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Analysis of the Development of the Dairy Industry During COVID-19

Yuchen Duan[1, †], Qihui Lai[2, †], Siqi Li[3, †], Zeyang Liu[4, †], Chuantong Yang[5,*, †]

[1]*University of Toronto(UTSG),Toronto, Canada*
[2]*University of California, Berkeley, U.S.*
[3]*Second high school attached to Beijing Normal University, Beijing*
[4]*Pennsylvania State University, State College, U.S*
[5]*North broward preparatory school Florida, U.S*
[*]*Corresponding author. Email: chuantong_yang@mynbps.org*
[†]*These authors contributed equally.*

ABSTRACT
The outbreak of COVID-19 at the end of 2019 has brought a huge impact on the development of the world economy, and this paper reviews and summarizes the existing research results from three aspects: producers, manufacturers, and retailers, respectively, focusing on the impact of the epidemic on the dairy industry. The results show that the epidemic has an impact on farm costs by affecting the three aspects of producers, labor and livestock. At the same time, through the analysis of dairy production companies, it is found that the government's protection policies for the dairy industry are still not in place. Retail Businesses tend to keep the price of dairy products stable, but they will be affected by consumer behavior and the supply chain. This research has important reference value for policy makers and market practitioners who are concerned about the impact of COVID-19 on the dairy industry.

Keywords: *Diary Industry, Producer, Manufactures, COVID-19.*

1. INTRODUCTION

1.1. Research Background and Motivation

Dairy products include Liquid milk, Milk powder and other dairy products, and became popular in the world after experiencing the invention of pasteurization technology and UHT sterilization technology revolutions. From 2015 to 2019, both production and consumption of global dairy products are increasing annually before COVID-19[1]. With the continuous expansion of young consumer groups, and in order to meet people 's personalized, interesting, novels and other demands, all kinds of innovative dairy products are launched, such as probiotic, rich protein, Low-calorie, low-sugar and sugar-free for health concerns, flavored butter and spicy, pickled cheeses and plant-based dairy alternatives. The analysis of the producers in the dairy industry is mainly focused on labor and livestock in examined farms during the pandemic. Through the research of examined farms, it found that collective organizations of farmers quickly offered alternative sales channels to offset the negative impact on the decreased direct sales in France, and found that since the producers are paid mainly based on the cost of production, not the final price of commodities, dumping milk did not affect the farms' turnover a lot in Canada [2].It proved there is resilience against the impact of Covid-19 in examined farms. But in Bangladesh and India, the result is quite different. After the evaluation, the increased feed prices and decreased milk price, and overall milk production have negative effects on farm income [3]. The labor market in farms can also be affected besides production of milk and the turnover of farms. In the US, there was a labor shortage in April 2020. Among many agricultural sectors, the COVID-19 pandemic has most severely affected the dairy industry, which is highly perishable and relies on an integrated, time-sensitive supply chain. Due to the sharp drop in demand for milk and other dairy products during the epidemic, both in China and US dairy farms had to dump milk. In the US 2.3% more milked cows were slaughtered in response to the pandemic of meat shortages and milk surpluses. Similarly, in Canada and the UK, many dairy farms are also struggling to maintain their operations [4]. Economic and policy

research can help to understand the influencing mechanism of the pandemic, reduce the impact of this and future pandemics, and enhance the industry's ability to withstand market shock.

After the outbreak, both upstream and downstream of the supply chain have been affected. Food consumption shifted away from food service to home, e-commerce grows rapidly and develops simultaneously in online channels or in-store shopping, providers shifted to retail order size. This creates a stock gap in grocery stores, resulting in increased dairy prices. Based on the newly released report of the United States Department of Agriculture, the all-milk price forecast has a continuously increasing tendency. Retailers tend to keep dairy prices stable during the early and post-pandemic periods. Besides maintaining consumers' relationships, cultivating customer loyalty and obeying anti-pricing law, most importantly enhance competitiveness. This pandemic has heavily affected the dairy industries in both China and the US through similar and significant different mechanisms. While government financial reliefs are highly helpful for many dairy farms in the short term, long-term strategies and policies are needed to balance the industries' efficiency and flexibility.

1.2. Research Contents and Framework

Based on the current development status of the global dairy industry, this paper analyzes the changes in the business model of the global dairy industry in the context of the epidemic by combining quantitative analysis of dairy production and consumption data before the outbreak, and at the same time, analyzes the existing research results from three aspects: producers, manufacturers and retailers, respectively, in an attempt to give the development direction of the dairy industry in the post-epidemic period. The research framework of this paper is as follows: the second part analyzes the development of dairy products before and after the epidemic, the third part reviews the literature from three aspects: producer, manufacturer and retailer, and finally the conclusion of the article.

2. ANALYSIS OF THE CURRENT DEVELOPMENT OF THE DAIRY INDUSTRY IN THE CONTEXT OF THE EPIDEMIC

2.1. Global Dairy Production and Consumption Before COVID-19

According to data collected by United States Department of Agriculture (USDA) as shown in Table 1, cow milk production and consumption separately is 522,681 and 187,615 thousand Metric Tons in the year of 2019, and growth rate of production is 0.96%, consumption is 0.56%, compare with the year 2018. The top of cow milk production is European Union 155,300 thousand Metric Tons in the year of 2019, United States is No.2, 99,155 thousand Metric Tons in the year of 2019. Also from USDA Office of Global Analysis in 2019, cows numbers have increased to 142,078 from 139,714 thousand head in 2015, which are concentrated in India, Brazil, European Union, United State, China etc. The number of cows in the United States basically maintains a balanced level of development, the number of cows is 9,320 thousand head in 2015 and 9,330 thousand head in 2019. Meanwhile, cheese total production and domestic consumption have reached separately to 20,962 and 20,302 thousand Metric Tons from 19,525 and 18,859 thousand Metric Tons in 2015. Butter total production and domestic consumption have reached separately to 10,820 and 10,374 thousand Metric Tons from 9,999 and 9,373 thousand Metric Tons in 2015. From 2015 to 2019, all of milk production and consumption increased steadily year by year[5]. Through the above data analysis, it can be concluded that the production and consumption of global dairy products are increasing annually.

Table 1. Cow Milk Production and Consumption (Units: 1,000 Metric Tons)

Cow Milk Production	2015	2016	2017	2018	2019	2020 Dec
Argentina	11,552	10,191	10,090	10,837	10,640	10,800
Australia	10,091	9,486	9,462	9,451	8,750	8,550
Belarus	7,047	7,140	7,321	7,345	7,385	7,420
Brazil	24,770	22,726	23,624	23,745	24,450	25,250
Canada	8,773	9,081	9,675	9,944	9,995	10,095
China	31,798	30,640	30,386	30,750	31,000	31,800
European Union	150,200	151,000	153,400	154,575	155,300	155,900
India	73,645	78,099	83,634	87,800	91,300	95,200
Japan	7,379	7,394	7,281	7,289	7,305	7,360
Korea, South	2,169	2,070	2,081	2,041	2,035	2,030
Mexico	11,736	11,956	12,121	12,368	12,615	12,867
New Zealand	21,587	21,224	21,530	22,017	21,855	21,950
Russia	30,548	30,510	30,934	30,398	30,560	31,000
Taiwan	374	380	380	385	419	423
Ukraine	10,584	10,375	10,275	10,070	9,900	9,690
Others	13	14	15	16	17	18

Subtotal	**402,266**	**402,286**	**412,209**	**419,031**	**423,526**	**430,353**
United States	**94,578**	**96,366**	**97,761**	**98,690**	**99,155**	**100,880**
Total	**496,844**	**498,652**	**509,970**	**517,721**	**522,681**	**531,233**
Fluid Use Dom. Consumption	**2015**	**2016**	**2017**	**2018**	**2019**	**2020 Dec**
Argentina	2,095	1,718	1,681	1,771	1,645	1,780
Australia	2,700	2,550	2,530	2,620	2,600	2,600
Belarus	1,065	1,050	1,065	1,050	1,055	1,055
Brazil	9,573	9,600	9,993	10,762	11,040	11,250
Canada	2,923	2,917	2,884	2,832	2,800	2,780
China	13,130	12,555	12,810	12,700	12,800	13,350
European Union	33,800	33,600	33,550	33,500	33,400	33,260
India	63,750	67,700	72,185	76,180	77,680	80,800
Japan	3,932	3,988	3,974	3,995	3,969	3,999
Korea, South	1,529	1,500	1,561	1,566	1,575	1,580
Mexico	4,185	4,183	4,174	4,183	4,190	4,200
New Zealand	497	497	497	500	500	500
Russia	9,500	8,960	8,555	7,318	7,215	7,200
Taiwan	384	397	408	420	449	457
Ukraine	5,385	5,241	4,998	4,862	4,800	4,866
Others	62	81	86	96	117	123
Subtotal	**154,510**	**156,537**	**160,951**	**164,355**	**165,835**	**169,800**
United States	**23,378**	**23,220**	**22,719**	**22,220**	**21,780**	**21,400**
Total	**177,888**	**179,757**	**183,670**	**186,575**	**187,615**	**191,200**

Source: The United States Department of Agriculture"2015-2020 Cows Milk Production and Consumption"

2.2 Global Dairy Enterprise Pattern

Rabobank (Rabobank Group, Po bank), according to the world's biggest dairy company sales data and information, financial statements based on research and analysis on authority, compile and publish The Rabobank Global Dairy Top20, 2018 Report[6]. The results are as follows Table 2 shows.

Table 2. Global Dairy Top20 in 2018

Rank	Company	Headquarters Location	Sales in 2018
1	Nestle	Switzerland	24.2billion dollars
2	Lactalis	France	19.9 billion dollars
3	Danone	France	17.6 billion dollars
4	Dairy Farmers of America	American	14.7 billion dollars
5	Fonterra	New Zealand	13.7 billion dollars
6	Friesland Campina	Netherlands	13.6 billion dollars
7	ArlaFoods	Denmark/Sweden	11.7billion dollars
8	Saputo	Canada	10.8billion dollars
9	Yili	China	9.9billion dollars
10	Mengniu	China	8.8billion dollars
11	DeanFoods	American	7.5billion dollars
12	Unilever	Netherlands/British	7.0billion dollars
13	DMK	Germany	6.5billion dollars
14	KraftHeinz	American	6.2billion dollars
15	Meiji	Japan	5.8billion dollars
16	Sodiaal	France	5.8billion dollars
17	Savencia	France	5.5billion dollars
18	Muller	Germany	5.1billion dollars
19	Agropur	Canada	5.1billion dollars
20	SchreiberFoods	American	5.0billion dollars

Source: Rabobank Group"The Rabobank Global Dairy Top20, 2018"

3. LITERATURE REVIEW

3.1. Producers

As the supplier of the raw material in the dairy industry, the producer plays a significant role in the supply chain. Since milk is the primary raw material for most dairy products, the producers in the dairy industry are mainly the dairy farms that produce milk. In this

case, the fluctuation of the milk market deeply influenced the dairy industry. Therefore, the analyses of the producers in the dairy industry are mainly focused on two aspects: the livestock and labor in the dairy farms. In a study of the resilience of organic dairy farms in French, Augustine Perrin and Guillaume Martin proved there is resilience against the impact of Covid-19 in these examined farms. The farms can provide sufficient dairy products to satisfy the needs of society. Even though the turnover of farms dropped due to the decreased direct selling, the collective organization of farmers quickly offered alternative sales channels to offset the negative impact on the decreased direct sales [2]. A similar stable turnover situation also happened in Canada during the pandemic. Based on the research from Alfons Weersink, Mike von Massow, and Brendan McDougall, the most direct influence on farms is the increased cost of feed. However, the fluctuation of cost is not strong enough to alter the production system. The major problem is the demand for milk from different processors fluctuated due to the altered demand structure of customers. Also, there is a time lag in adjusting the demand for milk. Therefore, the situation of dumping raw milk happened due to the lack of storage space in some processors. However, the central selling and transportation coordination system in Canada helped shorten the adoption process and accelerated adjustments. Since producers are paid mainly on the basis of production costs rather than the final price of commodities, the dumping of milk did not affect the farms' turnover a lot [7]. However, based on the quantification of the economic loss of the dairy farms, Mohammad Mohi Uddin, Amrin Akter, A. B. M. Khaleduzzaman, Mst. Nadira Sultana & Torsten Hemme found different result in Bangladesh. After their evaluation, the increased feed prices and decreased milk price, and overall milk production have negative effects on farm income. Also, the national loss on the dairy farms is 4.43 million USD per day [8]. A similar situation happened in India. The dairy cattle farms in Sangavi Village, which is a village in India, suffered a worse situation. During the Covid-19 pandemic, the Indian government enforced the lockdown policy, which decreased the demand for milk like the previous two pieces of research. However, the Indian farms stored the milk in the farms and could not find a way to sell this milk to the processors. At the same time, the supply of milk is stable and relatively higher in the summer season than in the winter season. In this case, the farms in the research suffered huge economic losses during the pandemic [9].

Not only the production of milk and the turnover of farms can be affected by the pandemic, but the labor market in farms can also be affected depending on the structures of the farms. In the research of India, since the small and marginal farmers and landless laborers are the major groups of labor in dairy production, the shortage of labor was not a serious problem in India [9]. In the United States, there was a labor shortage in April 2020. In order to satisfy the labor needs, the US government published a series of immigration policies, especially on H-2A visas, which is the visa for Temporary Agricultural Employment of Foreign Workers. To help reduce the risk of spread of Covid-19, the employers extend paid sick leave to reduce the risk of spread. Also, for the reservation wage of these workers, the less opportunity to earn a high salary job and the high unemployment subsidies adversely affected the willingness to attend the works in the food supply chain in the United States. Therefore, the exact influence still needs further evaluation [10].

3.2. Manufacturer

Since the dairy products are extremely perishable and rely on an integrated and time-sensitive supply chain, the dairy industry is the one of the most industries that suffered a lot from the COVID-19[11]. Manufacturers, a key part of dairy production, have also been hit hard around the world by COVID-19. Through the impact of the COVID-19 on dairy manufacturers, I will discuss the problems behind the government's policy towards the dairy industry

In the last part, we mentioned the lots of negative impact of the COVID-19 on producers and farms. The similar effect also took a toll on manufacturers. For example, in response to the epidemic's meat shortage and milk surplus, dairy farmers in the United States released 2.3% more cows in April 2020, which could reduce the total number of cows in the United States by as much as 90,000 in 2020[12]. On the other hand, some processors design processing lines to process and package dairy products like cheese in bulk, which is just as difficult and expensive to process and package dairy products like milk used in groceries [11]. Because of the sudden drop in demand for milk, many U.S. dairy farmers have been forced to dump milk due to storage, transportation and processing restrictions. For example, it is estimated that about 5% of the country's milk production was dumped in April 2020[13].

However, these situations are not unexpected, and they reflect a lot of problems behind the government policy. These COVID-19 dairy market disruptions highlight a continuing trend of low adoption of risk management strategies on US dairy farms. For example, less than half of U.S. milk is covered by dairy margin insurance and dairy Income Protection programs[14]. Farmers who participated in these projects or purchased other risk management products are expected to receive compensation to mitigate some of the losses that occurred in early 2020. Some of the federal government's financial assistance, such as low-interest loans and direct payment projects, will be provided from the early summer of 2020. Many state and local

governments and industry-related organizations have also made great efforts to help dairy farms, but dairy farm producers and industry experts are worried that it may be too late to save some dairy farms[4].

In fact, the emergence of these problems is not an accident, because the relevant policies of the dairy industry issued by the US government have not solved the problems originally, whether it is before or after the epidemic. The United States has enacted many piecemeal policies affecting the dairy industry, but they have not addressed the fundamental problem of milk oversupply. As a result, the dairy industry, and dairy farms in particular, have been struggling for years with low and volatile milk prices and rising production costs. By 2019 (before COVID-19 disruptions), after four years of sustained low milk prices, an increasing number of regional dairy communities formerly opposed to market management efforts were openly discussing supply management mechanisms to promote more stable farmgate prices[4].

The pandemic has exposed many weaknesses in the American food system. Based on a highly integrated supply chain, the food system is often seen as both modern and efficient, offering a rich selection of quality food at prices significantly lower than in many other countries. However, a major problem with the food system is the trade-off between high efficiency and low flexibility. It is very likely that this pandemic will continue to disrupt dairy and other industries around the world, and other pandemics in the future may have similar negative effects on the dairy industry. When formulating development plans, investments, and budgets, every country and industry must consider the possibility of another or new interruption in the supply chain. Therefore, this negative impact of a pandemic may encourage dairy co-operatives to develop detailed plans for what to do with surplus milk in the event of too low farm prices or a pandemic or natural disaster to a certain extent in the future[15].

3.3. Retailers

Retailers tend to keep retail prices for dairy products steady when demand rises and the price falls in the early stages of the pandemic and rises in the later stages. Facing the challenge of overcapacity in the dairy industry, the retailer's demand for dairy products has also increased the supply. This article find out the change of consumers' food consumption habits has a significant influence on retailers. Based on Canning, Weersink, and Kelly [16] calculation, the difference between the farm share of at-home food expenditure and food-away-from-home expenditure is approximately 18% in the United States and 15% in Canada. The gap is growing in the following years, because the farm share of expenditure for dining out constantly decreases across countries, even though it already accounts for a small proportion in the total food dollar consumption, respectively 4% and 7%. Thus, we estimate the gap will keep growing during the pandemic. As food-away-from-home expenditure shifts to at-home food expenditure as well as food retail, it forces them to buy more food directly from retailers to cook or bake at home. Not to mention the stay-at-home orders and the hoarding behavior, cause consumers to buy more in case of the higher price and short supply [17].

At the same time, e-commerce grows rapidly as a choice for safe grocery shopping. It develops simultaneously in online channels or in-store shopping. By offering online orders and free pick up online, self-checkout in-store, groceries cultivate a new group of people as their potential consumers. Next, the change of food consumption promotes the shift of providers from industrial volumes to retail order size [18]. Grocery stores step into a period of adjustment to solve the abruptly increasing demand. The estimated dairy retail prices should increase instead of decrease as the wholesale price when people's demand increases and groceries supply chain disruption. However, according to the research conducted by Liu and Rabinowitz [19], the average dairy prices decrease and within a specific exam, dairy foods have heterogeneous responses to the epidemic impact.

This contradictory conclusion may come from the limitation of a three-month short-term research. So, it may not capture the real impact of the pandemic, because we are unsure when the pandemic hits the market. Then, it generates delayed impacts. In contrast, in another research on the whole year of 2020 research, the average retail price of dairy products in the United States was higher than the year of 2019 [20]. The market outcome varies with the perspective of the research length. Based on the newly released report of the United States Department of Agriculture [21], the all-milk price forecast has a continuously increasing tendency. High monetary inflation or increasing cost of the supply chain may cause the same result. We need more specific and long-run research to capture the real pandemic impact on dairy prices. Retailer purposes are to control and stabilize the price during the early and post-pandemic periods. There are several reasons to explain it. First, retailers want to keep a good relationship with their consumers and cultivate customer loyalty. Second, retailers try not to violate the price gouging laws, which is a sudden large increase of the price. Third, the most important one, this is retailers' marketing strategy to make them competitive in the dairy section with low retail prices and high variety.

4. CONCLUSION

The outbreak of the new crown pneumonia epidemic at the end of 2019 brought a huge impact on the global economy, and the dairy industry suffered a deep

recession, with a large amount of milk being overused. This paper provides an in-depth analysis of the current situation and solutions of the dairy industry during the outbreak from three aspects: producers, manufacturers and retailers, in an attempt to identify the path of the dairy industry development in the post-outbreak era. The findings show that, as far as producers are concerned, the reduction in dairy production and the reduction in storage space, which resulted in the dumping of a large amount of milk, along with the increase in the price of feed and the increased risk of employees contracting the virus, forced producers to develop a series of policies to safeguard production, such as granting some workers high pay leave. In terms of manufacturers, the decline in demand for dairy production, coupled with strict time limits on average daily production, has left much milk to spoil. Therefore, manufacturers are eager to be supported by government subsidies or incentives. For retailers, the demand for grocery dairy products has increased as people eat at home more often. In order to maintain a long-term relationship with customers, retailers tend to stabilize prices or modest increase of the price. However, due to the competitiveness of the market, we need to formulate reasonable price strategies to improve retailers' competitiveness.

With the gradual relief of the epidemic, the world economy gradually began to recover. For example, because the Biden government of the United States announced a law that citizens and people must obtain vaccine needles, and individual state governments also encouraged people to vaccinate through a bonus system, the epidemic has gradually been prevented. At the same time, the relief of the epidemic also means that most students will return to school, which will lead to an increase in milk production. As more workers are vaccinated, the number of supermarket customers and production employees will also increase. This means that the development of the dairy industry in the post-epidemic era is beneficial. In the future, researchers can search for information on consumer behaviors of dairy products during the epidemic and construct a prediction model of dairy product output based on the development trend of the epidemic, which will play an important role in the development of the dairy industry.

AUTHORS' CONTRIBUTIONS

These authors contributed equally.

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