, the However, the three countries are facing similar trend while taking into account the farm responses toward milk production and milk price during the Coronavirus (Covid-19) crisis as it is seen the table 4.

It is quite clear that the highest decrease in milk production is observed during Covid-19 crisis. This if combined with feed price increase which is observed particularly for Bangladesh. However, Bangladesh government has taken dynamic decision as soon as the onset of the Corona infection with a financial supporting package of 11301.1 million USD (95615 Crore BDT) for agricultural support which is 3.3% to the total GDP of the country. The question remains what the real feed costs is with and without Corona situation and which type of farm should be supported for reducing feed costs and how much. The answer lies on the estimation of feed costs and feed efficiency considering with and without Corona. A synthesis of current research findings is presented in Table 5.

The results clearly revealed that purchased concentrate feed cost represents the highest cost which is accounted for 70% of the total cost of milk production (Tale 4) where the large farm has more concentrate costs than smaller one. In this regard, the findings of the present study clearly revealed that even the support for the small and marginal farmers are sought to be done but this results could guide that the feed support and price support is needed more for the large farmers compared with small farmers. The study done by Uddin et al. (2020) considering the effect of Corona on financial resilience, it was found that large farms were trouble due to decrease in operating capital and reduced cash flow.

The extent of the loss in the dairy industry will be further increased as a result of overall global and local economic loss at the macro level where feed costs and efficiency would play role to overcome the crisis. With immediate reactions from the government is to make short-term crisis management which has already been in implementation process while the medium to long-term strategies might need to be taken. To overcome the challenges arises from the crisis, all the stakeholders might have to take their own responsibility while the government can act as mediator and provide all kind of legal and regulatory actions. The multi-stakeholder's participation (e.g. dairy farmers, processors, input suppliers and companies, farmers association, university and research organization, policy makers and donor agencies in the development of strategic framework for addressing the impact of Coronavirus.

Table 3 Milk production in Bangladesh, India and Pakistan in relation to global milk production in 2019 (before Covid-19)*

Country	Milk production (m.ton SCM)	Comparison with Global (%)	Rank in Global
Bangladesh	8.36	1%	23
India	201.22	23%	1
Pakistan	48.36	5%	3

*Total milk production globally in 2019: 887 m. ton SCM
Source: IFCN, 2019 and IDRN, 2020 and adjusted to SCM (4.0% fat, 3.3% protein)

Table 4 Real time farm responses on milk production and milk price changes during COVID-19 time (March 2020)*

	February/20	March/20	February/20	March/20	February/20 *Vs* March/20	
Indicator	Milk production (m.ton SCM)		Milk price (USD/100 kg)		Milk prod. change (%)	Milk price Change (%)
Bangladesh	0.76	0.69	53.09	50.10	-8.0%	-5.6%
India	20.28	19.15	42.35	40.68	-5.6%	-3.9%
Pakistan	5.06	4.88	32.32	31.58	-3.7%	-2.3%

Source: Source: IFCN, 2020 and IDRN, 2020
*estimated based on IFCN real time monthly data in natural content and adjusted to SCM (4.0% fat, 3.3% protein)

Table 5 Different types of feed cost to produce 1 kg SCM and total feed efficiency

Parameter	Unit	BD-2/19-WOC	BD-14/19-WOC	BD-2/20-WC	BD-14/20-WC
Total feed costs (purchased + home-grown)	USD/kg SCM	0.31	0.42	0.34	0.45
	BDT/kg SCM*	26.23	35.11	28.56	38.052
Costs for purchased feed	USD/kg SCM	0.22	0.32	0.24	0.35
	BDT/kg SCM	18.70	27.24	19.99	29.4
Concentrate	USD/kg SCM	0.17	0.25	0.19	0.28
	BDT/kg SCM	14.76	21.41	15.86	23.226
Non-concentrate	USD/kg SCM	0.05	0.07	0.05	0.08
	BDT/kg SCM	3.95	5.86	4.25	6.3672
Cost for home-grown feed	USD/kg SCM	0.089	0.093	0.10	0.102
	BDT/kg SCM	7.53	7.87	8.57	8.568

*The results are also expressed in local currency for quick understanding for the local use; Currency conversion: 1 USD =84.61 BDT (2019) and 84.00 BDT (2020), SCM = Solid Corrected Milk.

The farmers have to make quick adaption to the changing farm and feeding management. As a first step is to change their feeding practices from purchased based concentrate feeding to locally available feed resources. Since the feed cost is the highest cost item for the dairy farms (Uddin et al. 2010, Hemme et al. 2014, Ndambi et al. 2008 and Alqaisi et al. 2019), the reduction in the concentrate feed would make trade off with cost of milk production. At the same time, the milk yield might be decreased which is quite meaningful to do since the market access become limited due to Corona. The other study done by Uddin et al. (2017) showed that cost reduction is the key strategy for increasing profit and in this case, feed cost reduction ´strategy can be taken by the famers where government support can be extended in the form of cash support per kg concentrate use or supporting the feed industry to reduce the compound feed cost for the dairy farmers. Hence altering the feeding management and rationalization of overall feed related activities are key areas that might be supported by the policy decisions.

At the same pace, the research organization and research networking should act as mediator among the key stakeholders between Government and famers as well as processors. The research organization should apply the suitable methods (either it is forecasting or forward modeling), networking among several stakeholders, analysis of the real time data and facts without any judgment, and visual the real status quo to the government for implement their strategic actions. The strategic action plan will be more effective once the data and facts are authentic. The government, in other way, also might use the research capacity and network for their use rather to rely on the annual published data.

Considering the negative impact of Coronavirus the Bangladesh Government initiatives to declare the emergency services for all the things related to dairy is highly appreciated to trade off the losses encountered by the farmers as well as to increase the farm level profitability from the negative to the positive trend. This study results are, thus, expected to be beneficial for the dairy farmers and policy makers as well as input suppliers (e.g. feed suppliers) and processors to take their right decision to increase the dairy farm income.

At this current scenario of the dairy sector development which has passed turbulent situation in Bangladesh, India, Pakistan, Sri Lanka and Nepal, the implications of this study might be extrapolated. Bangladesh has already taken incentives policy for providing the direct cash subsidy for feeding support to the dairy cows considering the loss of the Covid-19 between 60 USD/ household farm (BD-2) and 235 USD/family farm (BD-14). (With the latest data on global milk price and feed price which are decreasing trend in January 2022 in one hand and on the other hand, the on-going fourth Wave of Covid-19 (Omicron variants), each of the country can take strong lessons on the defining the feed policy both for feed ingredients and compound feed price considering the unexpected shock on feed market. Due to the fact that feed price vis-à-vis feed costs directly influence the profitability of the dairy farms, strategic actions plan on ensuring the feed with affordable price in all South Asian Countries are highly recommended.

Conclusions

The application of the farm simulation model of IFCN has produced the output which are quite helpful to make policy decisions. The impact of corona infection has impacted on feed price increase by 3.7% which has been translated to have impact at farm level by increasing purchase feed cost by 8.6% and decrease the margin over feed cost from positive to extremely negative which is from +4.8 USD/kg SCM to -5.05 kg USD/kg SCM. Total feed efficiency is decreased from 81.5% to 77% as a result of the incorporation of the corona infection in the analysis with higher decrease in large farm than smaller farm. To combat the corona-induced crisis, both type of farmers (small and large)

needs feed support, however, the relatively higher support might be sought for the large farmers. The findings of this study are expected to be useful for other country South Asian countries like India and Pakistan as the Covid-19 has affected with the similar pace in neighboring countries like India, Pakistan, Nepal and Sri Lanka

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