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The influence of the pandemic COVID-19 on the food supply chain management

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Abstract. Food supply chain management is a main object of the food security. How to form an effective food supply chain in pandemic conditions is the one of the most important questions nowadays. The agro-food system is becoming not only a tool for solving many economic and social problems that arise in the context of a pandemic, but itself is experiencing a serious impact from consumers, business, and the state. The pandemic negatively affected the agri-food system of different countries. Among the main problems, we will single out the reduction in demand for fresh food, disruptions in the supply of incoming resources, both for the production of products and for their sales, a shortage of labour, especially seasonal. The article examines the impact of the COVID-19 pandemic on the food supply chains in Russia. Using the example of supply chains in St. Petersburg, we show that the food supply chain tends to be shorter because of the consumer's willingness to buy food direct from farmers avoiding risks to be infected with COVID-19. Another change in food supply chain is the increasing role of government in regulation of food security in region.

1. Introduction

The COVID-19 pandemic, quarantine restrictions in different countries, as well as measures to curb the infection spread have led to serious consequences for both the economy and society. Agriculture, being the basic type of human activity, is not only a food provider, but also a source of employment and a source of a food support for the population in these pandemic conditions. The distribution of roles in the economy has changed under the influence of the difficulties that have arisen in business, healthcare, and society. In addition, food security issues have come to the fore not only in developing but also in developed countries. This study draws attention to the changes in food supply chains associated with special challenges during a pandemic. Not only the composition of the participants, but also the volumes of supplies have changed. The experience of transforming supply chains during a pandemic can be viewed as a temporary measure, as a long-term trend in the development of the agri-food system.

2. Materials and methods

The study is based on a comparative analysis of a statistical data on the agriculture with the example of the Leningrad region of the Russian Federation before the pandemic and during quarantine restrictions from March to May 2020. This region was chosen due to the developed agri-food system and proximity to sales markets in one of the largest Russia - St. Petersburg.

Comparison of the new tasks of food security in the region and the transformation of the volumes and channels of food sales make it possible to identify changes in food supply chains, as well as to divide



them into temporary reactions and long-term changes. Compilation of the studies [1, 2] on the impact of the COVID-19 pandemic on the agri-food system set out a number of issues farmers faced with in many countries.

2.1. A sharp decline in sales of perishable products

The main problem faced by farmers in different countries is connected with a significant decrease in sales. There are many reasons for this. The main reasons are:

1. The temporary closure of urban and rural fairs has disrupted the supply chain of farmers' food. In Italy, Kenya, China and other countries, many street and farmer fairs have been temporarily closed to limit crowds. This has deprived smallholder farmers and their associations of the ability to market directly to consumers.

2. Decrease in demand for perishable products is a result of lower incomes of the population, the panic mood and the tendency of the population to form food reserves. During the COVID-19 outbreak in Italy, there was a shift in consumption patterns. Markets experienced an increase in purchases of both basic foodstuffs and long-term storageable food, as well as an increase in the share of online purchases [3]. At the same time, there has been a decrease in demand for fruits, vegetables and other perishable products, which leads to a drop in prices [4]. Likewise, in China, declining demand for vegetables, fruits and seafood has resulted in falling prices and slowing sales. Poultry and egg production chains have also faced strong downward price pressure [5].

3. Restrictions on public catering, including restaurants, cafes, school feeding. In Italy, the closure of cafes, restaurants and small rural tourist hotels has led to a 10 percent drop in milk consumption, creating problems for the dairy industry [6]. India Media reports shows that the closure of hotels, restaurants, sweet shops, and tea shops during the lockdown led to depressing milk sales [7].

2.2. Incoming resources supply disruption

Barriers, control points, restrictions on transportation have led to disruptions in the supply system of agricultural production. The supply of seeds, plant protection products, animal feed was disrupted, packaging material and containers were complicated as a result of the introduced strong security measures. In China, roadblocks and inspections in some cases have discouraged smallholders from marketing or purchasing agricultural inputs, resulting in income and production losses, and possibly negatively influenced on future harvests [8].

2.3. Labour problems both due to the disease itself and due to restrictions on labour migration, including seasonal one

Restrictions in international transport system led to difficulties in seasonable migration in agriculture. Implementation of a nationwide travel blockade and quarantine policy required all public spaces, businesses, and schools to shut their doors until further notice and placed restrictions on individuals leaving their homes or traveling. Furthermore, a large number of infected by COVID-19 people and necessity to keep self-isolation were also conducted with agri-food system. Seasonal planting works in agriculture were connected with lack of seasonal labour from another countries.

The specific impact of the pandemic is that it significantly affected the food security of developing countries. According to the International Food Policy Research Institute, the export of agricultural and food products decreased by 24.8% (with a drop in developed countries by 23.8%, and in developing countries by 30.5%).

3. Results and discussion

The quarantine restrictions in the agri-food system in Russia were organized by the non-working days in April in order to limit the crowding of the population and limit the spread of the coronavirus. Organizations in the agri-food sector were not affected by these restrictions. However, the suspension of activities of enterprises in related industries affected the functioning of the food supply chain. What's more, sanitary cordons in some regions, limiting traffic flows, led to an increase in the delivery time of

products, which is very important for perishable products. One of the most restrictions were in the HoReCa segment what have reduced the demand for food, especially perishable products (milk, vegetables, fruits). The closure of city markets and fairs has reduced the opportunity for small farmers to sell their products directly.

The sharply increased demand for disinfectants led to a decrease in the production of other types of products, namely detergents. The increased demand for disinfectants dispensers has led to difficulties in the supply of plastic containers for dairy products.

The agri-food system has received a serious challenge not only in the field of production, but also in the field of product sales. Thus, state support for families with children was implemented in the form of food supplies at schools and kindergartens. In addition, large families received food support. The food set included cereals, vegetable oil, shelf-stable milk, sugar, confectionery products, juices, tea, that is, products with a long shelf life. Thus, during the period of a pandemic, the load on the supply of products with a long shelf life, including packaging and transportation of products, increased.

The traditional food supply chain, including production, processing, wholesale trade, retail trade (public catering), the final consumer has experienced significant changes during the period of quarantine restrictions.

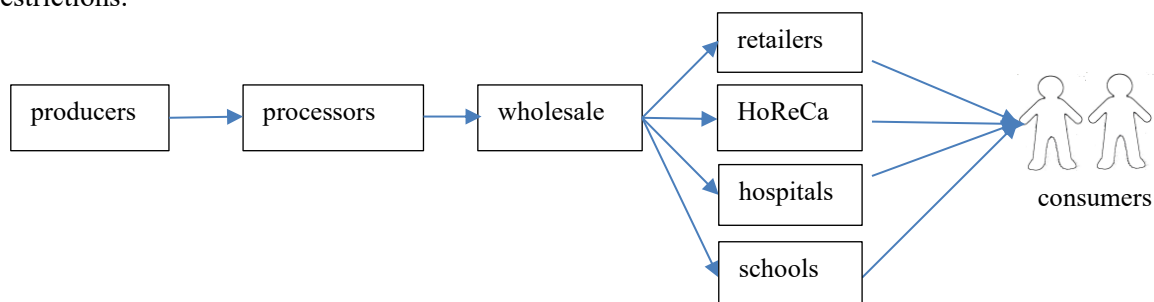


Figure 1. Food supply chain in general

In a pandemic, the traditional distribution of efforts in food supply chains is changing as a result of the imposed quarantine restrictions, the increased burden on the healthcare system, and changes in consumer activity. Let's list the following changes:

1. Development of e-commerce in food retail. Supermarkets are opening online stores. Digital platforms are developing their own product delivery from the supermarket to the consumer. Mobile applications for joint trading of farm products are being developed. All these efforts are aimed at meeting the population's demand for food in the context of limited mobility (quarantine, observation).

2. Significant reduction in the activity of supply chains in the HoReCa segment. This led to a decrease in the purchase of food, including fresh farm produce, and a decrease in sales directly from farmers.

3. The increased volume of food supplies to health care organizations due to a significant increase in the number of patients in hospitals and sanatoriums, which led to a sharp increase in the volume of government purchases of food. The role of government as an actor of food supply chain is came more active.

4. The transfer of educational organizations to remote work has led to a reduction in the supply of food to schools and universities. School feeding was partly organized as long shelf life food kits. The supply of vegetables, fruits, bread during the period of remote learning was closed.

The transformation of food supply chains is shown in Fig. 2.

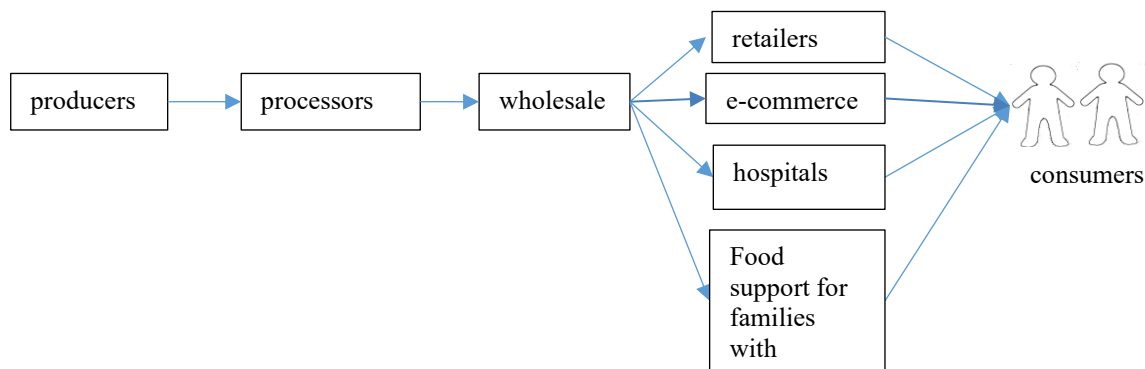


Figure 2. Food supply chains in pandemic COVID-19 conditions

Instead of a sales channel for products in the HoReCa segment, e-commerce is actively developing. Internet-stores, mobile application, delivery services support the agri-food system in pandemic period. Such transformation influence not only on actors but also on food prices. Main food price indexes in Saint-Petersburg in period from July 2019 to July 2020 are presented in Table 1.

Table 1. Food price indexes in Saint-Petersburg

Product	Price index	
	July 2020/December 2019, %	July 2020/July 2019, %
Carrots	75.6	-6.2
Apples	73.3	36.8
Potatoes	63.5	0.7
Sugar	21.1	-7.3
Buckwheat	31.5	59
Rice	10.4	10.8
Milk	-2.6	-1.9
Eggs	-10	6.7
Beef	3.4	3.7
Pork	-0.2	-0.4
Lamb	-0.1	-2.4

Source: Rosstat.ru [accessed: 10.09.2020]

As we can see on the table 1, prices for short shelf life tend to decrease because of decreasing demand from the HoReCA segment (milk and eggs, pork and lamb). Production volume of these products can't be cut in short-term period. Agriculture is a very inert business activity and such strong volatility in demand can't be adapted in production processes. Long shelf life food prices increase in period from December 2019 to July 2020 due to the increased demand from population and healthcare system in analysed period.

Restoring the agri-food system, bringing it to a new level of efficiency in the context of the transformation of supply chains under the influence of the pandemic, requires the government to develop various strategies to ensure food security in the long term. Practical experience shows that prior to Covid-19, productivity and sustainability in the agro-industrial sector was driven by digital technologies implementation, sustainable supply chains development and circular economy principles aimed to preserve all nutrients in a closed chain.

Over the past decade, a number of leading companies have transformed their linear supply chains into closed ones, social organizations and government authorities have put forward important legislative proposals that promote the development of circular principles in the agri-food system. For example, the EU, with partners from China and Hong Kong, formed the AgroCycle consortium that consists of

universities, farmers associations, technology producers and industrial enterprises in agricultural industry to create closed supply chains in livestock and crop production, food processing and retail to increase sustainability by increasing volume of processing and production of related products, minimizing waste and resource consumption [9].

The early stages of the Covid-19 crisis diagnosed the fragility of many global supply chains, reducing the efficiency of food systems and excluding a number of segments. While the European Bank for Reconstruction and Development has declared it will devote its entire activities to addressing the economic impact of the pandemic, the Investor Agenda group, which collectively manages trillions of dollars in assets, said that “Governments should avoid the prioritisation of risky, short-term emissions-intensive projects” [10].

4. Conclusions

Transformation of agri-food system in Russia under the influence of COVID-19 pandemic is not only short-term reaction but also long-term tendency of agri-food system development. The significant role of government is in fast coordination of food flows to prevent rise in prices, food shortage. Meanwhile, some changes in this period form long-term tendency in food supply chains. E-commerce, delivery services, digital platforms allow to develop a cooperation between farmers, as consumers without governmental support. These direct communications can cut time and costs in supply chains increasing its efficiency.

The problem of post-crisis recovery of Russian economy and its individual sectors, including the agri-food system, while maintaining environmental and social security, can be solved by developing the principles of a circular economy, which provide reliable solutions with significant opportunities to increase sustainability and competitiveness by realizing the recovery and reuse potential, resource conservation and waste-free production and consumption.

There are many opportunities for the development of a circular economy in the agro-industrial complex, for example, by creating a restorative agricultural system that combines livestock and agriculture to create closed production chains, and also uses the possibilities of minimal soil cultivation with inorganic fertilizers, which allows to save natural capital from degradation while conserving yield. Precision farming technologies combined with restorative techniques such as remote sensing, environmental data collection and analytics, and fertilizer minimization help to optimize yields while reducing environmental impact.

Circular methods used in agribusiness, such as recycling food waste and organic matter to replace synthetic fertilizers, and cover crops that minimize tillage, and others, play an important role in improving sustainability and ensuring food security. For example, the introduction of resource conservation practices has led to record rice yields in some of the poorest regions of India [11]. In general, according to experts' forecasts, a circular economy by reducing food waste and reusing by-products and organic substances will save \$ 700 billion [12], reduce emissions by 5.6 billion tonnes CO_{2e}, corresponding to a 49% reduction in the projected 2050 total food system emissions. All this indicates that the development of closed supply chains, digital technologies and the principles of a circular economy will not only help to neutralize the consequences of the pandemic, but also increase the level of sustainability of agro-industrial complexes in the long term.

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