New algorithms for providing safe food raw materials: lessons from the pandemic

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Abstract. The food crises of the 21st century are characterized by the presence of multidirectional obstacles of a socio-economic and organizational nature in the structure of international relations that function on the problems of maintaining a wide range of export-import supplies of raw and related resources. This situation is caused by the specifics of the international epidemiological situation with the widespread incidence of COVID-19, which leads to the adoption of extraordinary measures to counteract the further aggravation of this situation. Additional factors in the formation of food crises are the complication of the full functioning of natural-artificial aggregates of elements that make up the system of agro-industrial production, formed within the framework of national socio-economic systems, as well as in the structure of international food production and consumer relations. The main means of overcoming these crises consist in the development and further implementation of rational resource-saving technologies for the functioning of the agro-industrial complex with the extraction of various components from the environment, subject to the minimum possible negative impact on it. Thus, the most important ways to overcome the food crises, which are aggravated by the spread of COVID-19, are the sustainable partnership of state management structures and representatives of the private sector of the economy through modern electronic and digital communications in the development of advanced resource-saving technologies for the production of high-quality food, providing comprehensive public-private financial support for the production of high-quality food, as well as comprehensive compliance with epidemiological safety standards.

1. Introduction
The key constraints to the implementation of international resource-production processes in the field of providing the population in various territories with food with the necessary qualitative and quantitative characteristics are special measures of complete or partial prohibition of the movement of human resources necessary to maintain an optimal level of food production, as well as various individuals acting as subjects of industrial relations of food supply. In modern conditions of ensuring the necessary socio-
epidemiological safety, which is caused by the rapid incidence of COVID-19, there is a search for effective ways to maintain the processes of obtaining food raw materials with the subsequent production of socially demanded food products.

The current threats to reduce the production of various types of food are caused by the factors of violation of international resource and raw material and production chains in the system of production of high-quality food, as well as the growth of negative characteristics of the influence of the natural environment on the processes of social life. Thus, the author reveals the demand for establishing promising methods of food production in the format of using resource-saving technologies for the functioning of the agro-industrial complex with the production of high-quality food raw materials with its further production transformation on the basis of ecological and economic methods for obtaining optimal profits. This is due to the minimum possible use of irreplaceable components of the natural environment and the minimum possible discharge of industrial waste, which is supplemented by the need to comply with social epidemiological safety standards in the context of the COVID-19 pandemic in the production and sale of various levels of high-quality food products in market processes.

2. Materials and methods
The results of the study were obtained through the use of various scientific methods aimed at identifying productive ways to maintain the necessary food stability and food supply processes in the face of negative processes, with the relevance of implementing resource-saving innovations in agricultural technologies and food production in the context of preventing the spread of COVID-19.

These methods are the analysis of scientific-theoretical and practice-oriented information, official statistical data, as well as methods of forecasting and forming new knowledge. These methods allow us to optimally identify the dynamics of industrial modernization of food supply of social and consumer processes, as well as the need for the use of resource-saving and energy-efficient structural elements in the system of agro-industrial production.

The initial materials of information and scientific nature are the results of scientific research obtained on the basis of studying the features of the formation of modern food crises, associated with the prospects for implementing resource-saving technologies while preserving the natural state of biosystems formed in the natural environment and additional restrictions on the activity of implementing agricultural projects during the spread of COVID-19.

3. Results and discussion
The current specifics of the food crisis are expressed in the combination of obstacles to the use of technologies for obtaining and further converting food raw materials with the production of vital food products for the population and their subsequent sale on the market, which is limited by the increased problems of resource provision of the agro-industrial complex with the rapid expansion of the incidence of COVID-19.

This crisis can be eliminated with the constructive expansion and maintenance of information communications between the structural elements of the state-administrative apparatus for regulating the ongoing socio-economic processes and representatives of the private business sector of the economy. Through these electronic and digital communications, which provide a wide range of ways to process, transform and systematize information resources, a comprehensive mechanism for anti-crisis regulation of the processes of food supply to the population in various territories is being formed, as well as the information and technological base for further modernization of the agro-industrial complex operating within the framework of the world community is being expanded.

One of the negative trends in changing production and food processes is the slowdown in the rate of increase in grain yields, which has been seen since the mid-1980s [1]. Thus, it is necessary to maintain an optimal food security regime through the use of technologies in food production with the minimum possible dependence on additional resource supplies in the form of structural components of the natural environment, which should be associated with taking into account negative climate changes and conditions for the maximum possible reduction of production waste. This defines positive changes
aimed at eliminating the problem of limited and scarce natural resources as sources of fuel and energy. In this regard, the modern agro-industrial complex should rely on the widespread use of land-use technologies to preserve the qualitative and natural properties of available land in order to obtain plant-growing raw materials, as well as raw materials in the structure of animal husbandry of the required quality. Effective ways to expand agroecological innovations can significantly reduce the dependence of various subjects of agricultural relations on external factors of natural resource provision with repeated use of the properties of natural resources.

Reducing the cost of natural resources in the functioning of the agro-industrial complex causes the need to intensify the use of the initial components introduced into the production process, which is to establish the maximum possible level of production of high-quality food products while reducing the cost of purchasing these resources [2, 3]. At the same time, if the resulting value of the final results of food production significantly exceeds the cost of the initial resources necessary for their production, this reflects the promising nature of economic activity in food production. This is associated with the implementation of the productive ratio of "small inputs" (the minimum possible quantitative parameters of the use of raw natural materials as elements of natural biosystems) with "extended outputs" (production output of the maximum possible amount of food products), which occurs with a comprehensive account of the biochemical processes occurring in the environment.

In the current crisis situation of food supply, advanced technologies of the agro-industrial complex must meet a number of requirements that have been formed on the basis of changes in the socio-economic and natural-industrial nature in the XXI century:

1. Reducing the quality and production characteristics of agricultural land in the format of conducting full-fledged crop production while reducing the volume of obtaining natural feed for effective animal husbandry. This is aggravated by the increased damage to the environment in the form of the release of unused residual forms of the resources involved, the discharge of harmful substances, irrational parameters of fertilizer application and unproductive organization of land reclamation [4].

2. Expansion of restrictions in providing safe water resources to various branches of the modern agricultural complex, which determines the obligation to comply with the imperatives of rational practice-oriented water use by individual economic entities.

3. Search for effective energy-saving methods of farming and further production transformation of natural raw materials components in order to produce food products that meet the established quality standards and meet the interests of various consumers in the market. The article identifies the need to reduce the cost of energy-intensive components of food production while minimizing the dependence on additional supplies of petrochemical resources, as well as reducing the cost of moving raw materials and the results of food production through the development and expansion of the use of biological components in fuel supply.

4. Effective elimination of problems of pest and disease control causes the need to develop qualitatively new varieties of agricultural varieties, plants with a high degree of their adaptability in unstable natural conditions, and also causes the urgent need to reduce the use of fertilizers and pesticides.

5. Taking into account climate changes with unstable temperature conditions and precipitation, which determines the nature of changes in agricultural production systems in order to further maintain the efficiency of the production of high-quality food [5].

6. Insufficient nature of electronic and technological support for the collection and analysis of significant volumes of multidirectional information data while ensuring full-fledged state administration in the field of technological modernization of modern environmental management systems and production components in the agro-industrial complex for the production of food products [6, 7].

7. The aggravation of the epidemiological situation in connection with the COVID-19 pandemic, which leads to the introduction of additional restrictions on the movement of labor resources and constraining factors of economic activity of various enterprises and organizations while maintaining special sanitary security measures.

One of the current food crises, which occurred in 2007-2008, was characterized by instability in the price indicators for food products, which, first of all, was caused by a reduction in world food supplies
compared to market demand. Thus, it is revealed that it is necessary to search for an increase in the productivity of agricultural technologies while increasing the productivity of land use and the use of available water resources, which determines the growth in the number of high-quality food products with the prevention of an increase in the overall price level for them. The current stage of development of production and consumer relations in the food sector is characterized by compliance with safety standards during the expansion of COVID-19, and, consequently, the adaptation of food producers to these conditions.

Using the example of China, two key problems can be identified in connection with the spread of COVID-19:

- Livestock breeders face serious pressure due to interruptions in the supply of feed for livestock and poultry [8].
- Obstacles to the formation of labor resources for the cultivation of land, which is caused by the restriction of the movement of people.

These problems can be compensated by providing state support to agricultural enterprises in the livestock sector to reduce rents, while expanding financial support for individual producers [9].

One of the most basic ways to overcome the negative impact factors of the food crisis is the formation of an integrated ecological and economic approach in the management of processes in individual organizations and in the system of state and municipal regulation of production and consumer processes in various territories with the implementation of green landscape management.

This approach as a set of effective measures to overcome food crises in the context of the COVID-19 pandemic can be presented in figure 1.

Figure 1 shows a general set of key anti-crisis measures aimed at maintaining an optimal level of food production productivity. These measures are combined into three main areas of public-private cooperation to jointly ensure the ecological and economic modernization of the specified production
sector, taking into account the expansion of information relationships in public-private partnership within the agro-industrial complex, as well as ensuring sanitary and epidemiological protection of the population and the labor resources involved in the structure of the agro-industrial complex during the spread of COVID-19.

These methods of eliminating the crisis phenomena related to the food supply of the population should be supplemented by the production of food products and supplements of an immune-strengthening and health-saving nature, which prevents the incidence of COVID-19 or significantly facilitates the condition of those who become ill.

This ensures that the negative impact of COVID-19 on the transport, storage and sale of food products, such as fish products, dairy products, animal products, grain and legumes, is eliminated while maintaining the added value. At the same time, public administration bodies should conduct a comprehensive assessment of inventory while facilitating the import of missing products through preferential treatment at the border. These measures should be optimally complemented by a practice-oriented set of measures aimed at preventing the spread of COVID-19. Examples of these measures are presented in table 1.

Table 1. Practices of international application of administrative and economic measures to counteract the increase in the incidence of COVID-19.

| Country            | Measures taken                                                                 |
|--------------------|--------------------------------------------------------------------------------|
| Russian Federation | Measures to restrict exports under certain quotas, implemented in order to stabilize grain prices and ensure sufficient volume in the domestic market. |
| Armenia            | Conducting commodity interventions to stabilize the price situation.            |
| Armenia            | Compensation of interest on loans for all agricultural development projects, in particular, for drip irrigation and the construction of greenhouses. Increasing the level of subsidies for promising agricultural programs. |
| Belarus            | Introduction of a three-month ban on the export of a number of basic food products (for example, buckwheat). Administrative control over food prices. |
| Georgia            | Temporary emergency price control mechanism for imported food products (for example, rice, wheat grains and flour). |
| Kazakhstan         | Use of regional stabilization funds to purchase and ensure the availability of basic foodstuffs (e.g. sugar and vegetables) with appropriate price stability. Introduction of benefits for agricultural producers, including exemption from land tax. |
| Kyrgyzstan         | Setting the maximum level of wholesale and retail prices for a number of food products, which vary depending on the region. The national action plan for the pandemic, which defines the roles and responsibilities of national and international partners, has been approved. |

Table 1 shows a number of complex practices aimed at preventing the aggravation of the situation of the spread of COVID-19, which occurs in order to maintain the necessary level of functioning of domestic food producers. This is complemented by ensuring the stability of foreign economic relations while maintaining the necessary level of export-import movements of food products on the world market [10].

Based on the specifics of the established and implemented practices of state regulation of production and consumer processes of food products, it is necessary to form a set of special measures that can be taken to support the subjects of production of meat and dairy products (figure 2).
Figure 2. A set of state-regulatory measures aimed at supporting the activities of meat and dairy production entities.

The measures presented in figure 2 are a specialized set of actions focused on ensuring the stability of the functioning of enterprises and organizations of meat and dairy production in the agro-industrial complex, which is aimed at creating a high-quality raw material base with the necessary set of organizational, information and communication and economic measures. The effectiveness of these measures is ensured through a constructive partnership between public administration bodies and private business entities, which contributes to the productive search for optimal forms of food production in the situation of the COVID-19 pandemic.

The negative impact of the pandemic on the production and transportation of food products is seen in almost all countries of the world, as an example, we can point out the problems that occur in Kyrgyzstan, Kazakhstan, Turkey, Albania and Azerbaijan. The reduction of direct contacts between buyers and sellers to a certain extent caused increased costs for food storage, which is observed in the example of Kazakhstan [11].

At the same time, on the one hand, there is a reduction in food products from retailers, on the other hand, there is a rapid increase in prices for imported food products. These price fluctuations are transmitted through the food supply chains, which has an extremely negative impact on farms. Thus, many economic entities expressed concern about this price increase and began to avoid the risk of economic losses when expanding crop production [12, 13].

The elimination of the problems caused directly by the expansion of COVID-19 is largely expressed in maintaining optimal logistics of international economic and domestic economic relations, which can be seen in the example of food products produced in a number of Central Asian countries (Tajikistan, Uzbekistan, Kyrgyzstan) in the form of productive public-private regulation of agri-food chains with their continuous monitoring.

4. Conclusion
The food crises of the twenty-first century are characterized by a whole complex of problems, which are significantly complicated by the increasing incidence of COVID-19 and, consequently, measures to limit the movement of resource and raw materials components and elements of human capital.
Overcoming these crises takes place on the basis of sustainable interaction between representatives of public administration and private business entities on the issues of joint development and productive implementation of the three main directions of anti-crisis measures.

Thus, public-private cooperation, provided by modern electronic and digital technologies, is aimed at maintaining the ecological and economic modernization of the food production system, which is associated with the expansion of the use of resource-saving technologies and compliance with environmental safety standards, as well as ensuring sanitary and epidemiological protection of the population and the labor resources involved in the structure of the agro-industrial complex during the spread of COVID-19.

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