



Agricultural Diversification in Low- And Middle-Income Countries: Impact on Food Security

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ABSTRACT

Low- and middle-income countries involved in agro-industrial production and exporting agricultural products are facing a considerable number of barriers when trying to implement the development and growth strategies for this sector. Food security issues are strategic both in national and global context, which determines the relevance of this research. The study is aimed to analyze and compare the agricultural diversification strategies in low- and middle-income countries of Central Africa and America, Asia and Eastern Europe. Particular attention was paid to a number of East European countries involved in agro-industrial business and characterized by high soil fertility. These countries are actively implementing reforms to diversify the agro-industrial sector. Quantitative and qualitative methods were used to analyze world and national agricultural markets. Countries' food security was assessed through the Global Food Security Index. A direct relationship between food and energy security of the countries under consideration was identified. The potential for the production of innovative types of alternative energy through the example of Russia were estimated. The research analyzes the competition between international agricultural holdings and private farming in low- and middle-income countries and builds a typical agro-industrial supply chain model. The results of the study can be applied for further researches in the field of food security in low- and middle-income countries and provide the analytical basis for the development of governmental decisions related to food security strategy and tactics.

INTRODUCTION

Low- and middle-income developing countries rich in natural resources often face the problem of low consumption of agricultural products due to low production diversification and the abundance of imported or cheaper substitutes in the domestic market that are in high demand. Most often this can be explained by the desire of poor developing countries to integrate into the global trade in order to promote their national products (Kotykova and Babych, 2019). It is not always possible to fully realize export ambitions, since to enter, for example, European or North American markets, it is necessary to break through significant barriers related to high quality, compliance with environmental regulations and standards and food safety (Szczepaniak, 2018). The extremely high level of competition in these markets gives rise to a need for a flexible taxation policy and strict control of export pricing. Due to liberalization policy and reduction of barriers imported goods force out national products adversely affecting the country's food security (Frison, 2016; Aragie and Genanu, 2017; Dev et al., 2017; Kopainsky, 2017; Kolkova, 2018; Skulski, 2018; Senyshyn et al., 2019).

The strategic need for the development and diversification of agriculture in the regions with severe climatic conditions, where there is a shortage of drinking water and fertile soil for growing crops, fruit, vegetables and other products should be considered. In sub-Saharan Africa agricultural development is a reliable solution to accelerate economic growth, overcome poverty and strengthen food security (Asmah, 2011; African Development Bank, 2014; Ahmed, 2016). In Central America, local government reforms in agriculture are currently aimed at the development of small-scale farming due to high unemployment rate and poverty in the region and the need to create new job opportunities for the people in countryside engaged in subsistence farming. State support is required for proper functioning of the farm system with regard to a number of problems: population growth, urbanization, income inequality, land degradation and climate variability (Central America: the Challenge of Food Security, Human Development, and Economic Growth, 2014; Food and nutrition security in Latin America and the Caribbean, 2019). Understanding small-scale farming practices is crucial for development and implementation of successful programs, including programs to analyze local opportunities, allowing reducing economic constraints, increasing agricultural adaptation to diversification and controlling climate change (Rosegrant, 2014; FAO, 2017; Morkunas et al., 2018; Bi and Wang, 2018; Yonetani, 2019).

A number of West European analysts note that agricultural diversification policy in African, Central American and Asian low-income countries should also be based on the fact that due to the growing shortage of land and water resources, increasing impact of other factors caused by globalization, the future of agriculture is inextricably linked to a more responsible use of natural resources (Birhanu, et al., 2010; Canali and Slaviero, 2010; Binswanger-Mkhize and Savastano, 2014; Dev et al., 2017). Rapid growth of national and international markets, innovative institutional market, finance and joint action solutions, biotechnology and information technology revolution bring opportunities of using agriculture to stimulate development. The use of these opportunities requires the political will to carry out reforms aimed at improving agricultural management. The issues of global agricultural diversification are associated with sustainable development. The creation of enterprises (participation in the creation of farms) and income diversification (shift towards non-farm employment) can help stabilize the economy and create prerequisites for sustainable development. In order to combat poverty and optimize resource distribution (Chmielewska and Horvathová, 2016), political reforms related to agricultural diversification should be also complemented with necessary social protection measures (Crop Prospects And Quarterly Global Report Food Situation, 2018; FAO, 2017; Tung, 2018; Pekovic, 2017)

Particular attention should be paid to recent changes and reforms in agriculture in Eastern Europe. First of all, this is about the CIS countries that have large agro-industrial complexes: Russia, Moldova and Kazakhstan. The problems here are poor physical condition of food storage elevators, roads and sea ports for the transportation of goods. In recent years, there have also been reforms arising from the growing poverty level to restructure the agricultural sector in Moldova and Kazakh-

stan. We decided to focus on the analysis of this region in order to get more accurate and reliable results (Presidential Decree, 2010; Yizengaw, 2014). The research questions addressed in this study are:

- to determine the level and prospects of the global agricultural market development in order to identify the categories of goods which the main demand of consumers around the world comes from;
- to analyze current opportunities and assess the need for agricultural diversification in low- and middle-income countries;
- to analyze the already implemented diversification reforms in the countries under consideration: East European countries (Russia, Moldova, Kazakhstan), and, in general terms, in African and Central American countries in order to identify new opportunities, negative consequences or possible threats;
- to assess the level of food security in low- and middle-income countries, as well as to identify and classify threats related to it;
- to develop recommendations on the choice of the vectors for the diversification of agricultural analysis and the content of relevant programs and national strategies.

1. METHODS

Qualitative and quantitative data analysis methods were used to address questions of this study. Quantitative data analysis consisted of data preparation, validation, editing and descriptive statistics. Qualitative data were analyzed through data preparation, basic data analysis, content analysis, narrative analysis and grounded theory. Among quantitative data the following parameters were investigated:

- world grain prices by years and profit in the grain market by product type and region
- gross value added in agriculture as a share of GDP
- financial results of the largest grain market players
- values and volumes of export and imports of food products and agricultural raw materials
- sales of agricultural products in the international market
- annual volume of greenhouse gases caused by food waste
- rankings of Global Foods Security Index (GFSI)
- drinking water contamination
- number of people suffering from hunger
- share of farms run by small farmers
- share of income spent on food
- share of natural resources in exports of various countries
- import/import of food products, industrial goods, agricultural and nonagricultural products, agricultural raw materials
- share of land irrigation and land affected by soil degradation
- shares of expenditures on food and other products and services
- other applicable parameters

Data both for qualitative and quantitative analysis were obtained from open sources, as follows:

- reports, prospects, data and estimates presented by various projects and organizations (the World Bank, the United Nations, UNCTAD, FAO, Corteva Agriscience, The Economist Intelligence Unit, US-African (Tanzania-USA-Nigeria) agrarian program “Agritech - smart partnership”, etc.);
- official information of governmental bodies (governments, ministries of agriculture, departments of statistics, national banks etc.);

- governmental official documents (laws, bills, orders, decrees, national strategies, programs, and doctrines);
- previous studies and researches; and news.

2. RESULTS

The world grain prices increased by 3.4% in 2017 and reached \$ 621,200 million. It is predicted that in 2022 it will amount to \$712,700 million, which is 14.7% higher than in 2017 (Fig 1).

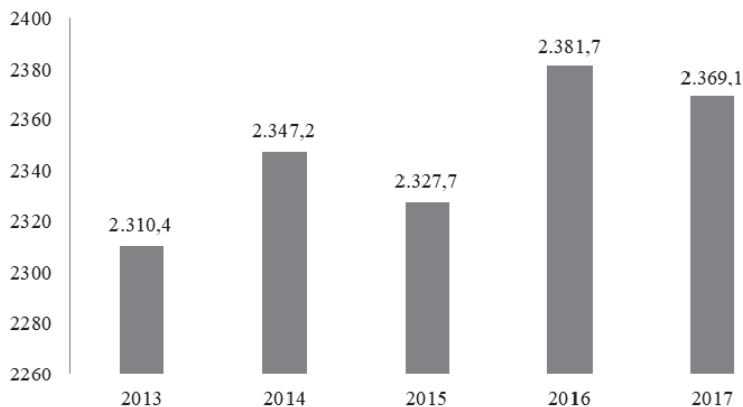


Fig. 1. Grain market size in 2013-2017, million tons [compiled by the author on the basis of source
 Source: Crop Prospects And Quarterly Global Report Food Situation, 2018

The grain market size decreased by 0.5% in 2017 compared to 2016, and amounted to 2,369.1 million tons. The compound annual market growth rate for the period of 2013-2017 was 0.6%. Global grain market has been affected by various weather conditions like largest number of hurricanes since 2005. Floods caused damage to a lot of crops stored in bulk. In 2016, the drought caused by El Nino had a huge impact on the Brazilian grain industry and lead to a production decline. The rice segment, one of the largest grain market segments, was the most profitable in 2017, with a total profit of \$ 262,900 million, making up 42.3% of the industry's total value. The maize segment generated revenues of \$198,500 million in 2017, representing 32% of the industry's total value (Fig. 2). The "other" segment consists of such crops as sorghum, oats, millet, triticale, rye, mixed grain, buckwheat, canary seed and fonio.

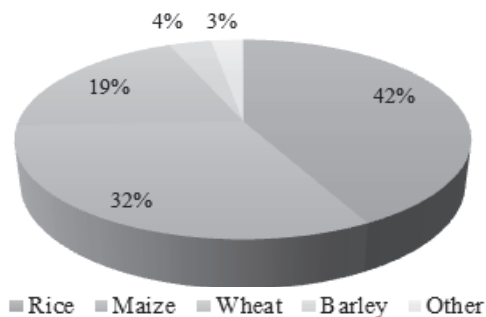


Figure 2. Distribution of profit in the grain market by product type in 2017, %

Source: compiled by the author on the basis of *Crop Prospects And Quarterly Global Report Food Situation, 2018*

China accounts for 38.5% of the global grain value; the share of the United States is 10.4%. Shares of Europe and Brazil of the total industry profit were 9.5% and 2.6%, respectively.

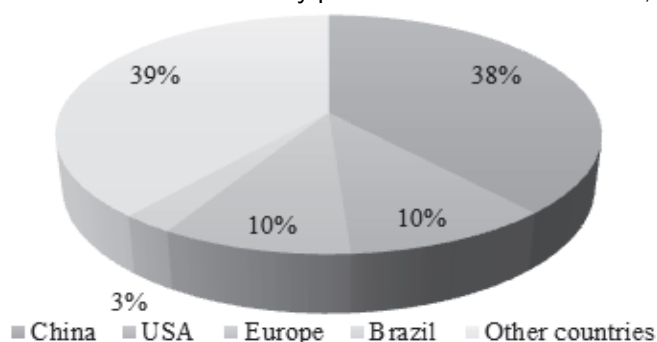


Figure 3. Distribution of profit in the grain market by region in 2017, %

Source: compiled by the author on the basis of *Crop Prospects And Quarterly Global Report Food Situation, 2018*

The majority of players in the grain market are independent farms that are classified as small- and medium-sized enterprises. The competition in the industry is significantly increased by the presence of large consolidated companies, such as Archer Daniels Midland Co., Bunge Limited, Cargill, Louis Dreyfus Company B.V. (Table 1).

Table 1. Financial results of the largest grain market players in 2017, USD mln

No.	Company	Revenue from sales	Net profit
1.	Archer Daniels Midland Co	60 828	1 389
2.	Bunge Limited	45 794	160
3.	Cargill	114 700	3 200
4.	Louis Dreyfus Company B.V	43 000	317

Source: FAO, 2017.

The level of income and profit received by international agricultural holdings (Table 1) and the number of their production assets around the world, show that these structures are almost oligopolistic. This allows them to influence agricultural pricing and policy fundamentally in countries in which they have assets. The model below shows the supply chain in agro-industrial sector. Corteva Agriscience and The Economist Intelligence Unit published the Global Foods Security Index (2018). To calculate the GFSI index, experts gave each country a certain point, showing their food security level. Experts calculated and analyzed a number of indicators affecting food safety. Such indicators as the risk of drinking water contamination (80%), average food inventory level (73%), and population growth rate (75%) received the highest weight coefficients (from 0 to 100%). The sample of our study consisted of 113 countries. Table 2 includes the countries located in the regions that were selected as objects of the research. The countries having natural resources for agricultural business, primarily East European countries – Kazakhstan, Azerbaijan, Uzbekistan, Tajikistan occupy a rather low position in the ranking. Chile has the highest position in the middle- and low-income countries; the lowest position in this group belongs to the countries of Central Africa. According to Table 2, low- and middle-income countries demonstrated the most significant growth last year. Despite the highest poverty level, the underdevelopment of the economy and hot climat-

ic conditions of countries of the Central Africa, several state and international partnership programs in agricultural business have been implemented in recent years.

Table 2. Global Food Security Index (GFSI) in the countries with different income level (2018)

<i>High-income countries</i>			<i>Low- and middle-income countries</i>		
<i>Country</i>	<i>2018 GFSI</i>	<i>2018 GFSI / 2017 GFSI</i>	<i>Country</i>	<i>2018 GFSI</i>	<i>2018 GFSI / 2017 GFSI</i>
Singapore	85,9	+0,9	Chile	75,1	+0,4
Ireland	85,5	-1,2	Russia	67,0	+0,8
United Kingdom	85,0	+0,6	Mexico	66,4	0,0
United States	85,0	+0,1	Belarus	65,7	+2,9
Netherlands	84,7	+1,6	China	65,1	+0,9
Australia	83,7	+0,2	Colombia	63,7	+3,0
Switzerland	83,5	+0,6	Azerbaijan	58,2	+0,4
Finland	83,3	+2,0	Kazakhstan	57,7	+1,8
Canada	83,2	+0,7	Vietnam	56,0	+0,7
France	82,9	+0,4	Ukraine	55,7	+1,8
Germany	82,7	-0,1	Uzbekistan	45,9	-0,6
Norway	82,2	+0,6	Tajikistan	40,7	+1,0
Austria	82,1	+0,2	Ethiopia	36,0	-1,1
Denmark	80,9	+0,3	Zambia	33,7	+0,5
Japan	79,9	+0,1	Yemen	28,5	+1,4

Source: EIU Global Food Security Index, 2018.

US-African (Tanzania-USA-Nigeria) agrarian program “Agritech - smart partnership”, joining public and private organizations was successfully implemented in 2017. The program was aimed at the development of tomato growing business in Africa for the needs of American food processing industry. More than 20,000 African farmers were trained to use sealed bags reducing losses by more than 90 % according to American tomato cultivation and packaging technologies. The key for future development is partnership, financing and support of ecosystems (FAO, 2016; 2017).

Most recent FAO estimates reported 37 million people suffering from hunger in Latin America and the Caribbean (6.1% of the population), which is a significant progress compared to 68.5 million (15.3%) in 1990-1992. Although the region produces enough food to meet the needs of all its inhabitants, poorest members of society have no access to this food. Family farming comprises major share of domestic food production in Latin America and the Caribbean. Farms run by small farmers make up more than 80% of the total and provide from 30 to 40% of the region's agricultural GDP. According to the UNCTAD data for the period of 2015-2017, natural resources dominate in the exports of Azerbaijan (93%), Turkmenistan (89%), Kazakhstan (78%), Russia (71%), Moldova (56%) and Kyrgyzstan (45%). Production and export diversification and the search for new markets for industrial products are still relevant for these countries (Search for solutions for the development of industry and international trade, 2016).

Since 2000, agriculture in Moldova has been characterized by unstable and much slower growth compared to other economy sectors. The macroeconomic environment in the Republic of Moldova is similar to the environment of the countries covered by the European Neighborhood Policy (ENP) and other countries in the region, but different from the EU member states. Its average contribution to GDP over the past decade has been 10%. In 2016 the contribution of agriculture to GDP was 10% in Eastern Europe and 2% in EU countries (Presidential Decree, 2010 -Fig. 4).

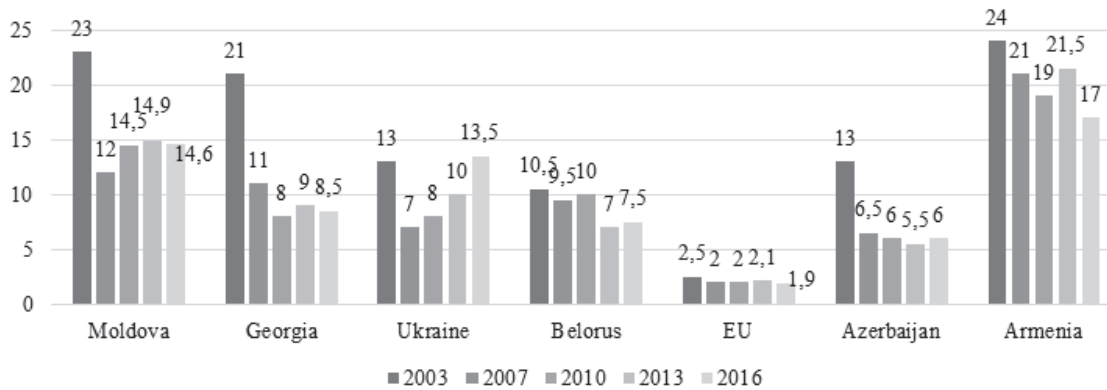


Figure 4. Gross value added in agriculture as a share of GDP in Eastern Europe and in the EU-28, 2000–2016 (%)

Source: compiled by the author on the basis of *World Bank*, 2017)

The most exported agro-food products were cereals and sugar. There was a positive trend in exports of industrial goods to EU countries compared to other sectors. Although the value of export declined by 2.5% during the base period, its total volume increased by 68%. From 2014 to 2017, there was a decline in the import of food products from the EU and its total amount decreased by 15%. Due to decline in oil prices at the international level, import of nonagricultural products to the EU countries decreased by 23%, which affected about 81% of total imports to the EU countries (Presidential Decree, 2010). Agriculture in Tajikistan is the least productive: more than 20% of food is imported due to low productivity, water shortage, and losses from natural disasters. The country is excessively focused on cotton production; it has poor water management systems; insufficient protection of property rights does not encourage farmers to cultivate the land properly. Agricultural productivity growth is restricted by worn-out facilities, lack of technological progress, high taxation and land tenure regulation. Only 7% of all land resources are irrigated while 97% of them are affected by soil degradation, including erosion, waterlogging, deforestation and salinization (Climate Risks and Food Security in Tajikistan, 2017). Western sanctions on Russian products affected the volumes of Russian exports and imports from/to trading partners. Per capita consumption rates recommended by the Ministry of Health (Fig. 5) were reached or exceeded for major products in 2017.

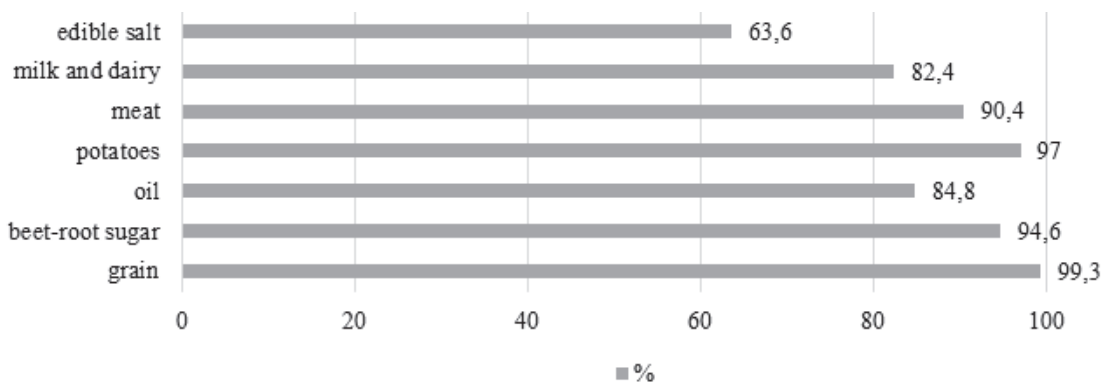


Figure 5. The results of the Food Security Doctrine at the end of 2017, %

Source: compiled by the author on the basis of *Export and import of food products and agricultural raw materials*, 2019)

Economic barriers to the access to food have increased in recent years in Russia: the share food expenditure of poorer and wealthy Russians from 2013 to 2016 increased from 48% to 54.4% and from 22 to 26%, respectively. The data of the Federal State Statistics Service show that both exports and imports have increased in recent years (Fig. 6-7), but Russia still buys more than sells. However, despite the export growth (mainly grain), food import has grown even more.

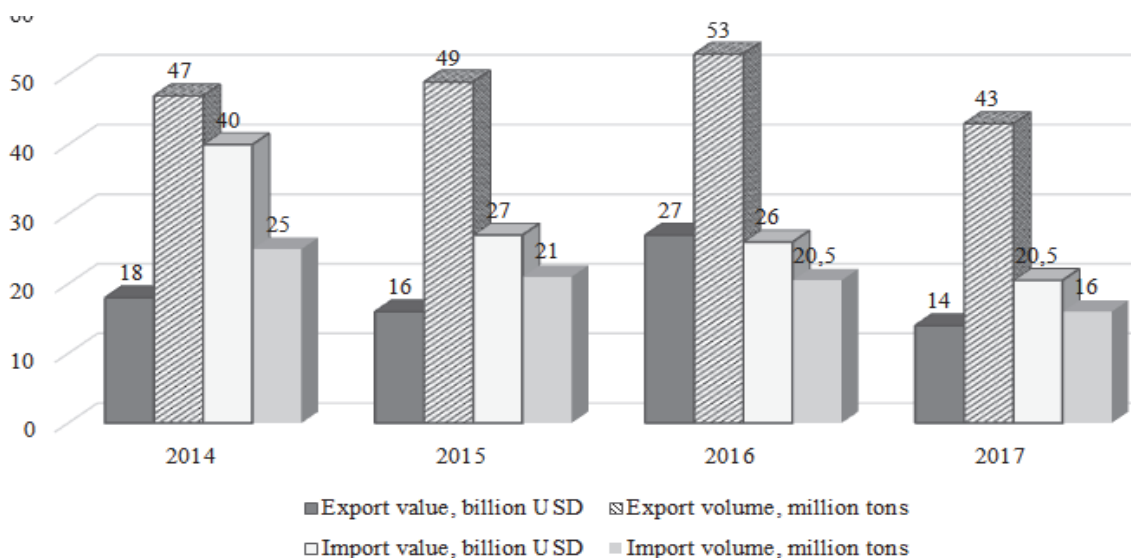


Figure 6. Values and volumes of export and imports of food products and agricultural raw materials (except textile), 2014-2017.

Source: compiled by the author on the basis of source *Russian Federal State Statistics Service, 2019*

Last year the largest buyers of Russian agribusiness products were Egypt (\$ 1.78 billion), Turkey (\$ 1.78 billion), China (\$ 1.77 billion) and South Korea (\$ 1.46 billion) (Ministry of Agriculture of the Russian Federation, 2019).

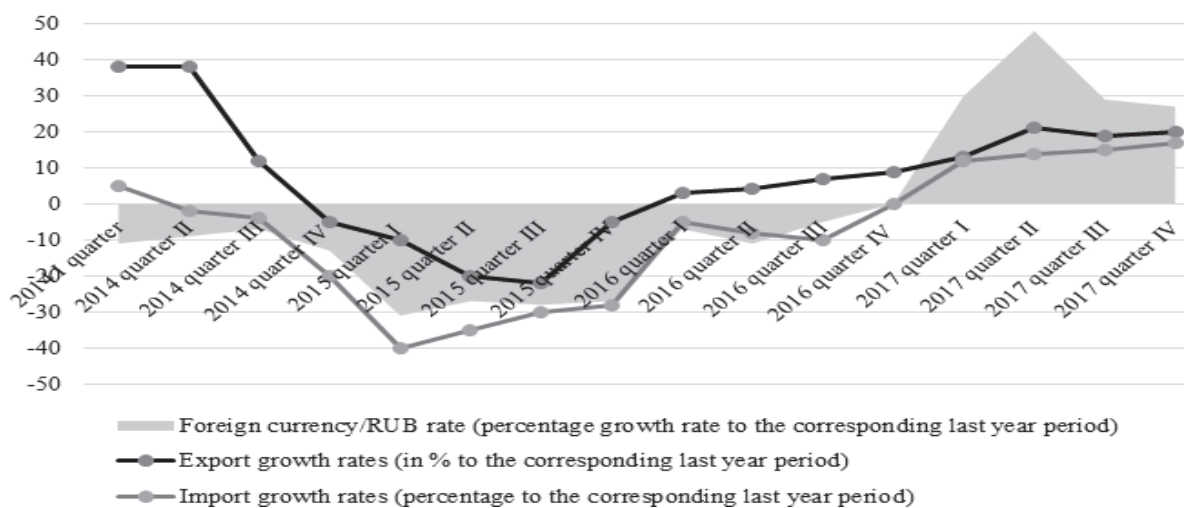


Figure 7. Annual growth rates of value of Russian exports and imports of food products and agricultural raw materials, and the change in the real exchange ruble rate

Source: compiled by the author on the basis of *Ministry of Agriculture of the Russian Federation, 2019; Russian Federal State Statistics Service, 2019*

Russian experts in agriculture (Export and import of food products and agricultural raw materials, 2019) believe that the new doctrine assumes that food supplies to Russia may be stopped due to political reasons, but this rarely happens in peace time. It is expected that after the approval of a new amendment to the DASKA bill, Russia's growth rates may not exceed at least 3% by 2021, despite its policy aimed at accumulating reserves to stabilize the economy (RBK, 2019).

3. DISCUSSION

Our research is focused on assessing the food security level in low- and middle-income countries, which are implementing reforms in order to develop and modernize their agricultural sector. Particular attention is paid to the diversification of production. We used a detailed approach to analyze statistical indicators characterizing the volume of the agricultural market, exports and imports of products demanded within the country and by importing countries. This helped to identify trends in the change of the export-import situation, as well as explain (taking into account external macroeconomic factors) why there may be some prerequisites for a more intensive growth of imports compared to exports. This situation has an immediately negative impact on the trade balance. The growth of the country's import dependence will naturally reduce its food security.

Most of the reviewed studies devoted to food security, as well as publications showing the opinion of politicians and business leaders, represent a more superficial approach to analyzing mainly external macroeconomic factors affecting food security. The level of an established demand for agricultural products in other countries that determines the types of products to be produced. It justifies the effectiveness of production diversification strategy for the growth and development of the agricultural sector in poor countries, but at the same time there isn't enough attention to internal factors and causes that hamper and block the implementation of these strategies (Brugère et al., 2008; Canali and Slaviero, 2010; Haggblade, 2010; Search for solutions for the development of industry and international trade, 2016; Aragie and Genanu, 2017; Gecho, 2017).

A number of other studies emphasize the effectiveness of supporting the competitiveness of small-scale farms. Small-scale farms are often regarded by the government as the main business unit to diversify agriculture and create new jobs in rural areas through innovative institutional solutions. Experts usually refer to the rapid growth of agriculture in India due to the introduction of technical innovations like high-yielding varieties of crops, as well as Chinese innovations in the institutional sphere (household responsibility system and market liberalization), which significantly reduced poverty in the villages. The growth and diversification of agricultural production in Ghana contributed to the rapid poverty reduction recently observed in rural households (Lowder, 2016; Anderson, 2019).

Further in-depth research can be focused on the effectiveness of innovative institutional solutions for medium- and small-scale farming not only in China, India and Africa, but also in Eastern Europe.

CONCLUSION

Agriculture is one of the key economy segments of most middle- and low-income countries that are rich in natural resources and fertile soil. This can be explained by the fact that agricultural products are a resource component of production in various economy sectors and the major component in the food industry. The whole agricultural market, especially the market of grain and oilseeds, is characterized by a quite high volatility associated with the yield of raw materials.

The agro-industrial complex consists of economy sectors involved into the production and processing of agricultural raw materials, which can be used to produce innovative types of alternative energy like bioethanol and biodiesel.

We paid a particular attention to the analysis of the success of political reforms and development programs and industry diversification. We identified the opportunities that could be achieved, as well as the barriers blocking or impeding their implementation. A direct relationship between food security and energy independence was revealed in the study. This is explained by the growing production of environmentally-friendly alternative energy sources based on natural raw materials – crops that low- and middle-income developing countries, in particular, Eastern Europe (Russia , Kazakhstan, Uzbekistan, Moldova, etc.) are reach in.

The rapid growth of national and international agricultural markets, innovative institutional solutions in agriculture, the search for new sources of financing, the development of joint international partnership projects, as well as the biotechnology and information technology revolution bring exciting opportunities of using agriculture to stimulate sustainable development at the global level. But to take the advantage of these opportunities, the political will is needed to carry out reforms aimed at improving the management of agricultural development and diversification in poor developing countries. In the long term, concerted efforts at the “state-business” level aimed at addressing the challenges of the international community seeking to contribute to the development of the world economy will be one of the keys to success.

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