

Analysis of food security and sustainable development of the agricultural sector in Georgia

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Abstract. The paper aims to analyze food security and the sustainable development of the agricultural sector in Georgia. The paper examines the development potential of the agricultural sector in Georgia. The following qualitative indicators are discussed: indicators of food self-sufficiency according to the main food products, indicators of compliance of Georgia's food exports with imports, the volume of investments in the agricultural sector and the factors affecting them. Factors affecting the implementation of the food security policy in Georgia, the establishment of agricultural orientation, the realization of the concept of organic agriculture, the increase in profitability, modernization, and financing policy have been analyzed. Econometric analysis of food security has been provided by the multiple logarithmic regression equation, according to which important factors influencing the growth rate of food self-sufficiency ratio were identified, such as the growth rate of agro-food net export's share; the growth rate of investments' shares in agriculture; the growth rate of the share of local agricultural production in the gross domestic product. The paper analyzes the experiences of other countries with better results than those in Georgia regarding food security. The effectiveness of their mechanisms in ensuring food security is studied, and recommendations are given for making changes.

1 Introduction

In the new geopolitical conditions, the main strategic task for any country is the provision of national security, which is ensured by individuals, society and protection from internal and external threats of the state. It refers to the satisfaction of fundamental human needs with limited resources. Accordingly, food security is included in the complex of national security problems and presents one of the most urgent problems of the XXI century, which requires detailed consideration and solutions for future prosperity.

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Modern aspects of food security formation are discussed by international organizations (FAO, United Nations, ILO, UNICEF and others), regional integration associations, governments of countries, and groups of experts [5, 6]. In their works, the theoretical-applied aspects of the research of the problem have also been given by Georgian researchers [17-18], [20-21]. Despite many publications, food security issues have not been comprehensively studied and resolved at the regional and global levels.

In modern conditions, the high level of integration of the economies of different countries leads to a high dependence of national security on the ability of different countries to ensure food security. Most countries buy food on open global food markets, the global food import rate has long exceeded one trillion US dollars, and according to 2021 data amounted to 2.0 trillion US dollars [27]. The current economics of food production mean that small changes in production can cause significant price swings. In the period of global crises, national governments can apply certain measures for the protection of the domestic market, which do not disturb the common market chain. For example, due to the anticipation of a possible crisis caused by COVID-19 major producing countries of various products introduced quotas and additional taxes, which directly affected not only import-dependent countries but all countries globally. In such a situation, the problem is more acutely affected by low-income households, whose income is spent on buying food for more than 75%. Such interventions are announced as short-term restrictions by governments, but they cause long-term problems in terms of food security and are quite painful.

At the global, regional and national levels, FAO builds partnerships to support favorable conditions, in the direction of food security and sustainable agriculture, the organization works on strengthening the capacities of stakeholders and mobilizing resources [9] to achieve the transformation of food policy by carrying out a complex of measures [3], which will systematically and effectively solve not only the tasks of production, development, foreign trade, storage and processing but also ensures a fair distribution of basic foodstuffs, as well as social development of rural settlements. Members of the international community are convinced that hunger can be eradicated and are making concerted efforts to achieve this goal [16].

2 Research methodology

Research methods are based on general and specific research methods. Among them, are induction and deduction, analysis and synthesis, methods of scientific abstraction, and comparative analysis. Socio-economic processes have qualitative as well as quantitative expression, has been used research statistical methods: observation, gathering, grouping and others. When discussing the economic factors affecting the food security policy of Georgia, we studied the following qualitative indicators: indicators of food self-sufficiency according to the share of basic food products in the dynamics, the share of agriculture in GDP, Georgia's food export-import compliance rate, the volume of investments in the agricultural sector and the factors affecting it.

In order to give empirical content to relationship between main indicators we provided econometric analysis by the multiple logarithmic regression model based on statistical data for 2001-2022 years.

3 Results

The challenge of global food security deepened in late 2021 due to the lingering effects of the COVID-19 pandemic, as well as new and ongoing conflicts and climate-related changes.

After the sharp decline in economic activity recorded in 2020, rising food, fuel and transport prices resulting from an uneven economic recovery have hindered progress in food security [7]. Food security is one of the main goals of the state's international and economic policy. It depicts the vector of a movement to ensure the ideal state of any national food system [3]. In this sense, striving for food security is continuous [21]. To achieve this, it is necessary to change the mechanisms of development priorities and implementation of agrarian policy [1, 5].

The socio-economic development of the country can be characterized by the level and quality of food consumption by the population and almost 70% determines the health of the population and the life expectancy of a person. It is no coincidence that one of the sustainable development goals adopted by the United Nations in 2015 is "Eliminating hunger, ensuring food security, improving nutrition and supporting the sustainable development of agriculture" to achieve this, it is important to provide a link to support sustainable agriculture, increase the capacity of small farmers [16], promote gender equality, eliminate poverty in rural settlements, promote a healthy lifestyle, fight climate change, and more. The 2030 Agenda for Sustainable Development obliges the international community to act collectively and transform our world for present and future generations [4]. Focusing on food and agriculture, and investing in and transforming the agricultural sector are actions that can accelerate progress towards the 17 Sustainable Development Goals. Food security is considered a complex and multifaceted phenomenon, which requires taking into account a complex of interrelated factors. It should be noted that the concept of food security has undergone a certain evolution since the 50s of the last century (Table 1).

Table 1. Food security challenges and the evolution of their mitigation measures.

Period	The main challenges	Activity carried out
1940-1950s	Food shortages caused by the consequences of war and demographic growth	Utilization of new lands, introduction of "green" revolution, assistance from donor countries.
1960s	Food aid does not promote self-development	Formation of the World Food Program to promote economic and social development.
1970s	Drought and world food crisis, rising food prices	Ensuring availability of food supplies, monitoring food availability
1980s	The problem of economic access to food, malnutrition of children	Development of measures to overcome poverty, increasing the role of women in the economic development of society
1990s	The problem of hunger and malnutrition is still relevant for a number of countries	Developing policies to end world hunger and malnutrition.
2000s	Broadening the issue to include social inclusion and achieving the Sustainable Development Goals	Taking measures to popularize the concept of healthy and balanced nutrition and the principles of sustainable development.
2010s	Activating sustainable development goals and increasing food security risks, including rising food and energy prices.	Support for sustainable agriculture, increasing the capacity of small farmers, eradication of poverty in rural settlements, approval of a healthy lifestyle, and combating climate change.
2020s	The COVID-19 pandemic, the Russia-Ukraine war and the conflict in the Gaza Strip - creating new global problems	Development of anti-crisis plans. Development and implementation of ecologically acceptable and permissible technological production of food.

The Green Revolution of the mid-20th century provided a much-needed increase in agricultural productivity to keep up with rapid population growth. Currently, in the Second Green Revolution, the supply of abundant and healthy food is still relevant, but at the same time the preservation and use of the ecosystem and biodiversity is becoming a challenge. There are approaches to produce more and healthier food with fewer resources without disturbing natural ecosystems.

In our opinion, in the conditions of the world population growth trend [23, 28], more efforts and innovations are needed to increase agricultural productivity, to improve the functioning of global production-supply chains, to reduce the volume of food losses and waste, to increase access to food. In addition, we think that the concept of food security is not limited to the problem of providing food to the population, although it is the ultimate goal. National food security should also be assessed based on the level of food self-sufficiency. The share of imports in covering commodity resources and domestic demand, the level of production of agricultural products for ensuring the country's food self-sufficiency, taking into account the advantages of the international division of labor. It is established that the key values for the implementation of the food safety policy are food safety criteria. They allow us to determine the critical limit of food dependence on foreign markets. The mentioned criteria can be used in the preparation of the country's development strategy (Fig. 1).

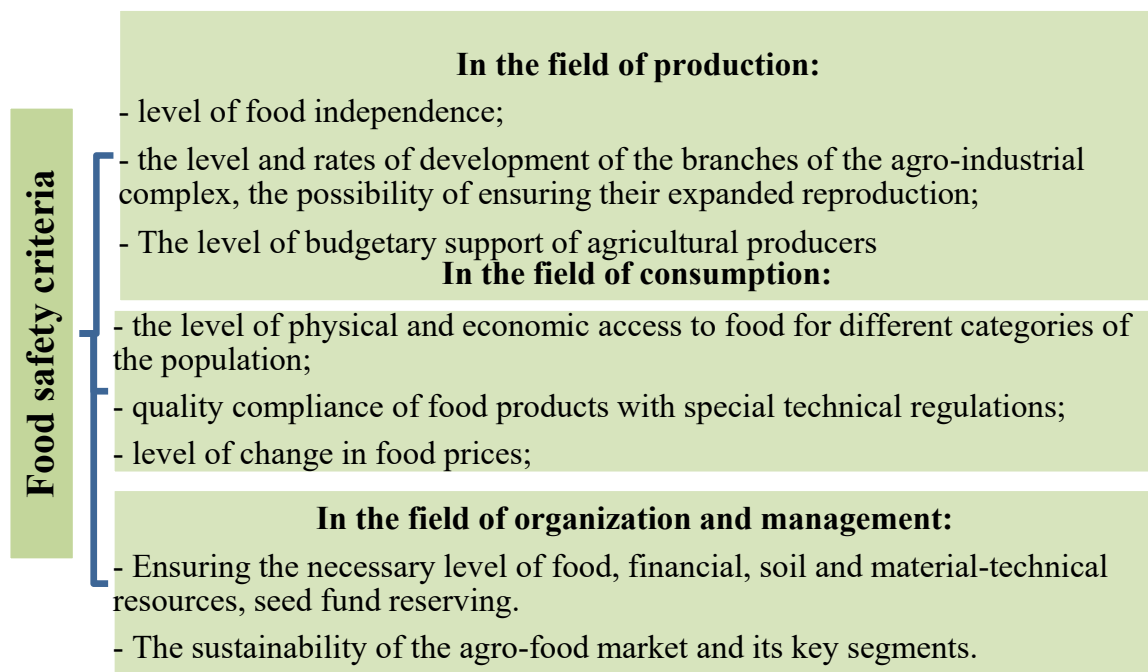


Fig. 1. Food security criteria.

Those countries that claim to be world leaders are trying to develop their own agriculture to avoid social crises arising from various reasons. In addition, the states direct significant funds to maintain competitiveness, ensure minimum profit and expand the export of products, which is a prerequisite for the fulfillment of strategic tasks of economic independence.

To convince the priority of the sustainable development of the agricultural sector, it is enough to note that in 2019-2021, the support of agriculture in the USA increased by 13% compared to the indicator of 2018-2020. In 2020-2022, total agricultural support in 54 countries reached a record high of \$851 billion, aimed at consumer protection and high inflation.

Support is concentrated in several large producing countries, China, India, USA and EU countries receive 36%, 15%, 14% and 13% of the total aid respectively [25]. We think that by pursuing a policy of supporting the competitiveness of Georgian products, such products as: wine, nuts, tea, citrus fruits, beekeeping products, fruits and others can find their own niche in the world market.

It should be noted that almost 2/3 of the total number of calories consumed by the population of Georgia comes from food products of vegetable origin, which is 1.5 times higher than the recommended proportions. The main reason is that the cost of every 1000 kilocalories consumed by the population from products of vegetable origin is about 3-4 times cheaper compared to the cost of the same number of calories of animal origin. As a result, the food basket is formally cheaper, a formal basis for reducing the subsistence minimum is created, however, at the same time, the proportions in the consumption of proteins, fats, and carbohydrates by members of society are violated [21]. As a result, agricultural orientations are formed, according to which farms are developed (Fig. 2).

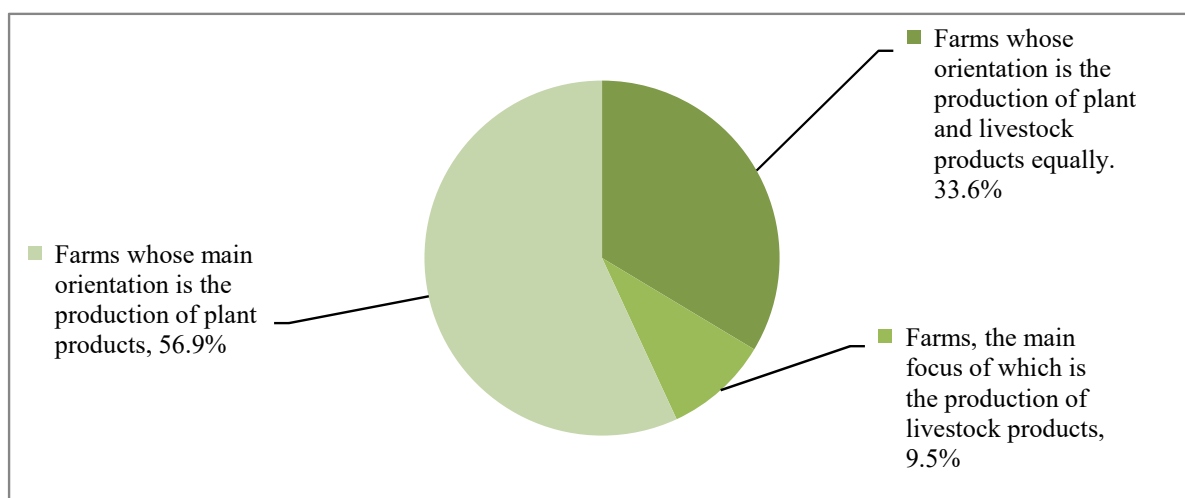


Fig. 2. Distribution of agricultural farms according to the agricultural orientation of the farm, 2022, % [12].

All countries face unique circumstances and strive for self-sufficiency. For instance, some nations grapple with severe hunger despite having a rich cultural heritage, while others may not. In certain regions, high poverty levels impede access to food. Consequently, even high-income countries that do not achieve food self-sufficiency may not prioritize their own food security, opting instead to rely on international trade, regardless of their technological advancements. On the other hand, some countries experience inadequate self-sufficiency.

The sovereignty of a nation is often linked to its capacity to utilize its resources for food provision. This capability hinges not only on the production of foodstuffs but also on the ability to import essential food items and ensure equitable distribution.

Food self-sufficiency is a pivotal objective of national policy and is regarded as a vital component of safeguarding national security. It must be shielded from the vagaries of international markets, as evidenced by the disruptions experienced during the global pandemic of 2020. A strategy for food self-sufficiency should eschew reliance on imports and instead focus on bolstering the agrarian economy as part of a broader economic development plan.

Thus, food security is primarily the provision of a specified level of domestic production (Table 2), or complete self-sufficiency, or support of a critical minimum. Food safety criteria allow to determine the critical limit of food dependence on foreign markets.

The analysis of data over the years showed us that the self-sufficiency ratio of some products was improving during the mentioned period of time, while others were getting worse. For example, according to the coefficient of self-sufficiency, the following agro-food products are characterized by a decreasing trend: corn, vegetables, milk and milk products, meat. According to local production, in the same period, with an increasing trend - eggs, potatoes and wheat (nevertheless, a large part of the latter (78%) is imported from abroad).

Table 2. Food balances according to the main food categories in Georgia (%) [14].

Food types/years	2014	2015	2016	2017	2018	2019	2020	2021	2022	2022-2014, compared, %	2022-2019, compared, %	2014-2022, compared, %
wheat	7	17	19	15	14	15	15	22	22	214	46	181
corn	91	77	79	64	71	70	68	74	62	-31	-11	-18
potatoes	88	89	90	113	102	93	92	115	101	14	8	31
vegetables	66	66	64	65	60	62	63	61	52	-21	-16	-9
grapes	165	122	151	184	152	151	145	173	207	25	37	19
meat	43	48	48	48	52	48	49	51	50	16	4	18
Cattle meat	73	79	81	78	78	76	80	83	83	13	9	13
Pork	44	49	44	40	44	46	53	52	48	9	4	19
Lamb and goat meat	79	95	113	299	345	184	97	105	103	30%	-44%	133
Poultry meat	24	31	35	33	35	31	33	37	34	41%	10%	48
Milk and milk products	90	87	82	82	81	81	81	81	77	-15%	-5%	-11
egg	96	102	100	98	99	96	97	98	96	0%	0%	2

In analyzing food self-sufficiency, we chose to examine and draw comparisons with other nations. For this comparison, we selected neighboring countries Azerbaijan and Armenia, which share similar socio-economic development levels with Georgia. Notably, in 2021, Azerbaijan’s agricultural land spanned 2,089,000 hectares, employing 36% of its population. Armenia’s agricultural land covered 443,000 hectares, while Georgia’s comprised 312,000 hectares. Additionally, Israel was included in the comparison as an example of a country with limited land area yet advanced agricultural technologies. Israel’s agricultural land measures 377,000 hectares, with 50,000 individuals working in this sector, representing 2% of the country’s workforce. Despite these figures, Israel manages to produce 95% of the agricultural products it requires, underscoring the efficacy of its agrarian policy [19].

As illustrated in Table 3, the production indicators for key food product categories are on the rise in the countries under comparison. Azerbaijan’s growth in potato, vegetable, meat, and egg production is particularly noteworthy. In 2021, potato production surged by 26% compared to 2015 and saw a 5% increase from 2019. The country’s meat production has also shown significant progress, impacting its import figures. For instance, Azerbaijan imported 12,000 tons of meat in 2021, a reduction from the annual 20,000 tons imported over the previous four years. The meat self-sufficiency ratio stood at 92% [2].

In Armenia, despite a noticeable decline, the self-sufficiency ratios in 2021 were as follows: vegetables at 102%, potatoes at 101%, eggs at 101%, milk and dairy products at 83%, and meat at 61%. Israel, despite a reduction in production, maintained high self-sufficiency rates in 2020, with potatoes at 115%, vegetables at 101%, milk and dairy products at 93%, meat at 93%, and eggs at 92%.

Compared to Georgia, the countries analyzed demonstrate distinct advantages in food product self-sufficiency. The low self-sufficiency rates in meat, dairy products, and vegetables, coupled with a high reliance on imports, are particularly striking. These nations have realized some success through agrarian reforms. For example, Azerbaijan has been actively encouraging substantial investments in agriculture and facilitating preferential lending from commercial banks. The introduction of digital farming—an intelligent system—marks a significant advancement in the sector. This electronic system aids farmers in precisely planning their sowing areas to align with market demand and in accurately forecasting commodity demand.

Table 3. Production of some categories of food products, (thousand tons) [10].

	Azerbaijan				Armenia				Israel				Georgia			
	potatoes	vegetables	meat	egg	potato	vegetables	meat	egg	potato	vegetables	meat	egg	potato	vegetable	meat	egg
2015	840	1764	299	93	608	1261	101	37	562	1590	764	122	187	213	67	40
2016	902	1740	302	97	606	1152	106	35	598	1637	796	140	249	202	65	39
2017	914	1848	317	103	547	1028	109	35	522	1563	798	149	180	194	66	40
2018	899	1928	326	101	415	687	108	36	511	1489	804	153	238	200	72	42
2019	1004	2165	336	110	404	719	107	36	524	1441	785	148	195	229	69	44
2020	1038	2189	346	115	437	789	108	42	528	1405	862	149	209	260	69	45
2021	1062	2278	358	111	365	715	111	39	509	1435	828	166	209	227	73	43
2021 2015 relative %	26	29	20	19	-40	-43	9	5	-9	-10	8	36	11	7	8	7
2021 2019 compared %	5	5	6	1	-10	-0,5	4	8	-3	-0,4	5	12	7	-0,9	5	-2

The adoption of modern technologies is crucial for advancing agriculture in Georgia. In this context, Israel’s experience with drip irrigation, water purification, and reuse systems is particularly relevant. Such innovations are vital for Eastern Georgia, where certain regions boast highly fertile soil but yield less produce due to inadequate irrigation.

Georgia owns certain types of resources - food, energy, labor, land and water resources, but it cannot provide the population with quality food at the expense of its own production and is forced to fill the deficit even in the case of such food goods, which it can produce and ensure self-sufficiency. For 77% of family farms, the main purpose of producing agricultural products is their own consumption, 21% produce mainly for sale, and 2% of family farms do not produce agricultural products at all[15].

The main challenge in the field remains the low level of productivity. In Georgia, the share of agricultural fields in the total area is 43.4% [31], in Israel it is 20%. Nevertheless, 3.7% of farmers in Israel meet the needs of their population by almost 95% [17]. We agree with the opinion of several experts that to increase the productivity, it is necessary to enlarge the divided farms and introduce modern technologies. The main source of inefficiency in the agricultural sector is the average farm size. According to the data of 2021, 93.6% of farms in Georgia had a farm size of less than two hectares. While the average farm size in the US is 180 ha, in Canada it is 327 ha, in Belgium 35 ha, in Croatia

10 ha, in the Netherlands 27 ha, etc. [18]. It is not worth cultivating their small land for a large part of rural residents, it is also unprofitable to purchase machinery that would increase productivity. In some cases, the land of the rural population remains uncultivated, as there is a migration from the countryside to the urban settlements to find a job [15].

For the development and promotion of agriculture and agribusiness of Georgia, the Ministry of Environmental Protection and Agriculture of Georgia has developed the Strategy of Agriculture and Rural Development of Georgia for 2021-2027, the vision of which, based on the principles of sustainable development, is diversification/development of economic opportunities in rural areas, improvement of social conditions and living standards. For the successful implementation and promotion of the strategy, special programs are initiated in Georgia. The programs initiated cover almost all links of the value chain. The largest share of the funds allocated to the agricultural sector is held by the unified agro project, which was created in 2016 and is managed under the Rural Development Agency. The single agro-project includes the financing of various activities in the agricultural sector, and various activities are added or removed every year. In total, 1.9 billion GEL was spent on a single agricultural project (Table 4).

As we can see, the agricultural sector of Georgia enjoys special supportive approaches from the government compared to other sectors, however, despite this, it is much less successful than other sectors. In 2015-2023, the economy of Georgia grew by 4.3%, while the real growth rate of the agricultural sector in the gross domestic product was only 2%.

Table 4. Components included in the unified agricultural project and the costs incurred for them in 2015-2023, Georgia (million GEL) [18].

Project title	Total 2015-2023	Share
Preferential agricultural credits	869	44%
Other projects (40 million GEL)	117	9%
Introduce the future	177	6%
Management of agricultural projects	115	6%
Measures to promote spring work of small land farmers	97	5%
Co-financing project of processing and storage enterprises	88	5%
Agro insurance	72	4%
Promotion program for owners of agricultural plots of land	71	4%
Measures to promote the purchase and processing of grapes	70	4%
Payment of agricultural equipment loan and leasing obligations	70	4%
Agricultural Modernization, Market Access and Sustainability Project	62	3%
Dairy Industry Modernization and Market Access Program (DIMMA)	55	3%
State co-financing program for agricultural mechanization	55	3%
Infrastructural development of agricultural cooperatives		2%
Total:	1960	100%

It is established that the economic growth of the agricultural sector in the GDP reduces poverty much more than the growth of other sectors [29]. Food security is significantly dependent on the development of agriculture. The development of this field is especially important for developing countries. In Georgia, the import of agro-food products is steadily 3.5 times higher than the export. By creating a positive trade balance, the GDP will increase significantly. Today, the share of agriculture in GDP is 6.4% [13]. In the period 2012-2022,

the average value of added value created in agriculture, forestry and fish farms, calculated per one employee in the same sector, increased by 5.3 thousand GEL (68.7%) and amounted to 13.0 thousand GEL. In the same period, the average absolute increase of the mentioned indicator amounts to 214 GEL [14].

According to the data of 2022, agro-food products worth 1,252.1 million US dollars were exported from Georgia, which is 9.7% higher than the figure of 2021, and agro-food products worth 1,852.8 million US dollars were imported, which is 37.3% higher than the figure of 2021.

It should be noted that the specific share of agro-food products in the total exports of the country is 22.4%. In 2022, compared to 2021, the negative trade balance of foreign trade with agro-food products increased 2.9 times and amounted to 601 million US dollars. As from 2012 to 2022, the negative value of this indicator decreased by 20% [13].

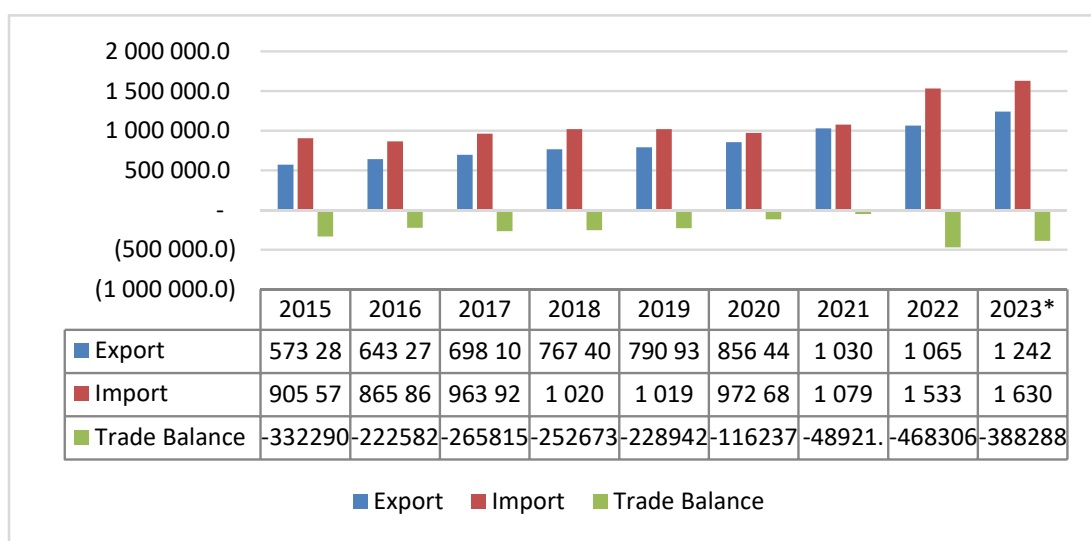


Fig. 3. Foreign trade in agro-food products (1000 US Dollar) [13].

There is a well-argued opinion of researchers regarding the fact that in our country there are additional opportunities and conditions for the establishment and expansion of import-substituting production [17, 21], however, it is acceptable to increase the load of the existing production capacities and to introduce new capacities, for which investments are necessary, first of all from the private sector with a long-term perspective, after which we can talk about import substitution (Fig. 4).

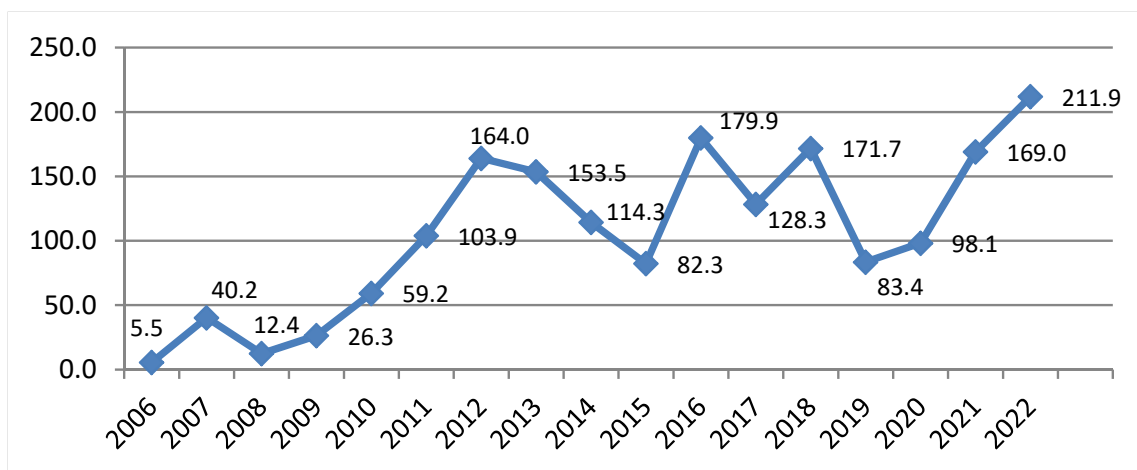


Fig. 4. Investments in fixed assets in agriculture, forestry and fisheries, Georgia (million GEL) [14].

Investing in agriculture is hampered by uncertainties, which represent a great risk for investors [16]. Environmental conditions are particularly noteworthy in this regard. For example, by 2021, 55% of 546,600 farms in Georgia were hindered by drought, 32% by extreme temperatures, 4% by floods, 3% by air pollution, 2% by soil pollution, 3% by Hail and pest infestation for 1% of farms [12, 13].

It should be noted that the implementation of investments in fixed assets in the agrarian sector is relatively slow and in a small volume compared to other sectors and it is mainly implemented by the state at the expense of the programs implemented in the agricultural sector. From an export potential perspective, the production of bioproducts emerges as a promising sector for Georgia, having experienced rapid growth since the 1990s. This growth has been bolstered by the sustainable development movement. Currently, the biomarket stands out as one of the few global markets exhibiting consistent expansion even against the backdrop of a global economic crisis that has contracted other markets owing to the demand for bio products significantly outstripping supply.

The manufacture of eco-friendly products poses a considerable challenge worldwide. In Georgia, organic products represent less than 1% of total food production, while in developed nations, this figure does not surpass 15%.

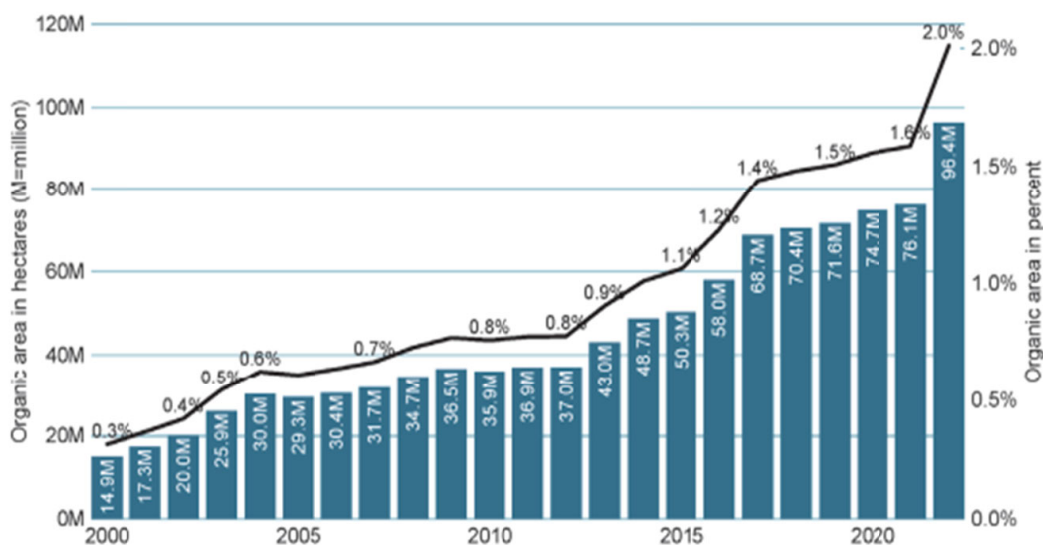


Fig. 5. World: growth of the organic agricultural land and organic share 2000-2022 [11].

According to the Research Institute of Organic Agriculture (FiBL), sales of organic products were projected to reach 135 billion euros in 2022. The countries with the largest organic markets included the USA, with sales amounting to 58.6 billion euros, Germany at 15.3 billion euros, and China at 12.4 billion euros. Furthermore, in 2022, the global organic agricultural land was expected to expand by 26%, surpassing 120 million hectares [11].

Georgia’s favorable natural conditions offer a unique opportunity for establishing organic farms and fostering the growth of organic agriculture. Approximately 150 companies in Georgia are engaged in the production of organic products. A significant portion of this output is attributed to viticulture, but the production spectrum also encompasses honey, berries, nuts, and other commodities, predominantly destined for the European Union market. The export portfolio of Georgian organic products comprises wine, tea, blueberry fruits, wild collections, wild honey, licorice, nettle leaves, blackberry leaves, herbs, rose seeds, and honey. In terms of export volumes, organic products reached 50 tons in 2013, increased to 233.3 tons and 923,402 euros in value in 2017, and further rose to 450.4 tons valued at 1,411,650 euros in 2018. However, in 2019, there was a slight decline to 445 tons.

4 Econometric analysis

In order to analyze food security, we compiled and evaluated the multiple logarithmic regression equation.

As a dependent variable, we took the total food self-sufficiency ratio SSR, which is calculated as the percentage share of local production in the total supply by the formula:

$$SSR = \frac{Production}{Production+import-export} \cdot 100 \quad (1)$$

Based on the factor analysis, we selected as independent variables the important factors that determine food independence. In particular, the share of agro-food production in GDP, the share of investments in agro-food production in total investment and the share of net export of agro-food in total export.

It should be noted that in order to assess the impact of investments, we considered both direct foreign investments and investments in fixed assets in agriculture.

The estimated regression equations are:

$$\ln SSR = 0,07 - 0,15 * \ln NX + 0,0001 * \ln FDI + 0,18 * \ln GDP + u \quad (2)$$

$$\ln SSR = 0,07 - 0,15 * \ln NX + 0,001 * \ln INV_F + 0,18 * \ln GDP + u \quad (3)$$

Where, SSR- growth rate of food self-sufficiency ratio; NX - growth rate of agro-food net export's share; FDI - growth rate of foreign investments' share in agriculture; NV_F - growth rate of investment's share in fixed assets in agriculture; GDP - growth rate of the share of local agricultural production in the gross domestic product.

All variables in the regression equation represent the growth rates of the corresponding indicators taken by the natural logarithm, for which we transformed the variables in the appropriate rule (eg, $x' = ABS(\min x_i) + 1$), because they also have negative values for which the natural logarithm could not be calculated.

The coefficients in the regression equation have the appropriate sign, expected from their economic interpretation. In particular, the negative sign of net export indicates that the negative trade balance in the agricultural sector of Georgia over the years leads to a decrease in the rate of food self-sufficiency. Therefore, we believe that the formation of the optimal level of the ratio of own production and import is important for ensuring food security. As for direct foreign investments and investments in fixed assets, they have a positive but very small impact on the self-sufficiency rate, which is proof that the implementation of both direct foreign investments and investments in fixed assets in the agrarian sector is relatively slow and in a small volume compared to other sectors. The increase in the share of agricultural products in the gross domestic product has a positive effect on food self-sufficiency.

The analysis of the regression results confirmed the statistical significance of all coefficient except the investments (which is the result of the dynamics in the agro-food sector, we talked about above). By the diagnostic tests we proved the validity of the regression model. The VIF (Variance Inflation Factor) analysis showed that model hasn't a multicollinearity problem (VIF<5), the Breusch-Godfrey Correlation LM test of autocorrelation (F-prob>0.05) and the Breusch-Pagan-Godfrey Heteroscedasticity test denied the existence of autocorrelation and heteroskedasticity (F-pro>0.05), which confirms the validity and reliability of the regression model. The results are presented in the table 5.

Table 5. Results of econometric analysis for multiple regression equation.

Independent Variables	Coef.	Std.Err.	t-value	p-value	Sig.
lnNX	-0.147	0.022	-6.639	0.000	***
lnINF_F(lnFDI)	0.001 (0.0001)	0.006 0.007	-0.253 (0,017)	0.807 (0,99)	
LN_GDP	0.181	0.043	4.260	0.0028	***
C	0.070	0.009	7.591	0.0001	***
Diagnostic Tests					
R-squared		0.92	Mean Dependent Var		0.06
Adjusted R-squared		0.88	S.D. Dependent Var		0.03
S.E.		0.01	Sum squared residual		0.001
F-statistic		28.71	Prob.(F-statistic)		0.0001
Akaike info criterion		-5.84	Schwarz criterion		-5.68
Breusch-Godfrey Serial Correlation LM test		Prob.F=0.36>0,05	H0: No serial correlation		Accepted
Breusch-Pagan-Godfrey Heteroscedasticity test		Prob.F=0.77>0.05	H0:No heteroscedasticity		Accepted

*** significant at 0.05

Notes: compiled by authors based on the data of National Statistics office of Georgia (2001-2022 years) and calculation in Eviews.

Thus, the evaluated logarithmic regression model revealed the important factors that should be focused on ensuring food security and sustainability.

5 Conclusions

Despite the measures that are actively implemented in Georgia the solution to the problem of ensuring food safety and import substitution during the last decade is prevented by a number of factors:

1) Low potential for technical and structural-technological modernization of agro-industrial production, renewal of basic production funds and natural-ecological potential, also, the country's high dependence on agricultural machinery and equipment on the import of other material and technical resources.

2) Unsatisfactory level of market infrastructure development for agricultural functioning, complicated access of agricultural producers to financial, material-technical and informational resource markets. In modern conditions, there is an imbalance between the economic interests of producers of agricultural products, trade organizations and consumers, which is manifested in low prices for producers of agricultural products, at high selling prices for food, and financial inaccessibility of goods for a large part of the population.

3) The financial instability of the branches of the agro-industrial complex, which is due to the instability of the raw materials and food markets of agricultural products, decapitalization, insufficient private investments, and poorly developed insurance, which increases the sector's dependence on natural conditions

4) Shortage of qualified staff, which is caused by low income and small volume of industries, historically determined by the low level of development of social and engineering infrastructure, with the existence of conditions for alternative employment. The low incomes of the rural population lead to the aggravation of social problems in rural areas (15.6% of the rural population have incomes below the subsistence minimum).

5) The low productivity of the agro-industrial complex is related to the disposal of production funds, the reduction of useful land resources, the fragmentation of agricultural fields, the increase in distribution, the scarcity of organic fertilizers and the difficulty of transportation.

6) Radically increasing the price of material resources involved in the process of food production compared to agricultural products.

7) Less interest in implementing the achievements of scientific and technological progress in agriculture, thus lagging behind developed countries.

8) The country's high degree of dependence on food imports, due to which imports do not serve to supplement the results of domestic production, but essentially suppress the development of domestic production.

Thus, it's important to giving appropriate recommendation for ensure food security:

- Formation of the optimal level of the ratio of own production and import;
- Creation of strategic food stocks, Creation of production network for development of agricultural food base and processing of raw materials;
- Expansion of transport networks to supply raw materials to food industry enterprises, and for the consumer - to supply food;
- Increasing interest in the implementation of scientific and technological progress in agriculture;
- Development of agro-insurance for redistribution of risks in the agro-sector.

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