Innovative strategy to achieve food security in the Republic of South Ossetia

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Abstract. Achieving food security is a pressing issue for many countries. Over the past years, the global emphasis has transitioned from merely comprehending the challenge to actively formulating policies and crafting innovative solutions to ensure food security worldwide. This research specifically targets South Ossetia's food security status and the potential innovative strategies in agriculture to enhance it. Utilizing a blend of analytical, economic-statistical, and benchmarking methodologies, combined with data sourced from South Ossetia's official statistics and various Russian agencies, the findings paint a concerning picture. South Ossetia's agriculture is facing escalating difficulties characterized by production inefficiencies and foundational economic hurdles. Alarmingly, the region's food security is teetering on the edge, evidenced by a glaring deficit of 47.5 thousand tons in basic foodstuffs production in 2022 alone. For South Ossetia to navigate these challenges and attain its food security goals, a two-pronged approach is pivotal. First, an innovative overhaul of its agro-industrial sector is necessary, promoting its seamless integration with the broader Russian economic framework. Subsequently, aligning with the EAEU member states' food systems could further reinforce this. Such transformative initiatives in agriculture will not only secure food supply but can also rejuvenate the region's social infrastructure and elevate its attractiveness for migration.

1 Introduction

In the modern world, food security is becoming an important component of the understanding of national security, which turns out to be no less important than measures to combat terrorism or various foreign policy or military threats. This was well demonstrated in 2020-2021 years during global COVID-19 epidemic, when the general index of market prices for food reached its 30-year maximum (Figure 1), which is why the possibility of providing adequate nutrition has deteriorated even in developed countries, and in African and Asian developing countries the nutrition problem has been in the focus of world attention for the past decades. In particular, the programs of the World Health Organization (2019), the World Food Program are aimed at its solution (2020) [11, 12, 27, 29]. The food security of the world's population is a central element of such political initiatives as the UN Sustainable

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Development Goals [26], it represents an important section of long-term development strategies of countries and continents [24, 28].

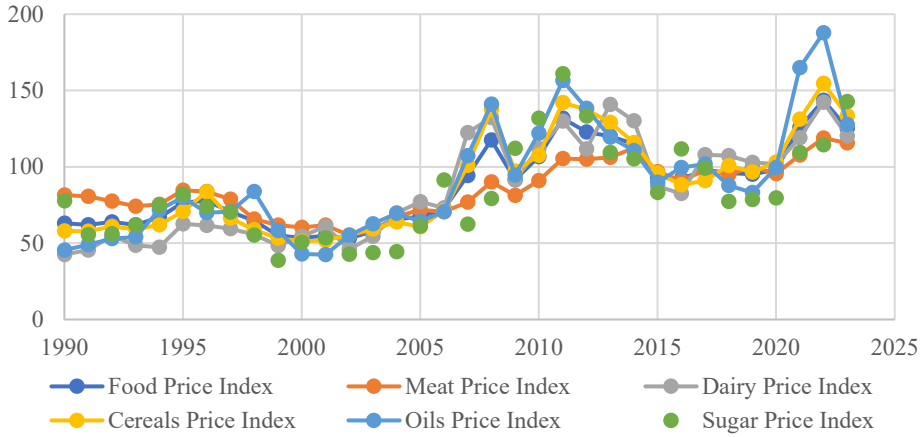

Fig. 1. Annual FAO Food Price Indices, 2014-2016=100
Compiled on the basis of source [28]

Universal access to adequate nutrition is becoming a key goal for a number of newly formed countries, which include the Republic of South Ossetia (ROS), which has experienced three bloody wars since 1989 (1989, 1992 and 2008) and having lost the significant potential of its agro-industrial complex. During the Soviet period of development, South Ossetia had sufficient land and other agro-industrial resources for self-sufficiency and sale on foreign markets [10, 15, 18], however, according to available estimates, while maintaining the size of land resources, the self-sufficiency of the RSO with food is about 37-38%, the rest falls on food imported mainly from Russia [8]. However, under the conditions of sanctions pressure from the United States and EU countries, Russia itself is experiencing some food problems. So, at the beginning of 2023, Russia was provided with sugar – by 103.2%, meat – by 101.6%, dairy products – by 85.7%, vegetables and melons – by 80%, while grain, vegetable oil and fish security in Russia is high and amounts to 153.2%, 221.1% and 185.5%, respectively [9, p.57]. Thus, the reliability of sustainable food supply to the population of South Ossetia in the future is not yet obvious.

In the conditions of a long-term upward trend for basic foodstuffs prices, according to our estimates, a new, in-depth and expanded understanding of the state's *food security is being formed as achieving the parameters of sustainable self-sufficiency in food and constant availability of high-quality food for all people, according to their food preferences*. At the same time, we share the position of T. Garnett [23], B. Burlingame & S. Dernini [5], P. Caron, G. Ferrero y de Loma-Osorio, D. Nabarro & E. Guillou [21] that food sustainability is the long–term ability of food systems to ensure food security and nutrition in the present so as not to jeopardize the environmental, economic and social foundations necessary for food security and nutrition of future generations.

As for understanding the constant availability of quality food, this implies not only the absence of short-term instability of food systems, but also their long-term state of sustainability. The mention in the definition of "all people" and "food preferences" indicates the importance of key aspects of subjectivity, that is, that all people have not only the opportunity to receive a sufficient amount of safe and nutritious food to meet their nutritional needs, but also free choice regarding the food they eat and produce. This aspect of food security is well disclosed in the works [6, 7, 19].

The most important condition for ensuring the food security of the state is the formation of an effective innovation system that allows meeting the needs of participants in the reproductive process in the latest achievements of science and technology in a timely manner and to the fullest extent. This, as is known, assumes, firstly, the presence of a complex of interrelated elements of the scientific and production system "fundamental research - applied research - experimental development – pilot production and certification – production", functioning within the framework of a single development strategy, and secondly, the availability of necessary and sufficient material, financial, human resources resources to achieve the set goals.

Market efficiency of agricultural production in the modern world can be achieved solely on the basis of innovative development of the economy and its individual sectors, including the agricultural and agri-food sectors. Galbraith J.M. notes that technological progress "changes production costs and thereby makes it possible to set prices that stimulate more sales" [13, p. 464-465]. In this regard, in the Republic of South Ossetia, the directions of innovative development strategies should be built taking into account the organizational and economic features of the emerging highly competitive technological paradigm of the economy, as well as the specifics of financial and economic relations that have developed in the agricultural sector of the country [14, 17].

The purpose of the study is to substantiate the key directions of the strategy of innovative development of agriculture of the Republic of South Ossetia to achieve food security of the country in conditions of accelerating scientific and technological progress and permanent global instability.

2 Materials and Methods

In the course of the research analytical, economic-statistical, computational-constructive and other research methods were used. In particular, the authors found it justified to use such a method as benchmarking as one of the promising tools of argumentation in the construction of an evidence base.

When preparing the article, the data of the state statistical bodies of the Republic of South Ossetia, regulatory legal acts of the Government of the Republic of South Ossetia were used. The work uses the regulatory framework of the Russian Federation, including analytical and statistical materials of the Ministry of Agriculture of Russia. The results of the research activities of the Vladikavkaz Scientific Center, other research centers and institutes of the corresponding profile of Russia were also used.

3 Results and Discussion

The Republic of South Ossetia has agricultural land with a total area of 14,481 hectares, while the level of their use is extremely insignificant: in 2018 it was 2,540.2 hectares or 17.5%, in 2022 3,226.9 hectares or 22.3% were used. The hayfields of the RSO with an area of 9211 hectares are used somewhat better: in 2018, 2523 hectares or 27.4% were used, in 2022, 3284 hectares or 35.7% were used.

Table 1. The area of agricultural land of the Republic of South Ossetia, ha

Period	Arable land			Haymaking		
	Total	Used	Usage rate, %	Total	Used	Usage rate, %
2018	14481	2540.2	17.5	9211	2523	27.4
2022	14481	3226.9	22.3	9211	3284	35.7

Compiled on the basis of source: [22, p. 97-101]

As a result of the insufficient development of agriculture, the food security of South Ossetia is in a zone of high risks and threats. Taking into account the Russian consumption norms, we calculated the missing volume of own agricultural production in the RSO, according to the data of 2022, which showed a total shortage of at least 47.5 thousand tons of agricultural production of basic foodstuffs (Table 2)

Table 2. The missing volume of own agricultural production in the Republic of South Ossetia in 2022

Product	Consumption rate per year, kg	Lack of own production, tons
Meat and meat products	78	-3253.51
Milk and dairy products	406	-8708.18
Fish and fish products	18,5	-881.366
Potato	110	-5336.93
Fruits and berries	91	-2864.93
Bread products	115	-5884.25
Eggs, thousand pieces	263	-11346.2
Sugar	37	-2081.73
Vegetables and melons	130	-7109.79

Compiled on the basis of source: [20; 22, p. 95-137]

It should be noted that 30 years ago the Republic of South Ossetia acted for neighboring regions as a food supplier of meat and dairy products, eggs, fruits and berries, as well as melons. The main reasons for the decline of the agro-industrial complex of the Republic of South Ossetia are low agricultural productivity due to the use of worn-out machinery and outdated technologies, as well as a high proportion of manual labor, low availability of borrowed funds to agricultural producers, insufficient state support for the development of the agro-industrial complex, underdevelopment of farming, lack of seed material, others [4, 3, 16]. As a result of the current situation, rural areas lose their attractiveness as a place of life and work of people, there is a strategically dangerous depopulation of rural areas [2, 14] The annual population decline in the context of rural areas only in the period 2018-2022 amounted to about 2%, despite the fact that out of the total population of 56263 people, 18,829 people. they live in rural areas (table3)

Table 3. Population of the Republic of South Ossetia as of 01.01.2023

Total	Including		Share in the total population, %	
	Urban population	Rural population	Urban population	Rural population
56263	37434	18829	66.5	33.5

Source: [22, p. 15]

In the process of conducting research on the RFBR project No. 20-510-07003 of the Ministry of Education and Science of the Republic of South Ossetia "Development of the agricultural sector as a factor in improving the standard of living and migration attractiveness of the Republic of South Ossetia" (2020-2023), we justified the need for the formation and

development of a regional innovation system, which is understood as a set of interrelated and interdependent institutions that determine long-term policies in the field of infrastructure formation, creation, financing, dissemination and use of advanced achievements of science and technology, as well as advanced experience in production [1-4]. This approach is conditioned by the existing challenges and threats facing the Republic of South Ossetia, which can be grouped into the following groups:

- increasing geopolitical instability and deepening economic confrontation (up to the termination of any trade relations) with unfriendly states that imposed sanctions against Russia in 2022 and have not recognized the legitimacy of the independence of the Republic of South Ossetia since 2008, including as a subject of international law;
- formation of a new technological base for the production of agricultural products, agricultural raw materials and food, which is based on the use of digital technologies, biotechnologies and other achievements of science and technology;
- significant activation of human capital as a factor of economic development of agriculture;
- the need to develop the rural local economy and related spheres of activity at the level of districts and the republic as a whole;
- the need to revise the financial and economic model of the development of the RSO in connection with possible restrictions on financial support of the republic from the Russian Federation due to a possible increase in the budget deficit and the introduction of a limit system of allocated resources;
- possible adjustment of the RSO support programs by Russia due to a sharp narrowing of the potential of the export-raw material model of Russia's economic development due to the imposition of sanctions and the establishment of non-market instruments for setting prices for Russian energy carriers by unfriendly states;
- changing approaches to financing various large-scale projects using public-private partnership instruments, expanding measures to attract public funds through involvement in the purchase of investment instruments;
- the need to develop a system of non-state pension system and private investment funds of the RSO to form a funding system for a long-term program for the construction of transport and engineering infrastructures;
- a shortage of qualified engineering and labor personnel and imbalances in the labor market with a high level of real actual unemployment.

Unfortunately, these challenges and threats were only casually reflected in the Law of the Republic of South Ossetia of December 2013. "On the strategy of socio-economic development of the Republic of South Ossetia until 2030" and the State Program of socio-economic Development of the Republic of South Ossetia for 2022-2025, adopted by the Parliament of the RSO on 31.12.2021. Although it is not possible to assume an aggravation of the political situation in the world and, accordingly, to foresee the corresponding risks and challenges. But, most of the above challenges are caused not only by the changing situation in the world and the sanctions pressure on Russia. They are, first of all, the result of the policy of state regulation of the economy of the RSO. The above-mentioned use of pastures and hayfields by agricultural producers of the republic and the practical absence of a mechanism of state support for the development of unused these types of agricultural land are sufficient.

The agricultural lands available in the republic are fixed (owned or leased) and are processed by 56 agricultural organizations, 65 farms and 8632 private subsidiary farms. The current share of agriculture in the gross domestic product, which amounted to only 0.43% in 2018 and 1.06% in 2022, does not reflect the role that the industry can have with an optimal load of unused production and labor resources involved in production. In our opinion, the agricultural sector of the economy of the RSO can be a significant driver of the economic

growth of the region with the involvement of the entire available area of agricultural land in the production process.

The strategic directions of innovative development of the agricultural sector of South Ossetia should be based on the principle of rational allocation of agricultural production, taking into account natural and climatic factors. If in the Znaursky and Tskhinvali districts of the RSO, the share of arable land is 43.4% and 41.7% of the agricultural land area, respectively, then in the Leningorsky district only 4.3%, in the Dzau district - 0.86%. Leningor and Dzau districts are distinguished by the predominance of pastures, the area of which is 42752 ha and 47042 ha, which is 92.4% and 88.5%, respectively, of the area of agricultural land [4]. In accordance with the recommendations of the Russian branch Ministry (for conditions corresponding to the natural and climatic conditions of the North Caucasus Economic Region of Russia), for example, at least 120 hectares of pastures are needed for 1000 sheep (with lambs), with a pasture period of about 200-240 days per year [20]. Calculations show that potentially only about 600 thousand sheep with lambs can graze on the pastures of the Leningor and Dzau districts of the RSO in compliance with the technological standards of grazing. From this livestock, 1200 tons of pure wool (up to 2 kg per head of sheep) can be obtained annually, according to minimum estimates up to 10,000 tons of mutton. In general, about 78-80 thousand can graze on the pastures of only two of these districts of the republic. conditional heads of cattle, whereas as of 01.01.2023 in all farms of the RSO (agricultural organizations, farms, households of the population), the total number of farm animals was, as calculations show according to the State Statistics Service of the RSO, only 13.8 thousand conditional heads of cattle.

In order to intensify the economic development of the Republic of South Ossetia on a new technological basis, the most important direction is the formation in the region of a diversified research institute of the Republic of South Ossetia (MRI RSO), in which one of the divisions (department) must be focused on research in the field of agriculture. It seems that the formation of such an international scientific research institute of the Republic of South Ossetia can be accelerated by the involvement of Russian scientific institutions in this process, such as the Vladikavkaz Scientific Center and one of its branches - the North Caucasus Research Institute of Mountain and Foothill Agriculture. Other direct participants in the formation of the International Research Institute of the Republic of South Ossetia can be: from the side of the Republic of South Ossetia - the Ministry of Agriculture of the Republic of South Ossetia, South Ossetian State University; on the part of the Russian Federation - Mountain State Agrarian University, North Ossetian State University and other higher educational institutions and research centers that deal, among other things, with issues of agriculture in mountainous and foothill areas.

The formation of the infrastructure of the innovation system of the Republic of South Ossetia is based on the premise of the need for full-scale involvement of current and future agricultural producers in the process of conducting research work and introducing the positive results of scientific achievements directly into production. In addition to the proposed creation of the International Scientific Research Institute of the Republic of South Ossetia, for the effective functioning of the innovation system, it is necessary to provide for the possibility of organizing experimental units on the basis of already existing public farms, one for each of the regions of the republic. It is advisable to carry out all expenses for organizing such units in selected farms (in agreement with the owners) at the expense of the republican budget within the framework of state support for agricultural production (research subprograms).

The most important elements of the republican innovation system of the region, which need to be formed and improved for integration into the existing structure of agro-industrial production, are:

- breeding seed station;

- breeding farm;
- information and consultation center for farms and agricultural producers.

These institutional entities, in cooperation with the diversified research institute of the Republic of South Ossetia, can become participants in the agricultural technology platform created by the countries of the Eurasian Economic Union (EAEU). As follows from the regulatory documents of the EAEU, the main goal of the Eurasian agricultural technological platform is "... to carry out systematic work to accumulate advanced national and world achievements of scientific and technological development in the field of the agro-industrial complex; mobilization of the scientific potential of the member states of the Eurasian Economic Union (hereinafter referred to as the member states) for the joint solution of applied problems in agriculture of the Eurasian Economic Union; development of innovative products and their implementation in the agro-industrial complex" (https://eec.eaeunion.org/upload/medialibrary/1f4/Selhoz.pdf). This will create the necessary prerequisites for increasing the accessibility of agricultural producers of South Ossetia to the innovations of the community of EAEU member states, without joining the organization itself at first. In the future, as statehood becomes established, the Republic of South Ossetia can be a full participant in this agricultural technological platform.

Considering that the innovation system represents not only institutions, but also, no less important, the external environment in which these institutions operate, then from the position of development strategy it is necessary to provide for promising directions for the formation of key components of this environment in the Republic of South Ossetia. The weakest link in the external environment of the innovation system in the region is the investment and financial infrastructure block, represented by a credit institution and the republican treasury. Therefore, it is necessary to form elements of the appropriate investment infrastructure and expand the range of financial and credit institutions to provide the innovation system being created in the Republic of South Ossetia with sufficient long-term financial resources. In particular, taking into account the scale of the existing production structure of the agricultural economy, in our opinion, it is promising to form such institutions as: investment and innovation partnership; microfinance organizations (agricultural credit consumer cooperatives, credit consumer cooperatives of citizens, etc.), agricultural production and marketing cooperatives.

The most important direction of the strategy for the development of the innovation system in the Republic of South Ossetia is solving the problem of debt obligations of business entities, and not only in rural areas. First of all, it is necessary to find resources to pay off the debt for Russian gas supplied to the region, the amount of debt of which, according to the Russian Federation, as of April 23, 2023, reached 1 billion rubles, which is 20% of the volume of material assistance included in the State Program for Socio-Economic Development of the Republic of South Ossetia for 2022-2025, adopted by the parliament of the republic. [25]. One possible solution to the problem may be to reach an agreement to freeze the specified amount with the registration of this debt in the form, for example, of securities, so-called "green bonds" for a period of 10 years with a yield of 3-5% per annum. Such a possible solution will allow, on the one hand, not to infringe on the interests of PJSC Gazprom, on the other hand, it will allow directing funds for the implementation of production activities of the food and processing industry in the Republic of South Ossetia without the threat of stopping gas supplies, and guaranteeing a stable supply of blue fuel to the population. Only the switching of part of the financial assistance funds in the amount of 1 billion rubles. to stimulate the production of agricultural products under the order of the state can significantly intensify the cultivation of crop products and fattening of livestock in government organizations, farms and households. This amount can be distributed among commodity producers both in the form of cash and in the form, for example, of purchasing the necessary equipment to start the process of restoring the industry, purchasing grain for

fattening cattle, raising poultry, purchasing mineral fertilizers. Also, part of these funds can be used for subsidizing interest rates on loans received for the needs of agricultural production, developing leasing, compensating producers for part of the costs of technical and technological modernization on an innovative basis and other similar innovative needs.

This, in turn, will solve the problems with the low workload of food industry enterprises in the republic and create the preconditions for saturating the regional market for food products of domestic (local) production. And one of the possible solutions to stimulate regional participants in the wholesale market of agricultural raw materials and agricultural food to switch to the use of the republic's products could be the phased introduction of customs duties on imported food products from Russia. Of course, this should be preceded not only by the saturation of the republican market, but also by preparing the economic system itself for such restrictions and the introduction of customs regulation instruments for those types of agricultural products that can be produced on the territory of South Ossetia.

Which will require the use of not only technological innovations, but also the use of organizational, marketing, management innovative solutions, and, accordingly, bringing them to the level of strategic decisions in the development of long-term development programs for the Republic of South Ossetia.

The high wear and tear of existing food industry enterprises does not allow for efficient production, guaranteeing product quality, requires constant repairs, and the lack of profit does not create the prerequisites for attracting investors to modernize production on a new technical and technological basis. We see a solution to the problem in the following possible directions:

a) through an interstate agreement, request on behalf of the republic an investment long-term loan of targeted financing for the renewal of fixed assets of agricultural producers, food and processing industries;

b) creating conditions for attracting a large private investor under guarantees from the government of the Republic of South Ossetia;

c) stimulating the creation of so-called "investment partnerships" to attract long-term funds to modernize the existing production capacities of small and medium-sized businesses in the food industry, the transport and logistics sector of the food complex and others;

d) holding an auction for the sale of unused production capacity with subsequent state support from the republican budget to potential investors, with the mandatory and only condition of preserving jobs and expanding existing production capacity (saving jobs and expanding existing production capacity are parameters relating to a specific enterprise and industry) for five (ten) years.

The introduction of new technologies, automation and robotization of technological processes is, of course, accompanied by a reduction in the need for labor, but, as is known, the demand for highly qualified specialists in servicing advanced equipment, especially in the field of programming and information technology, is increasing. This raises the question of the need to introduce advanced personnel retraining systems in the region to work on high-performance equipment and its maintenance.

4 Conclusion

The strategic directions for the development of the innovative system of the agro-industrial complex act in conjunction with strategies in other areas of the economic complex of the Republic of South Ossetia, which serves as the cornerstone for achieving the goals and objectives of increasing the well-being of the population of the republic. In the emerging realities of growing geopolitical tension, it is important to strengthen the integration of the economy of the Republic of South Ossetia into the national economic complex of Russia in all areas and, above all, in the innovation sphere. And, the solution to this problem must begin

by highlighting a special section in the State Program for the Socio-Economic Development of the Republic of South Ossetia, both in short-term and medium- and long-term forecasting, dedicated to the strategic directions of development of the innovation system, integrated both into the Russian economy and in the future built into within the framework of a single system with the member countries of the EAEU (and possibly within the BRICS countries or the Shanghai Cooperation Organization (SCO)). Of particular importance is the gradual and sustainable integration into the innovation chain of Russia of agricultural producers, enterprises of the food, processing, light and textile industries of the Republic of South Ossetia.

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