Indian Journal of Animal Sciences **91** (7): 582–594, July 2021/Article
https://doi.org/10.56093/ijans.v91i7.115908

Economic impact of COVID-19 pandemic on dairy sector: A meta-analysis

ABHIJIT DAS[1], MUNIANDY SIVARAM[1]✉ and THEJESH S[1]

Southern Regional Station, ICAR-National Dairy Research Institute, Adugodi, Bengaluru, Karnataka 560 030 India

Received: 29 March 2021; Accepted: 28 July 2021

ABSTRACT

The novel coronavirus discovered in Wuhan city of China has spread across the world and World Health Organization (WHO) declared it as pandemic. This pandemic has negatively impacted every sector of the economy including dairy sector. In this article, an attempt was made to undertake meta-analysis to assess the economic impact of COVID-19 pandemic on dairy sector with 71 published articles. About 30% of the authors reported that the limited availability of dairy inputs was the major issue for dairy farmers during pandemic followed by reduction in farm gate prices, unsold milk, increased input prices, reduction in milk production, decreased demand for milk and inferior milk quality. Only 3% of authors found that there was no impact of pandemic on dairy farmers. In case of dairy industries and dairy cooperatives, 40% reported that disruption of demand for dairy products was the major issue followed by difficulty in transportation of dairy products, labour issues, increase in inventory cost and decline in revenue. From consumption point of view, 36% of literature reported that people consumed more dairy products during pandemic followed by changes in consumption preferences, panic buying, increased milk prices and less availability of dairy products. Dairy international trade was also affected severely due to movement restrictions. The recommendations to minimize the financial loss to various stakeholders of dairy sector include availability of dairy inputs at subsidised rates, increasing procurement prices of milk, high-tech backend infrastructure, encourage domestic consumption and export of dairy products.

Keywords: Consumer, Dairy cooperative, Dairy farmer, Dairy industry, Dairy products, Milk, Lockdown, Unlock phase

Indian livestock sector contributes 28.2% to its total agriculture gross value added (GVA) and 5.2% to total GVA (MOSPI 2020). Dairy sector contributes about as high as 67% to livestock sector GVA (Suthar *et al.* 2019). India has held first position in global milk production for many years. As on 2019, India's milk production was 198.4 million tonnes (DAHD&F 2019).

Milk and milk products are considered as nutrient rich food as they supply phosphorus, magnesium, vitamin A, B_{12} and riboflavin to human body. Owing to its immense health benefits, people's attraction towards dairy products has been increasing day-by-day. The driving factors of the growth of Indian dairy sector include rising disposable income, nuclear family, change in the food habit and expansion of fast-food industries (Sunilkumar *et al*. 2016). According to 68th NSSO round, the monthly per capita expenditure on milk and milk products is greater than expenditure on all other food grains in urban area, whereas in rural area, the expenditure on milk and milk products comes next to expenditure on cereal products. To fulfil this high demand, milk production also increased very rapidly during the last decade. In India, per capita milk availability has increased from 273 g/day during 2010–11 to 407 g/day during 2019–20 (Sally 2021).

The dairy cooperatives are the backbone of dairying in India. The cooperative milk unions together covered 190,516 village dairy cooperative societies, with a cumulative membership of 16.93 million milk producers (NDDB 2019). The cooperative milk unions collectively procured an average of 507.69 lakh kg milk/day. The total number of women members in dairy cooperatives across the country was 5.06 million representing almost 30% of the total membership. Dairy sector provides huge employment opportunities both directly and indirectly. Approximately 20.5 million people across the country depend on cattle for their livelihood. It provides employment for around 8.8% of India's population (DAHD&F 2019).

The novel coronavirus (COVID-19) which was first discovered in Wuhan city of China has spread across the world. On 11 March 2020, the World Health Organization (WHO) declared the COVID-19 as pandemic. The number of COVID-19 cases has been increasing in the world day-by-day. Worldwide, more than 100 million people have been infected by COVID-19 and more than 2 million people have lost their lives in the battle against COVID-19.

Present address: [1]Southern Regional Station, ICAR-National Dairy Research Institute, Adugodi, Bengaluru. ✉Corresponding author email: sivaram.ndri@gmail.com

In order to prevent and contain the pandemic, the Government of India announced a series of nationwide lockdown since 24 March 2020, which limited the movement of 1.3 billion population of India. However, there has been a sequence of unlock phases to bring back normal life. Presently, the Central and State Governments are working hard to contain the disease spread and in the implementation of COVID-19 vaccine programmes. The pandemic has severely affected the Indian economy including dairy sector. The policies like lockdown, travel restrictions have disrupted the demand and supply chain of the dairy sector.

The COVID-19 pandemic in association with lockdown has changed the world economic scenario. The world economy experienced its sharpest year-on-year contraction for at least 40 years in the first quarter of 2020. Many of the major international forecasting institutes had expected 2020 to be the worst year for global growth since the 1930s (Linde 2020). The World Bank had forecasted a decline in world's GDP by 5.2% in 2020, which is fourth worst global downturn in 150 years (World Bank Group 2020). The lockdown has affected all the sectors (primary, secondary and tertiary) of the global economy. India is not an exception. According to National Statistical Organization (NSO), agricultural was the only sector whose growth was positive (2.9%) during the quarter April–June, 2020. The recent data from NSO shows that Indian GDP shrank by 23.9% year-on-year basis (Mahapatra 2020). Though, the growth rate of the Indian agricultural sector is in positive trend during the pandemic, but the effect of COVID-19 pandemic on both supply and demand side of the agrarian value chain is non-ignorable. There has been a huge disruption in the food supply chain due to potential labour shortages and restricted transportation and logistics services along with changing buying preferences of the consumers.

Among the stakeholders in the dairy sector, dairy farmers, dairy cooperatives and milk vendors are the most affected during the pandemic. Consumption pattern and preferences for dairy products have also changed due to this crisis. In the dairy sector, the demand for milk has not been impacted much but the demand for processed dairy products is adversely affected mainly due to demand disruptions caused by the lockdown. In many ways, the impact of COVID-19 pandemic on both demand and supply side of the dairy sector is noticeable. In this article we attempt to review and quantify the available literature from various sources, and provide a conceptual framework for the study of economic impact of COVID-19 pandemic on Indian dairy sector. The study also draws conclusions and policy implications for mitigating the effect of COVID-19 pandemic on Indian dairy sector.

MATERIALS AND METHODS

The economic impact of COVID-19 pandemic on dairy sector were reviewed and meta-analysis was undertaken with a total of 71 articles published as newspapers articles (16), web-based articles (20), research articles (13), popular articles (6) and research reports (16). The distribution of literature indicates that majority of the literature available in public domain are from Indian authors (59%) and rest are from other countries (41%) (Fig. 1). The study area wise distribution of literature is as follows: India (45), United States of America (4), Canada (5), United Kingdom/ European Union (5), Germany (1), Brazil (1), Italy (1), Switzerland (1), New Zealand (1), Australia (1), China (6), Bangladesh (1), Nepal (1), Ghana (1), Philippines (1), Egypt (1), Tunisia (1), Morocco (1) and country not specified (3). The major findings of the literature published by different authors and organizations are summarized in a tabular form for each of the stakeholder and according to focus area of research and study area. Component bar diagram and pie chart were employed to analyse the issues faced by stakeholders of dairy sector due to COVID-19 pandemic.

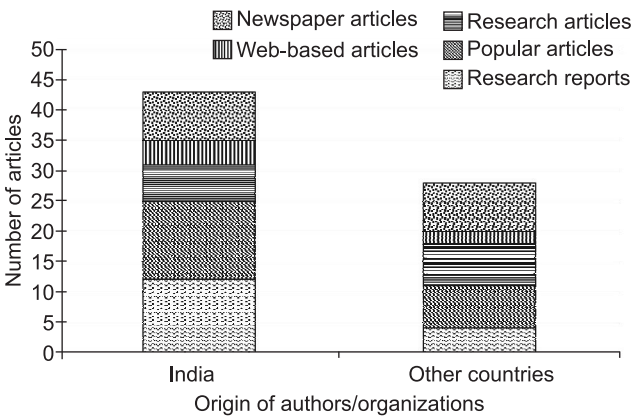

Fig. 1. Distribution of articles according to origin of authors/ organizations on the economic impact of COVID-19 pandemic on dairy sector.

RESULTS AND DISCUSSION

The major findings of the literature reviewed with respect to impact of COVID-19 pandemic on various stakeholders of dairy sector are summarized in Table 1.

Economic impact on dairy farmers: About 30% of the authors/organizations reported that limited availability of dairy inputs was the major issue faced by the dairy farmers during pandemic followed by reduction in farm gate prices (25%), unsold milk (12%), increased input prices (10%), reduction in milk production (10%), decreased demand for milk (5%), inferior milk quality (5%) and 3% of authors opined that there was no impact of pandemic on dairy farmers (Fig. 2).

Economic impact on dairy cooperatives and dairy industries: In case of dairy cooperatives and dairy industries (Fig. 3), maximum number of authors/organisations (40%) reported that disruption of demand for dairy products was the major issue followed by difficulty in transportation of dairy products from one place to another (23%), labour issues (17%), increase in inventory cost (10%) and decline in revenue (10%).

Economic impact on consumers of dairy products: From dairy product consumption point of view, a large number

Table 1. Summary of review of literature on the impact of COVID-19 pandemic on major stakeholders of dairy sector

Authors/Organization	Focus area	Study area	Key findings/Comments
		Impact on dairy	
Farmers Bavadam, 2020 (Newspaper Article)	Non timely payment, less farm-gate price	Maharashtra, India	Dairies have failed to pay regularly to farmers and they were unable to pay the same amount (40% less) of money to the farmers as of pre-pandemic. Dairy farmers dumped their milk production as a sign of protest.
Begum *et al*. (2020) (Research Article)	Low income	Bangladesh	About 12 to 15 million litres of milk remained unsold across Bangladesh per day, which caused Tk (Taka) 570 million in daily losses to the marginal dairy farmers. Milk farmers were forced to sell milk at Tk 10 to Tk 12/litre.
Bhandari and Ravishankar (2020) (Popular Article)	Input shortage	India	Dairy farmers faced problem in procurement of inputs to run dairy farm.
Bhandari and Lal (2020; Web-based Article)	Prices of feed and fodder	India	The prices of cattle feed and dry fodder increased by 20–30% during the lockdown. Farmers fed lesser feed and fodder to their animals, which leads to reduction in milk production.
Chandel *et al*. (2020) (Research Article)	Milk production, input shortage	India	Low milk production due to non-availability of inputs such as concentrated feed (40% less), fodder and labour.
Dadas (2020) (Newspaper Article)	Low profit	India	Low profit forced livestock owners to fed less feed and fodder to animals.
FAO (2020) (Research Report)	Feed/fodder scarcity, disruptions of income	Brazil, China, Ghana, Italy, Philippines, Egypt, Tunisia, and Morocco	Movement restriction caused scarcity of farm inputs such as feed/fodders. Disruptions of income from a small dairy farm caused more damage to women, which caused destruction in purchases of household essentials and nutrition.
Farmer's Weekly, (2020)(Web-based Article)	Market closure, production cost	USA	Limited access to markets forced farmers to keep their stock longer or dumped their milk production, which caused higher production costs or major losses.
Fleetwood (2020) (Research article)	Milk dumping	Switzerland	Dairy farmers in the United States and the United Kingdom dumped milk when demand in schools and restaurants dropped.
Food and Agriculture Centre of Excellence, (2020) (Web-based Article)	Demand-supply gap	India	Due to huge gap between demand-supply, farmers suffered the most as compared to other stakeholders, as they received less price for milk.
Huffstutter (2020) (Newspaper Article)	Supply chain disruption	USA	Due to disruption in supply chain, farmers were unable to transfer their dairy products to the market that resulted in the dumping of milk.
Hussain (2020) (Newspaper Article)	Less farm-gate price	India	The farmers were forced to sell milk at about ₹ 30/litre while they were getting ₹ 45/litre before the lockdown in March 2020.
ICAR-National Institute for Abiotic Stress Management, (2020) (Research Report)	Input unavailability	India	Milk production was adversely affected due to unavailability of inputs such as feed, fodder, medicine and vaccines; labour shortage for carrying out various physical activities and disruption in the marketing structure.
Jhajhria *et al.* (2020) (Research Report)	Low income	India	Local milk vendors were unable to collect milk from farmers, which caused significant loss as a significant amount of milk (25%) purchased by the vendors.
Kaur and Singh (2020) (Newspaper Article)	Low demand	Punjab, India	Small dairy farmers were worst hit due to lower demand and consequently no/partial procurement. Due to lack of good storage facility, farmers were forced to dump their milk.
Khan *et al.* (2020) (Research Article)	Low milk production	Not specified	Due to lockdown, the food and feed of dairy animals got affected which caused the decreased production of milk.
Khairnar (2020) (Newspaper Article)	Less farm-gate price	Pune, India	Some private dairies reduced farm-gate price by ₹ 6 to ₹ 10/litre during lockdown.
Kumar (2020) (Newspaper Article)	Milk procurement	Karnataka, India	As milk producers' cooperative societies have not stopped milk procurement from farmers or cut payments, dairy farmers did not face major problem during the lockdown.

(*Contd...*)

(Table 1 ... *concluded*)

Authors/Organization	Focus area	Study area	Key findings/comments
Lammifyad (2020) (Research Article)	Milk dumping	Not specified	The huge volume of milk was dumped due to closure of school and restaurants.
Lever (2020) (Popular Article)	Low demand, milk dumping	UK	Due to reduction of demand of milk, farmers were unable to sell their milk. Processors did not want to spend money on picking up milk and processing the milk, which caused dumping of milk.
Lusk *et al.* (2020) (Research Report)	Milk dumping, farmer income	UK	Farmers have dumped 3.7 million gallons of milk daily during the pandemic. Dairy farmers' income reduced by $3.97 billion nationwide in UK.
Mohan (2020) (Newspaper Article)	No loss to dairy farmers	India	There is no direct loss to dairy farmers, as there was higher procurement of milk than last year despite COVID-19 crisis.
Rude (2020) (Research Article)	Feed and labour	Canada	The feed sector is disrupted by labour shortages. Prices of feed increased.
Shashidhar (2020) (Newspaper Article)	Milk procurement	Maharashtra, India	Dairies were procuring more to help farmers and hence, surplus milk. There was a dip in procurement prices.
Shende *et al.* 2020 (Research Article)	Less farm-gate price	Maharashtra, India	Farmers got very less price (₹ 14–23/litre for cow milk and ₹ 21–25/litre for buffalo milk) during the lockdown period as compared to pre lockdown period where it was ₹ 26–35/litre for cow milk and ₹ 30–38 per litre for buffalo milk.
Singh *et al.* (2020) (Research Article)	Milk selling	India	The farmers faced problems in selling milk to their customers in town and cities.There was no significant decline in milk prices, dairy farmers were not found in any distress sale.
Singh (2020) (Web-based Article)	Input unavailability	India	Nationwide lockdown caused dairy farmers to reduced access to animal feeds, reduced access to inputs and services.
Tripathi *et al.* (2020) (Popular Article)	Income loss	India	Small farmers suffered heavy losses because of the pandemic as they were not able to sell milk to unorganized sectors such as halwai, milk contractors, milkmen, etc.
Weersink *et al.* (2020) (Research Article)	Milk quality	Canada	The supply of feed and other inputs for livestock production was restricted which caused inferior milk quality.
Workie *et al.* (2020) (Research Article)	Feed unavailability	Not specified	Livestock owners faced the problem regarding decreased access to feeds.
Zhang (2020) (Research Report)	Shortages of raw materials	China	Shortages of raw materials caused death to animal and poultry by starvation.
		Impact on dairy cooperatives/milk unions/dairy industry	
Agro and Food Processing (2020) (Web-based Article)	Labour management, milk procurement	Gujarat, India	During the lockdown, Amul provided extra cash incentives for dairy plant workers, drivers, sales executives, distributors and retailers, while daily workers received between ₹ 100–125 for their support for working during the pandemic. Amul provided accommodation facilities for workers inside dairy plants to avoid any labour shortages. As all hotel, tea stalls were closed, Amul received 15–17% more milk from farmers.
Bhandari and Ravishankar (2020) (Popular Article)	Labour shortage	India	Commercial dairy firms have faced the problem regarding the scarcity of labour as most of the migrant labourers have either returned to their home towns or are not able to reach their workplace
Bhandari and Lal (2020) (Web-based Article)	Low revenue	India	There was a significant reduction in the household demand for milk (–2.06%), paneer (–18.35 %), butter (–11.86%) and ice cream (nil consumption in 75% of respondent households) during the lockdown.
Bhosale (2020) (Newspaper Article)	Sale of dairy products	Pune, India	Some large dairies across the country have reported 50–100% jump in monthly sales of cheese, butter, paneer, cream and dairy whitener.
Cariappa *et al.* (2020) (Research Article)	Milk price Reduced demand	India	Unlike cereals, pulses and vegetables, milk prices were not severely affected by the lockdown.

(Continued...)

Table 1 (*Continued...*)

Authors/Organization	Focus area	Study area	Key findings/comments
Chechi (2020) (Newspaper Article)	Milk sale	India	Demand for dairy products dipped to 30%, as all the restaurants, sweet and ice cream shops, and other small manufacturing units were closed.
Coranil (2020a) (Web-based Article)	Government schemes	China	Milk sale increased as people were forced to remain at home and cook themselves.
Coranil (2020b) (Web-based Article)		India	The government has implemented several schemes for the development of dairy infrastructure during pandemic such as incentivization of investments in the establishment for dairy processing and value addition infrastructure, as well as the establishment of animal feed plants in the private sector. The government also set up a credit guarantee fund ₹ 750 crore.
Coranil (2020c) (Web-based Article)	Opportunity for dairy based industry	Australia	Keytone Dairy Corporation Limited in Australia saw this pandemic as an opportunity and developed dairy-based functional immunity booster powder. In China, sale of vitamins and dietary supplements has increased more than five-fold since the outbreak of Corona.
Coranil (2020d) (Web-based Article)	Sale of value added products	India	The sale of most profitable value-added products such as ice cream, cheese, flavoured milk, curd and yogurt has declined by 2–3%. Closure of hotels and restaurants during lockdown was responsible for the reduced sale.
CRISIL (2020) (Web-based Article)	Inventory cost, reduced sale	India	Surplus milk converted to skimmed milk powder (SMP) and unsold VAP inventory will increase. Due to restriction in transportation, dairy-based cold products did not reach to consumers on the peak demand season, resulting in reduced sale.
Dairy Business News, (2020) (Newspaper Article)	Govt. scheme	Canada	The government has increased the Canadian Dairy Commission's (CDC) borrowing limit by $200 million to allow cheese and butter to be temporarily stored and avoid waste.
Denver (2020) (Newspaper Article)	Price volatility	China	High price volatility occurred in dairy products throughout the lockdown period.
DPAC (2020) (Research Report)	Demand fluctuation	Canada	Due to pandemic, there was an unforeseen rapid fluctuation in demand for milk and dairy products.
Fodware 365 (2020) (Research Report)	Demand for dairy product	European Union	Demand for dairy products decreased from both EU and non-EU countries. The prices for packaging materials reached high which ultimately caused increased price in dairy products.
Food and Agriculture Centre of Excellence, (2020) (Research Report)	Demand crunch, Govt. scheme	USA	Demand for milk and milk products decreased by 30–35% due to closure of the HORECA (hotels, restaurants and catering) sector, QSR, unorganized sector, as well as sweetmeat shops. US Government announced a USD 3 billion relief package for the dairy industry. The USDA has announced that USD100 million/month will be spent on purchasing dairy products for food banks.
ICRISAT (2020) (Research Report)	Sale of dairy products	India	The sale of dairy products has been hit hard during the lockdown period.
Indo-Asian News Service (2020) (Newspaper Article)	Excess milk	India	Dairy cooperatives like Mother Dairy, Amul, Nandini, Parag and several others procured surplus milk from farmers while hundreds of milk plants across the country and produced skimmed milk powder to utilise the excess milk in supply.
Jitendra (2020) (Web-based Article)	Labour shortage	Gujarat, India	Cooperative units that opened with the help of the administration suffered from a lack of labour supply.
Kelkar (2020) (Newspaper Article)	Milk procurement, dip in demand	Gujarat, India	Amul procured 17% more milk or 45 lakh litre/day of milk during the initial months of lockdown.Amul's sales dip 10–15% depending on the city, as HORECA (hotels, restaurants and catering) segment closed down.

(Contd...)

Table 1. *(Continued...)*

Authors/Organization	Focus area	Study area	Key findings/comments
Khan *et al.* (2020) (Research Article)	Supply of dairy products	Not specified	Supply of dairy products became scarce in the market.The impact of COVID-19 on the dairy industry was different in different locations based on the number of active cases of COVID-19.
Khairnar (2020) (Newspaper Article)	Labour shortage	Pune, India	Milk unions severely faced a shortage of raw materials and workforce.
Lammifyad (2020) (Research Article)	Economic loss	Not specified	Dairy product processing industry was highly suffered by the outbreak of the virus. The virus affected dairy processors and dairy cooperatives morally and economically.
Maji *et al.* (2020) (Popular Article)	Sale of dairy products	India	The 21-day lockdown drastically reduced the milk sales as bulk consumers such as hotels, restaurants and cafes across the country were shut down and inter-state movement of dairy products was stalled.
Mukherjee (2020) (Newspaper Article)	Excess skimmed milk powder, inventory cost	India	There was a huge inventory of unsold skimmed milk powder (SMP) and other products on dairy cooperatives, as they converted the excess milk to the products. Indian cooperative milk unions were holding around 170,000 tonnes of SMP, which was 62% more than the same period last year. They were also holding around 104,000 tonnes of butter, which was 40.5% more than the same period last year and 22,000 tonnes of ghee (47% more).
Nepal Sansar (2020) (Research Report)	Low supply, monetary loss	Nepal	The supply of milk and dairy products has reduced by 75% in urban areas due to COVID-19 lockdown. Due to lockdown, there was a damage of milk and dairy products worth NPR 2 billion.
Raghu *et al.* (2020) (Web-based Article)	Inventory of skimmed milk powder, ice cream sale	India	Weak demand for ice cream during the peak summer season, which coincided with the nationwide lockdown, led to a sharp rise in the inventory of skimmed milk powder. As restaurants, retail stores, street vendors and ice-cream parlours shut down, sale of milk nosedived and ice cream was down by almost 50% as April 2020 and May 2020 are the two peak months for the sector.
Rath (2020) (Newspaper Article)	Profit to industry	India	COVID-19 has benefited the dairy industry as consumers shifted from meat-based to dairy-based protein.
Tripathi *et al.* (2020) (Popular Article)	Loss to industry	India	Around 20–25% of loss occurred in the dairy industry due to lockdown.
		Impact on dairy consumption	
Agro and Food Processing (2020) (Web-based Article)	Panic buying	India	There was a huge scarcity of dairy products during the initial stage of lockdown, as people brought more dairy-based product as there was an announcement of lockdown for 21 days.
Amrinder (2020) (Web-based Article)	Consumer preferences	India	After the outbreak of pandemic, consumers have more preference for hygienic products, so their preference has transferred to packaged products, which caused low demand for milk from local milkman (dudh wala).
Bhosale (2020) (Newspaper Article)	High demand of dairy products	Pune, India	Consumers in big cities have demanded nutritious food during the pandemic, which caused a rise in dairy-based products.
Chechi (2020) (Newspaper Article)	Surge in milk consumption	India	There was a significant surge in milk consumption during the first 2–3 days, due to panic-driven buying and customers stocking milk.
Coranil (2020a) (Web-based Article)	High demand of dairy products	China	Consumer expenditure on milk and milk products has increased due to health concern in China. About 47% of people have reported that they were extremely concerned about their health.
Dadas (2020) (Newspaper Article)	Consumer income	India	Due to the loss in income, most of the consumers did not prefer to buy livestock products.

(*Contd...*)

Table 1 (*concluded*)

Authors/Organization	Focus area	Study area	Key findings/comments
Denver (2020) (Newspaper Article)	Consumer habit	China	Consumers increased purchase of dairy products, as processed cheese sales increased by nearly 20% during the eight weeks ending 31 May 2020. White milk sales gained more than 10% during the same period.
Fitch Solutions (2020) (Research Report)	Consumption pattern	India	Demand for staples and basic dairy products remained relatively steady, but the consumption of high-end dairy products dropped due to the collapse of the hospitality sector under lockdown.
Huffstutter (2020) (Web-based Article)	Panic buying	USA	Due to panic buying, retail purchases of milk rose nearly 53% during the initial stage of lockdown, while butter sales surged more than 127% and cheese rose more than 84%, compared to the same period a year earlier.
Ipsos Group (2020) (Research Report)	Dairy demand	China	The demand for dairy remained strong despite the epidemic in China. In some places, consumers had even spent more on dairy. As everyone needed to stay at home both pure milk and yoghurt in normal temperature were popular with in-home consumers.With stronger health awareness among the consumers, the performance of dairy sales was quite noticeable as compared to other food products.
Kelkar (2020) (Newspaper Article)	Sale of dairy products	Gujarat, India	As consumers were stuck at home much of the summer season, sales of milk and milk products like ghee, paneer, cheese and chocolates surged.
Mead *et al.* (2020) (Research Article)	Hike in prices	USA	In June-2020, dairy prices rebounded sharply, increasing 24.5%. Higher input costs, coupled with low inventories and cold storage stocks, pushed cheese prices dramatically higher. Milk also contributed to higher prices because of large government purchases as part of the US Department of Agriculture Farmers to Families Food Box program
Petetin (2020) (Research Article)	Lack of stock	UK and Germany	There was a lack of availability of dairy products in the market due to restriction in transportation.

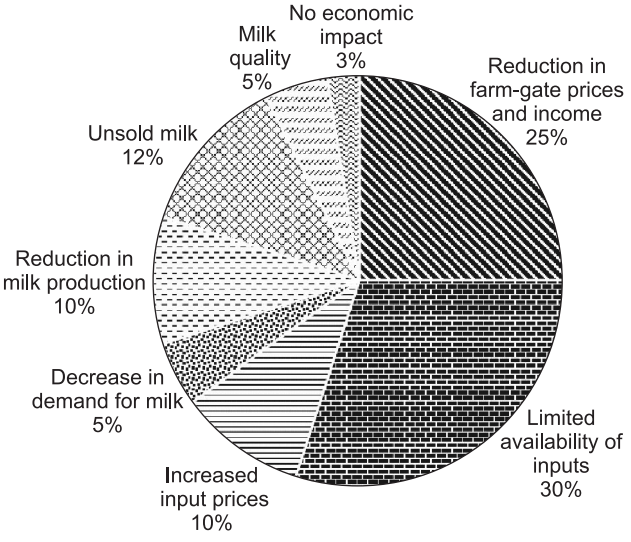

Fig. 2. Major issues with respect to economic impact of COVID-19 pandemic on dairy farmers.

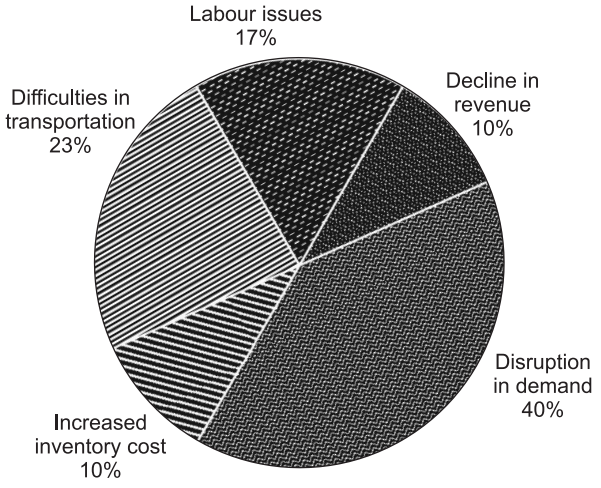

Fig. 3. Major issues with respect to economic impact of COVID-19 pandemic on dairy cooperatives/ dairy industries.

of authors/organizations (36%) reported that people consumed more dairy products during pandemic and there was an increase in demand for dairy products (Fig. 4), followed by changes in consumption preferences of dairy products (29%), panic buying (14%), increased prices of dairy products (14%) and less availability of dairy products (7%). Consumption of dairy products depends upon the availability of dairy products in the market at affordable prices and socio-economic conditions of the consumers. As regards consumption of dairy products in India, the

Table 2. Summary of review of literature on impact of COVID-19 pandemic on dairy international trade

Authors/Organization	Focus area	Study area	Key Findings/comments
Barichello (2020) (Research Article)	Livestock price in Canada	Canada	A year-to-year comparison of growth rates to March 25 2020, revealed that international market prices of livestock products have fallen by 15%. Livestock, pulses, and horticulture products faced a larger trade decline due to the large loss of purchasing power in many importer countries.
Civils daily (2020) (Web-based Article)	Export-supportive infrastructure in India	India	India has trade-surplus on commodities like rice, meat, milk products, tea, honey, horticultural products, etc. but due to worldwide lockdown, the surplus amount decreased drastically. Development of export-supportive infrastructure and logistics would need investments and support of the private sector that will be in the long-term interests of farmers in boosting their income.
Coranil (2020e) (Web-based Article)	More export in UK	UK	During the lockdown, Granny Gothards explored new export opportunity by developing in multi-flavoured ice cream and during lockdown; they earned 35% more profit by exporting.
Dadas (2020) (Newspaper Article)	Trade chain in India	India	Due to global lockdown, inter-country and intra-country trade chains were disrupted. Restrictions on transport disrupted supply and trade that caused huge livelihood losses across the country.
Keelery (2020) (Web-based Article)	Export quantity in India	India	About 110 thousand metric tonnes of dairy products worth over 19 billion Indian rupees were exported from India in the financial year 2020. This was a significant decrease from the previous year's export volume of over 180 thousand metric tonnes.
Mead *et al.* (2020) (Research Article)	Export price in US	USA	Export prices for dairy products and eggs fell 5.3% from January to April 2020 before declining 11.9% in May 2020.
Ministry of Commerce and Industry India (2020) (Research Report)	Import price in India	India	Imports of dairy produce in India decreased to 11.34 USD Million in 2020 from 24.97 USD Million in 2019.
Pandey (2020) (Newspaper Article)	FAO Food Price Index	USA	The FAO Food Price Index (FPPI) showed that international price dairy rose by 4.5% for the Indian Context.
Sally (2020) (Newspaper Article)	SMP export from India	India	There is a huge demand for Indian skimmed milk powder and white butter in countries like Nepal, Bangladesh, the UAE, Egypt and Singapore. India has a stock of more than 200,000 tonnes of SMP, dairy cooperatives in India asked govt. to provide an export subsidy so that they can export more quantity, as there is an excess quantity of SMP available in the country.
Shashidhar (2020) (Newspaper Article)	Global demand of SMP	India, New Zealand	Before the outbreak of COVID-19, the Indian dairy industry was going through a shortage of milk and lot of private dairy companies were planning to import SMP from countries such as New Zealand to make up for the shortfall. The global SMP prices, which had sky-rocketed to ₹340/kg before the COVID-19 outbreak, in the last few weeks have crashed to ₹ 230/kg, with demand in the global markets also dipping.

demand for dairy products was less during pandemic. On the other hand, abroad nations reported that consumption of dairy products increased during pandemic.

Economic impact on international dairy trade: The review suggests that dairy international trade was affected due to COVID-19 pandemic (Table 2). The nationwide lockdown along with movement restriction between countries caused damage to international trade. However, some countries took advantage of this pandemic, and developed some dairy based immunity-booster products and

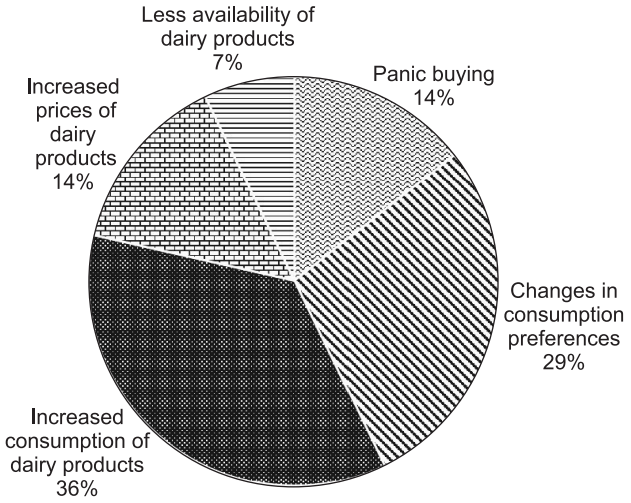

Fig. 4. Major issues regarding consumption of dairy products due to COVID-19 pandemic.

supplied to other countries during post pandemic period and earned more revenue. For this reason, in some countries, an increase in export of dairy products was seen during post pandemic situation.

Conceptual framework depicting impact of COVID-19 pandemic: Based on the above meta-analysis, a conceptual framework for the study of possible impact of COVID-19 on various stakeholders of dairy sector is presented as Fig. 5 and discussed below.

1. *Dairy farmers:* They have faced tremendous problem due to very limited availability of feed and fodder on regular basis. The dairy farms which are located in town are suffering from this problem the most (Jhajhria *et al.* 2020). On the other hand, the farms that are located in the villages have faced problems relating to availability of feed and to animal health (vaccination) and breeding services (artificial insemination). These disrupted the milk yield and milk quality affecting the profit (Bhandari and Lal 2020).
2. *Dairy cooperatives:* Due to lockdown, teashops and restaurants were closed and thus affecting the demand for milk. However, dairy cooperatives were to procure the milk to save the farmers. The excess milk collected were converted into skimmed milk powder to increase the shelf life of milk (Mukherjee 2020). Further, due to lesser demand for milk products, the sale of milk products was less which led to increase in inventory cost. They are also facing a problem regarding the scarcity of workforce, which causes difficulty in supply chain and value addition.
3. *Dairy industry:* Due to unavailability of the workforce, dairy industries are facing difficulties in running the firm smoothly and creates interruptions in the value addition process (Shashidhar 2020). Restriction in transportation is also another major issue for the dairy industry as to move final milk products to a distant market. Like dairy cooperatives, they are also facing the problem of increasing inventory cost due to diminished demand (Raghu and Deb 2020).
4. *Wholesalers/retailers:* They are not able to maintain the stock of products, as they are receiving less/excess amount from industries and cooperatives due to disruptions in transportation. This causes vast price fluctuations (Hobbs 2020).
5. *Local milk sales man:* After the outbreak of the pandemic, consumers have preferred more to hygienic products, so their preference has transferred to

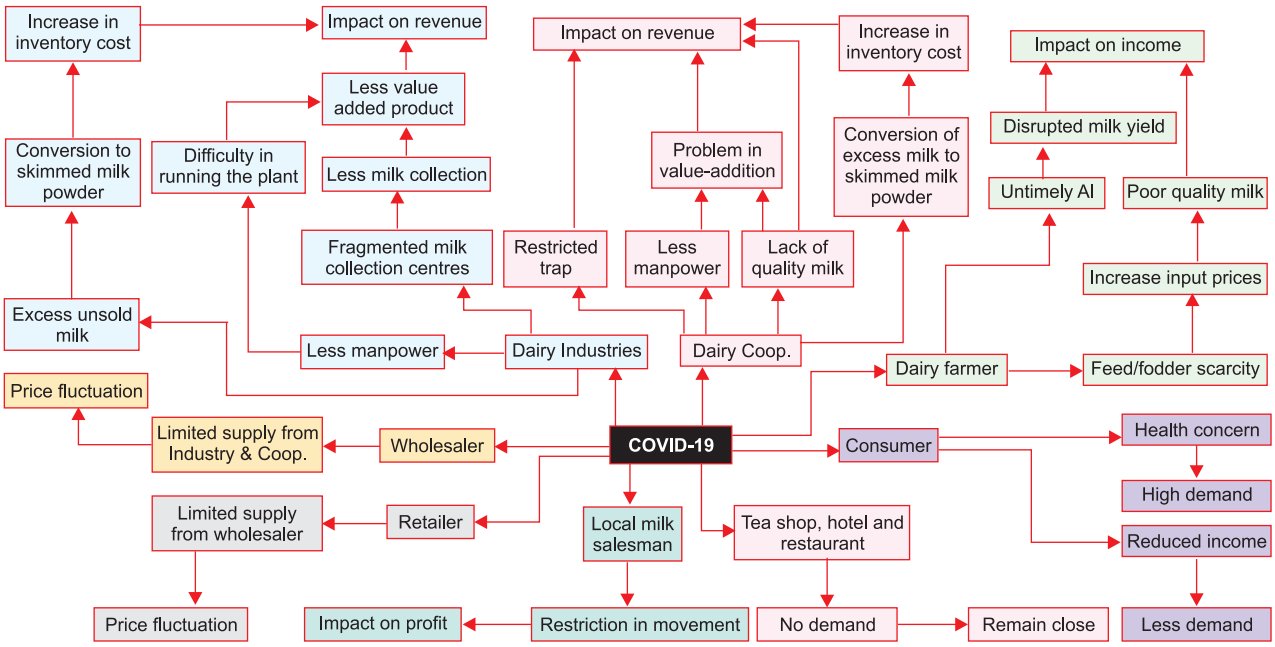

Fig. 5. Conceptual framework of the impact of COVID-19 pandemic on various stakeholders of dairy sector.

packaged products. Due to this reason local milkman have faced difficulties to sell their products (Amrinder 2020). Another problem is that they are not able to move to different locations to sell their products due to restriction in movement.

6. *Consumers of dairy products:* In this case, two different scenarios are visible. One where demand for dairy products has decreased and, in another scenario, demand has increased. Due to lockdown, the income of many consumers are affected which lead to low demand for dairy products among low income groups (Amrinder 2020). On the other hand, middle and high income groups of consumers wanted to be more immune to fight against the virus and in this condition demand for dairy products increased (Ipsos Group 2020).
7. *Teashop, hotel and restaurant:* Shutting down of restaurants, ice-cream shops and teashops due to nationwide lockdown caused a significant decline in milk sales

The review of literature conducted on the impact of COVID-19 pandemic on dairy sector suggested that all the stakeholders of dairy supply chain as well as international trade were affected in one or the other way. Initially, it was believed that dairy sector was not affected during pandemic as it was under essential commodities act. But our investigation reveals that along with several agricultural and non-agricultural sectors dairy sector also affected due this pandemic. As dairy products being more perishable, it was severely affected by the restriction in transportation and movement which ultimately caused supply chain disruption. It was also revealed that the prices of dairy inputs such as feed, fodder, concentrate etc. increased during the pandemic which ultimately contributed to rise in wholesale and retail prices of dairy based products. During the peak lockdown period, distress sale of milk was also visible, as farmers had no other choice to handle the excess milk. Reverse labour migration was the main problem for the dairy industry which caused reduced production of dairy based products and there was a scarcity of products in the market and it caused rise in price. International trades also affected due to limited inter-country movement during the pandemic.

In order to minimize the loss to stakeholders of dairy sector from this pandemic, role of government is crucial. Some of the important recommendations in the present context are given below.

Dairy farmers: Facilitate availability of dairy inputs at subsidised rates, and support farmers by increasing procurement prices of milk during pandemic and other natural disasters.

Dairy industry and dairy cooperatives: Develop high tech backend infrastructure, which include cold storage facility and transport network, and encourage dairy industries to produce and export dairy products of international quality standard.

Dairy consumers: Encourage domestic consumption of dairy based products at best prices (Vocal for local).

ACKNOWLEDGEMENT

The first author thankfully acknowledge ICAR-National Dairy Research Institute for providing financial assistance for pursuing PhD research work on the topic.

REFERENCES

Agro and Food Processing. 2020. Excellent maneuver of Amul during pandemic. http://agronfoodprocessing.com/excellent-maneuver-of-amul-during-pandemic/. Accessed on 4 February 2021.

Amrinder S. 2020. Impact of Covid 19- Changing consumer consumption pattern. *India Retailer*. https://www.indianretailer.com/article/whats-hot/trends/impact-of-covid-19-changing-consumer-consumption-pattern.a6602/. Accessed on 1 February 2021.

Barichello R. 2020. The COVID-19 pandemic: Anticipating its effects on Canada's agricultural trade. *Canadian Journal of Agricultural Economics* **68**(2): 219–24.

Bavadam L. 2020. Maharashtra's dairy farmers dump milk on the streets in protest against low procurement prices. *Frontline.* https://frontline.thehindu.com/dispatches/maharashtras-dairy-farmers-dump-milk-on-the-streets-in-protest-against-low-procurement-prices/article32157365.ece. Accessed on 4 February 2021.

Begum M, Barua S, Jahangir Alam M and Farid S. 2020. COVID-19 and Bangladesh: Socio-Economic analysis towards the future correspondence.

Bhandari G and Lal P. 2020. Is Indian dairy sector buoyant enough to sail through COVID-19 crisis/ ? *Agriculturepost*, July 1–11. https://agriculturepost.com/is-indian-dairy-sector-buoyant-enough-to-sail-through-covid-19-crisis/. Accessed on 3 February 2021.

Bhandari G and Ravishankar K M. 2020. Implications of COVID-19 for Indian dairy sector. *Food and Scientific Report* **1**(5): 43–46.

Bhosale J. 2020. Sales of dairy products soar as people work and eat from home. *The Economic Times.* https://economictimes.indiatimes.com/industry/cons-products/food/sales-of-dairy-products-soar-as-people-work-eat-from-home/articleshow/75523395.cms?from=mdr. Accessed on 4 February 2021

Cardwell A P K R. 2020. Introduction to the special issue on COVID 19 and the Canadian agriculture and food sectors: Thoughts from the pandemic onset. *Canadian Journal of Agricultural Economics* **68**(2): 155–59.

Cariappa A G A, Acharya K K, Adhav C A, Sendhil R and Ramasundaram P. 2020. Effect of COVID-19 on Indian agricultural system: A 10-point strategy for post-pandemic recovery. *Outlook on Agriculture* **50**(1): 26–33.

Cariappa A G A, Acharya K K, Adhav C A, Sendhil R and Ramasundaram P. 2020. Pandemic led food price anomalies and supply chain disruption: Evidence from COVID-19 incidence in India. *SSRN Electronic Journal* 1–40.

Chakraborty P. 2020. COVID-19 and Dairy Sector Automation. *Agro and Food Processing.* http://agronfoodprocessing.com/covid-19-and-dairy-sector-automation/. Accessed on 4 February 2021.

Chandel B S, Dixit A K, Singh A and Devi A. 2020. Economic analysis of the impact of COVID-19 lockdown on Indian dairy sector. *Agriculture Situation in India*. November 21–27.

Chechi K. 2020. Dairy industry growth before Covid-19; Impact of pandemic. *Food And Beverage News*. http://www.fnbnews.com/Top-News/dairy-industry-growth-before-

covid19-impact-of-pandemic-55799. Accessed on 1 February 2021

Civils daily. 2020. COVID-19 and its impact on agriculture. https://www.civilsdaily.com/burning-issue-covid-19-and-its-impact-on-agriculture/. Accessed on 4 February 2021.

Coranil J. 2020a. Covid-19 to add extra $1.6bn to milk sales in China in 2020. *Dairy Reporter.* https://www.dairyreporter.com/Article/2020/09/29/Covid-19-to-add-extra-1.6bn-to-milk-sales-in-China-in-2020. Accessed on 4 February 2021.

Coranil J. 2020b. India sets up $2bn fund to include dairy *sector. Dairy Reporter.* https://www.dairyreporter.com/Article/2020/06/25/India-sets-up-2bn-fund-to-include-dairy-sector. Accessed on 4 February 2021.

Coranil J. 2020c. Keytone launches immunity booster powder. *Dairy Reporter.* https://www.dairyreporter.com/Article/2020/08/18/Keytone-launches-Immunity-Booster-Powder. Accessed on 4 February 2021.

Coranil J. 2020d. Pandemic halts Indian dairy growth. *Dairy Reporter.* https://www.dairyreporter.com/Article/2020/06/15/Pandemic-halts-Indian-dairy-growth. Accessed on 4 February 2021.

Coranil J. 2020e. UK ice cream maker nets £3 m Dubai deal. *Dairy Reporter.* https://www.dairyreporter.com/Article/2020/10/05/UK-ice-cream-maker-nets-3m-Dubai-deal. Accessed on 4 February 2021.

CRISIL. 2020. Pandemic halts Indian dairy's cream run, profitability to spill 50–75 bps. https://www.crisil.com/en/home/newsroom/press-releases/2020/06/pandemic-halts-indian-dairys-cream-run-profitability-to-spill-50-75-bps.html. Accessed on 4 February 2021.

Dadas D R. 2020. COVID-19 decimated livestock sector; shattered livelihoods of millions. *Thewotrblog*. https://thewotrblog.wordpress.com/2020/06/18/covid-19-decimated-the-livestock-sector-shattered-livelihoods-of-millions/. Accessed on 4 February 2021.

DAHD&F. 2019. 20th Livestock Census. Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture. Accessed on 1 February 2021.

Dairy Business News. 2020. Helping the dairy sector mitigate the impact of COVID-19. https://www.dairybusiness.com/helping-the-dairy-sector-mitigate-the-impact-of-covid-19/. Accessed on 4 February 2021.

Denver. 2020. Dairy supply chains will need to adjust as consumer behavior changes. *GlobeNewswire*. https://www.globenewswire.com/news-release/2020/07/01/2056582/0/en/Dairy-Supply-Chains-Will-Need-to-Adjust-as-Consumer-Behavior-Changes.html. Accessed on 1 February 2021.

DPAC. 2020. Joint DPAC-DFC statement on milk supply situation–Dairy Processors Association of Canada. *Dairy Processors Association of Canada.* http://www.dpac-atlc.ca/media/joint-dpac-dfc-statement-milk-supply-situation/. Accessed on 4 February 2021.

FAO. 2020. Mitigating the impacts of COVID-19 on the livestock sector (April). DOI: https://doi.org/10.4060/ca8799en.

Farmer's Weekly. 2020. Saving The Livestock Industry From COVID-19. *MAGTER*. https://www.magzter.com/article/Business/Farmers-Weekly/Saving-The-Livestock-Industry-From-Covid-19. Accessed on 4 February 2021.

Fitch Solutions. 2020. India's Agribusiness Sector Impacted By COVID-19, Livestock Facing Most Challenges. https://www.fitchsolutions.com/corporates/commodities/indias-agribusiness-sector-impacted-covid-19-livestock-facing-most-challenges-22-06-2020. Accessed on 4 February 2021.

Fleetwood J. 2020. *Social Justice, Food Loss, and the Sustainable Development Goals in the Era of COVID-19. Sustainability* **12**: 1–9.

Fodware 365. 2020. The dairy industry | Facts & figures, challenges, COVID-19. https://www.foodware365.com/en/news/knowledge-base/2020/dairy-industry/. Accessed on 4 February 2021.

Food and Agriculture Centre of Excellence. 2020. Impact of COVID-19 on the Indian dairy segment. http://face-cii.in/sites/default/files/dairy_press_release_final.pdf. Accessed on 04 February 2021.

Hobbs J E. 2020. Food supply chains during the COVID 19 pandemic. *Canadian Journal of Agricultural Economics* **68**(2): 171–76.

Huffstutter P J. 2020. U.S. dairy farmers dump milk as pandemic upends food markets. *World Economic Forum*. https://www.weforum.org/agenda/2020/04/dairy-milk-pandemic-supply-chains-coronavirus-covid19-pandemic/. Accessed on 4 February 2021.

Hussain S. 2020. India's COVID-19 crisis has placed its dairy farmers at a crossroads. *The Wire*. https://thewire.in/agriculture/india-covid-19-dairy-farmers-milk-production. Accessed on 4 February 2021.

ICAR-National Institute for Abiotic Stress Management. 2020. National lockdown and agriculture: Impacts and remedies. http://www.niam.res.in/sites/default/files/pdfs/National Lockdown and Agriculture-Impacts and Remedies H Pathak.pdf. Accessed on 1 February 2021.

ICRISAT. 2020. Containing COVID19 impacts on Indian agriculture. *ICRISAT.* https://www.icrisat.org/containing-covid19-impacts-on-indian-agriculture/. Accessed on 4 February 2021.

Indo-Asian News Service. 2020. How India is ensuring uninterrupted supply of milk during COVID-19 lockdown. *Business Standard.* https://www.business-standard.com/article/companies/how-india-is-ensuring-uninterrupted-supply-of-milk-during-covid-19-lockdown-120050900400_1.html. Accessed on 4 February 2021.

Ipsos Group. 2020. Decoding COVID-19: The impact and outlook on dairy consumption. https://www.ipsos.com/sites/default/files/2020-04/decoding-covid-19-the-impact-and-outlook-on-dairy-consumption.pdf. Accessed on 1 February 2021.

Jhajhria A, Kandpal A, Balaji S J, Kingsly I, Jumrani J, Kumar K, Singh N P, Birthal P S, Sharma P, Saxena R, Srivastava S, Subhas S P, Pal S and Nikam V. 2020. COVID-19 lockdown and Indian agriculture/ options to reduce the impact. *ICAR-National Institute of Agricultural Economics and Policy Research.*

Jitendra. 2020. COVID-19: Milk supply under threat amid demand spike. *Down to Earth*. https://www.downtoearth.org.in/news/food/covid-19-milk-supply-under-threat-amid-demand-spike-70079. Accessed on 4 February 2021.

Kaur I and Singh P K. 2020. COVID-19 effect: Dairy sector in the doldrums. *The Tribune.* https://www.tribuneindia.com/news/features/covid-19-effect-dairy-sector-in-the-doldrums-76958. Accessed on 4 February 2021.

Keelery S. 2020. India–volume of dairy product exports 2020. *Statista.* https://www.statista.com/statistics/1169795/india-volume-of-dairy-product-exports./. Accessed on 4 February 2021.

Kelkar N. 2020. Amul says consumer demand for dairy products surged during lockdown. *The Week*. https://www.theweek.in/news/biz-tech/2020/06/06/Amul-says-consumer-demand-for-

dairy-products-surged-during-lockdown.html. Accessed on 4 February 2021.

Khan N, Fahed S, Naushad M and Faisal S. 2020. COVID-2019 locked down impact on dairy industry in the world. In *SSRN Electronic Journal*. DOI: https://doi.org/10.2139/ssrn.3616325.

Khairnar S D. 2020. Manpower shortage, supply chain disruption dry up Pune's milk demand. *Hindustan Times*. https://www.hindustantimes.com/pune-news/manpower-shortage-supply-chain-disruption-milks-pune-dry-of-essential-commodity/story-Wnf8DMCIDyBQr8eIKp5PSM.html. Accessed on 4 February 2021.

Kharbikar H L, Radhika C, Naitam R K, Daripa A, Malav L and Raghuvanshi M S. 2020. Consequences of COVID-19 pandemic and lockdown on food and agribusiness sector in India. *Food and Scientific Reports* **1**(6): 13–18.

Kumar B S S. 2020. Dairying comes to the rescue of farmers during times of lockdown. *The Hindu.* https://www.thehindu.com/news/national/karnataka/dairying-comes-to-the-rescue-of-farmers-during-times-of-lockdown/article31311374.ece. Accessed on 4 February 2021.

Lever C. 2020. The dairy industry–coming out the other side. *New Food Magazine.* https://www.newfoodmagazine.com/article/115970/the-dairy-industry-coming-out-the-other-side. Accessed on 4 February 2021.

Linde B. 2020. Economic impact of the coronavirus pandemic (Issue July). DOI: https://doi.org/10.1007/978-981-287–402-3_4.

Lammifyad C. 2020. Review on impacts of COVID-19 pandemic on life animals and dairy product processing industries of the world. *Insights in Veterinary Science* **4**(1): 18–24.

Lusk J L, Anderson J D, Charlton D, Coble K, Davis A, Dewey A, Dorfman J H, Ellison B, Engelhard E, Featherstone A M, Grant J, Gundersen C, Hake M, Hubbs T, Irwin S, Iyer A, Low S A, Malone T, Maples J and Zilberman D. 2020. Economic impacts of COVID-19 on Food and Agricultural Markets. *CAST science*. 1–44. https://www.cast-science.org/wp-content/uploads/2020/06/QTA2020-3-COVID-Impacts.pdf. Accessed on 4 February 2021.

Mahapatra R. 2020. Agriculture sector has beaten pandemic, latest GDP figures show. *Down to Earth.* https://www.downtoearth.org.in/news/agriculture/agriculture-sector-has-beaten-pandemic-latest-gdp-figures-show-73145. Accessed on 1 February 2021.

Maji S, Rakshit S and Roy D. 2020. Effect of novel coronavirus disease (COVID-19) Outbreak on Indian Agriculture: An overview through News Reports amid Nationwide Lockdown. *Food and Scientific Reports* **1**(4): 1–9.

Mead D, Ransom K, Reed S and Sager S. 2020. The impact of the COVID-19 pandemic on food price indexes and data collection. *Monthly Labor Review*. DOI: https://doi.org/10.21916/mlr.2020.18.

Ministry of Commerce and Industry India. 2020. India Imports of Dairy Produce. https://tradingeconomics.com/india/imports-of-dairy-produce. Accessed on 4 February 2021.

Mohan V. 2020. Cooperatives absorb COVID shock, help milk farmers beat crisis. *The Times of India.* https://timesofindia.indiatimes.com/india/cooperatives-absorb-covid-shock-help-milk-farmers-beat-crisis/articleshow/78852587.cms. Accessed on 4 February 2021.

Mukherjee S. 2020. Milk co-ops approach Centre for export sops to clear massive inventories. *Business Standard.* https://www.business-standard.com/article/economy-policy/milk-co-ops-approach-centre-for-export-sops-to-clear-massive-inventories-120072801630_1.html. Accessed on 1 February 2021

MOSPI. 2020. National Accounts Statistics. *Ministry of Statistics and Programme Implementation*. https://mospi.gov.in/web/mospi/reports-publications/-/reports/view/templateFive/901?q=RPCAT. Accessed on 1 February 2021.

NDDB. 2019. Annual Report 2018–19. *National Dairy Development Board*. https://www.nddb.coop/sites/default/files/NDDB-AR-2019-ENGLISH-24022020.pdf. Accessed on 26 March 2021.

Nepal Sansar. 2020. COVID-19 Inflicts NPR 2 Bn Loss on Nepal Dairy Industry. https://www.nepalisansar.com/business/covid-19-inflicts-npr-2-bn-loss-on-nepal-dairy-industry. Accessed on 4 February 2021.

NSSO (National Sample Survey Organization) 68th round. 2014. Household consumer expenditure across socio-economic groups (July 2011–June 2012). *Ministry of Statistics and Programme Implememtion, Government of India.*

Pandey S. 2020. Indian exports could take a hit as world food prices dip in February due to coronavirus. *The Print*. https://theprint.in/economy/indian-exports-could-take-a-hit-as-world-food-prices-dip-in-february-due-to-coronavirus/376539/. Accessed on 4 February 2021.

Petetin L. 2020. The COVID-19 crisis: An opportunity to integrate food democracy into post-pandemic food systems. *Cambridge.Org*. DOI: https://doi.org/10.1017/err.2020.40.

Raghu S and Deb A. 2020. Lost summer for ice cream doubles skimmed milk powder inventory. *Cogencis*. http://www.cogencis.com/newssection/lost-summer-for-ice-cream-doubles-skimmed-milk-powder-inventory/. Accessed on 1 February 2021.

Rath D. 2020. A new White Revolution: How COVID-19 could benefit the dairy industry. *The Financial Express.* https://www.financialexpress.com/opinion/a-new-white-revolution-how-covid-19-could-benefit-the-dairy-industry/1942634/. Accessed on 4 February 2021.

Rude J. 2020. COVID-19 and the Canadian Cattle/Beef Sector: Some preliminary analysis. *Wiley Online Library* **68**(2): 1–17.

Sally M. 2020. Dairy cooperatives seek 20% incentive for exporting milk products amid drop in demand. *The Economic Times.* https://economictimes.indiatimes.com/news/economy/foreign-trade/dairy-cooperatives-seek-20-incentive-for-exporting-milk-products-amid-drop-in-demand/articleshow/77746185.cms?from=mdr. Accessed on 4 February 2021.

Sally M. 2021. Economic Survey: Milk production rises by five percent to 198.4 million tonnes in 2019–20. *The Economic Times.* https://economictimes.indiatimes.com/news/economy/agriculture/economic-survey-milk-production-rises-by-five-percent-to-198-4-million-tonnes-in-2019-20/articleshow/80585416.cms?from=mdr. Accessed on 23 March 2021.

Shashidhar A. 2020. Coronavirus impact: Dairy industry faces 30% dip in demand. *Business Today.* https://www.businesstoday.in/current/corporate/coronavirus-impact-dairy-industry-faces-30—dip-in-demand/story/400517.html. Accessed on 1 February 2021.

Shende P, Jadhav A, Kadam R S and Mane S P. 2020. Effects of COVID-19 on dairy farming. *Juni Khyat* **10**(6): 16–30.

Singh L, Singh A K and Kumar S. 2020. Impact of COVID-19 on agriculture and allied sectors. *Journal of Community Mobilization and Sustainable Development* **15**(1): 8–16.

Singh R. 2020. Impact of COVID- 19 on Livestock production

sector and effective measures to be taken in India. *Pashudhan praharee*. https://www.pashudhanpraharee.com/impact-of-covid-19-on-livestock-production-sector-and-effective-measures-to-be-taken-in-india/. Accessed on 4 February 2021.

Sunilkumar, Sivaram M and Dixit P K. 2016. Determination of factors influencing consumption pattern of ghee in Bengaluru market: An application of logistic regression analysis. *Indian Journal of Dairy Science* **69**(5): 581–87.

Suthar B, Bansal R K and Gamit P. 2019. An overview of livestock sector in India. *Indian Journal Of Pure and Applied Biosciences* **7**(5): 265–71.

The Financial Express. 2020. Milk consumption drops 30% amid lockdown; here's how dairy players will cope up with the loss. https://www.financialexpress.com/industry/milk-consumptio-drops-30-amid-lockdown-heres-how-dairy-players-will-cope-up-with-the-loss/1986990/. Accessed on 4 February 2021.

Tripathi D, Sindher M and Garg T. 2020. The aftermath of COVID-19 on Food and Agrisector: Impact of COVID-19. *Food And Agriculture Spectrum*, 1–11. www. foodagrispectrum.org. Accessed on 4 February 2021.

Weersink A, Massow M and McDougall B. 2020. Economic thoughts on the potential implications of COVID-19 on the Canadian dairy and poultry sectors. *Canadian Journal of Agricultural Economics/Revue Canadienne d'agroeconomie* **68**(2): 195–200.

Workie E, Nyika J and Sendhil R. 2020. Deciphering the impact of COVID-19 pandemic on food security, agriculture and livelihoods in developing countries: A call for sustainability. *Current Research in Environmental Sustainability* **2**: 1–6. DOI:

World Bank Group. 2020. The global economic outlook during the COVID-19 pandemic: A changed world. https://www.worldbank.org/en/news/feature/2020/06/08/the-global-economic-outlook-during-the-covid-19-pandemic-a-changed-world. Accessed on 1 February 2021.

Zhang X. 2020. Chinese livestock farms struggle under COVID-19 restrictions. *International Food Policy Research Institute*. https://www.ifpri.org/blog/chinese-livestock-farms-struggle-under-covid-19-restrictions. Accessed on 4 February 2021.