Sustainable development of organic agriculture: strategies of Russia and its regions in context of the application of digital economy technologies

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Summary: In this paper organic agriculture is analyzed in the context of its potential to meet effectively the increasing demand for high-quality food, for increasing the export potential and for solving the country's import substitution problems. The article also reveals the importance of digital economy technologies to increase the sustainability of organic production. Among the most significant in this context are cloud computing and large databases that contribute to the development of precision farming, continuous online monitoring of the quality of the various stages of the technological chains, automation and robotization, etc. Following the recommendations of the "Organic Agriculture 3.0" conception, the authors examine the appropriate environmental, economic, social and institutional factors to elaborate complex development strategies for the agriculture of Russia and its regions. A special environmental index is proposed to determine the environmentally friendly regions, which are mostly suitable for organic production. The authors elaborate an economic indicator to assess the potential of unused agricultural land for organic farming. The proportion of unemployed working-age population in rural areas serves in the study as social indicator. By analyzing these selected indicators, four groups of Russian regions with different conditions for the development of organic agriculture are identified. With respect to the varying potentials of the regions and external institutional context, the authors qualify different regional competitive strategies and corresponding product niches. The study also provides guidelines for the Russian agrarian and the environmental policy to support effective development of organic production.

Keywords: sustainable development, digital economy technologies, organic agriculture 3.0, export potential, supply and demand for organic food, regional priorities, local food supply chains.

Introduction. In Russia, in the search for new sources of sustainable economic growth and an increase in the well-being of the population, with the implementation of the related strategy of import substitution and expansion of non-oil exports, increasing attention is paid to the potential that the agricultural sector has in this area. Thus, in 2018, the agricultural export from Russia has grown by 19.4%, reaching $ 25.8 billion. In 2024, according to official plans, it should increase to $ 45 billion. [Pertseva, 2019]. At the same time, when discussing this issue, both experts and representatives of official circles often focus on the traditional segment of agrarian production with its inherent product specialization and organizational forms and

domination of which large-scale industrial agricultural holdings [Danshin, 2018; Klimova, 2017].

When assessing the traditional approach, firstly, scholars notice that the agrarian sector miss orientation on innovative products, processes and high added value. Secondly, this approach does not take into account the chances of an agriculture which employs the progress from the 4th industrial revolution and digitalization. And, thirdly, the ecological impact of the growth of traditional agricultural production on other sectors of the economy remain out of serious analysis [Aganbegyan, Porfiryev, 2015; Porfiryev, 2015]. In this case, usually, the productivity growth is reached by increasing mineral fertilizers use, agricultural pest control chemicals, and other methods from the large-scale industrial production. Then the pressure on the environment increases as well.

In this context, several authors pay attention on the opportunities that opens the model of organic agriculture for contributing to integrated solutions of the problems mentioned above [Schulze, 2015; Altukhov, 2013; Norse, 2012; Einfalt and Kazda, 2016; Nesterenko, Pakhomova, 2016].

To discuss their proposals, the term organic agriculture should must be clarified. The International Federation of Organic Agriculture Movements (IFOAM) suggests the following definition: «The organic agriculture is a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects and combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good of life for all the parties involved»[1].

This integrated approach will promote the achievement of environmental, economic as well as socio-cultural goals. In the case of Russia, it means, on one hand, to reorient the country's agro-industrial complex to innovative products with high export potential and potentially steady global market demand. On the other hand, organic agriculture will help to meet the demand of the Russian population for high-quality, ecologically clean food. Focusing on this model of agriculture will also contribute to increasing the innovative potential of the country's economy. In this case we can talk about the use of the whole complex of innovations, including, along with product innovations, technological, organizational, marketing and social innovations. An example of technological innovation is given by the resource-saving technologies which provide minimal and “zero” soil treatment (tillage). Digital technologies open a significant innovation potential for the sustainable development of organic agriculture. In this context cloud computing and large databases technologies are called among the most important that contribute to the development of precision farming as a key component of the third wave of modern agricultural revolutions, which replaces the so-called green revolution[2]. In the same context the use of the industrial Internet and of high-resolution satellite data, which allow to organize an online monitoring of the quality of the interconnected technological chains of

[1] https://www.ifoam.bio/en/organic-landmarks/definition-organic-agriculture (дата обращения: 21.07.2019).

[2] «Precision agriculture is understood as application of precise and correct amount of inputs like water, fertilizer, pesticides etc. at the correct time to the crop for increasing its productivity and maximizing its yields» // URL: https://en.wikipedia.org/wiki/Precision_agriculture (дата обращения: 30.10.2019)

organic production can be noted. The use of digital technologies in organizing organic farming also contributes to the transparency of business processes, which is especially important to maintain high product quality and consumer confidence in organic products.

The development of organic production and the increase its role in export potential will also lead to a significant reduction of the environmental stress and will also mitigate climate risks. Let us discuss some of the above mentioned, consequences in more detail, which are often beyond the scope of attention of economists.

In many countries, especially in recent years, agriculture is given considerable attention due to the global interest in the implementation of measures aimed at reducing environmental pollution and avoiding dangers of global climate change. This sector accounts for 24 per cent of the total burden on the environment in the form of greenhouse gas (GHG) emissions. In 2015, in Russia, the share of agriculture was 4.98 per cent, not including its servicing branches and excluding LULUCF (Land Use, Land-Use Change and Forestry). While in Russia this share is relatively small, and though the atmospheric emissions of agriculture decreased by 58.1 per cent in 2015 in comparison with 1990, this sector is still considered as a source of emissions of some of the most dangerous GHGs[3]. These GHGs include methane (CH_4) and nitrous oxide (N_2O), whose negative climatic effects are many times higher than that of carbon dioxide. Not only negative impact of agricultural production in the form of the GHG emissions is now under consideration but also the negative ecological impact of such segments of the agro-industrial complex as the production of mineral fertilizers.

The measures to increase the productivity of agricultural production implemented in Russia over the last few years ask for answering the questions which environmental policymaking is needed. The growth of production, the increase of mineral fertilizer production, and the extension of the export potential have been accompanied by increasing pressure on the ecosystems. In 2015, according to above cited Federal report on the inventory of anthropogenic GHG emissions, emissions from the production of ammonia and nitric acid, which are mostly used for mineral fertilizer production, amounted for 67 per cent of all GHG emissions in the chemical industry[4]. Nevertheless, agricultural productivity in Russia remains behind the productivity of the countries with comparable climatic conditions. For example, in 2017 in Russia the yield of cereal was only 2.964 t/ha, in Canada 4.043 t/ha, in Poland 4.200 t/ha. One of the main reasons for this lag is the limited use of fertilizer, mainly mineral fertilizer. In 2016 in Canada the consumption of fertilizer has reached 87.6 kg/ha, in Poland 172.8 kg/ha, in Russia only 18.5 kg/ha (2016)[5]. Overcoming this lag without appropriate environmental measures will be accompanied by an increase in the negative ecological consequences. One of such measures can be the development of organic agriculture, which is characterized by less negative environmental impact.

[3] Third National inventory of anthropogenic emissions by sources and removals by sinks of all gases not controlled by the Montreal Protocol, 2017. URL: http://unfccc.int/files/national_reports/biennial_reports_and_iar/submitted_biennial_reports/application/pdf/386415_russian_federation-br3-1-3br.pdf

[4] Ibid.

[5] https://data.worldbank.org

Raising the question of the accelerated development of organic agriculture, specialists also draw attention to the favorable opportunities that our country has for increasing the supply of organic food both to the national market and to international sites. Russia possesses potentially significant areas for the development of organic agriculture. According to the Russian agricultural census in 2016, 17628,8 thousand hectares of agricultural land were not used for its intended purpose. That was, 12 per cent of all agricultural land in the country (142659,7 thousands of hectares)[6]. An important prerequisite, as will be shown in detail below, may be the presence in several regions of the country of many unemployed people, which, after appropriate training, may be involved in organic production.

In general, experts regard the situation with the potential demand for organic food, especially in the global market, as favorable, as well. The production of organic products currently forms a dynamically developing segment of world agriculture with an annual increase in production of 10% or more. Such dynamics are twice as high as the growth of the world food market. Thus, in 2017, the volume of production in this segment increased by 12%, reaching in absolute terms € 93 billion. By 2020, the global market for organic products is estimated to grow by 16% compared to the current year and its volume will be € 143 billion; [7] By 2025, the volume of consumption of organic products in the world will amount to € 195.8 billion [Pertseva, 2019]. Compared to China, which is currently the world's leader in terms of organic arable land, Russia is geographically much closer to the largest market for organic products – EU countries. The significance of this market is determined by the fact that the EU population is currently the leader in the world in the consumption of organic food. In the world, the share of organic products ranges from 5 to 15% of the total food supply. [Maksimova, 2018]. Of course, for the active participation of Russian producers at the foreign markets, it is necessary to overcome considerable obstacles, including the mutual recognition of national certificates for organic products.

Currently, in Russia, the demand for organic products is growing faster than worldwide, namely, by 23% per year. However, the share of organic products in the country accounts for only 0.1% of the total food market, and on average only 1% of Russians buy organic fruits and vegetables [Prospects for the development,,,, 2019]. In absolute terms, the market volume is estimated at between € 120 million and € 160 million, while the share of domestic producers in this market is about 20%. Less than 1% of all agricultural enterprises in Russia are engaged in the production of organic products. And Russia's share in the global organic market is only 0.15%. This situation is mainly a consequence of the fact that 95% of Russian investments in this sector are private. The state practically does not participate in the development of this direction of agriculture. Meanwhile, for organic production to become a stable segment of the national economy, it must occupy, according to experts, at least 10-15% of the country's food market [Maksimova, 2018]. These data indicate that there is a significant potential for increasing the volume of organic production of both in order to increase the export of

[6] http://www.gks.ru/news/perepis2006/totals-osn.htm

[7] См.: Когда в России расцветет рынок органических продуктов // https://s0.rbk.ru/v6_top_pics/media/rbcpro_presentations/2019/755562852094349/presentation-d5d9d7b8ff6245b89adbd7e521576e7b.pdf (дата обращения: 19.07.2019).

agriculture products and to meet the growing demand for high-quality food from the Russia population. They also indicate the need for a more active involvement in the development of this sector of all stakeholders, including the Russian government.

The problem of the development of organic production of agricultural products has been discussed by experts for several years [Schulze, 2015; Altukhov, 2013; Norse, 2012; Einfalt and Kazda, 2016; Nesterenko and Artemova, 2018; Pakhomova et al., 2017]. Representatives of the authorities have also joined this discussion in recent years. Positive changes are also taking place in the preparation and adoption of legislation. On January 1, 2020, the Federal Law "On Organic Products and on Amendments to Certain Legislative Acts of the Russian Federation" enters into force, dated 03.08.2018 N 280-FL[8]. The legal basis for the introduction of organic principles in agricultural production is also formed by the following GOSTs of the Russian Federation: GOST R 56104-2014 "Organic food products. Terms and Definitions"; GOST R 57022-2016 "Organic Products. The order of the voluntary certification of organic production". In addition, the International Standard adopted by the Eurasian Council for Standardization, Metrology and Certification (EACS) is applied in the Russian Federation - GOST 33980-2016 "Organic Products. Rules of production, processing, labeling and implementation. NEQ CAC / GL32-1999". The International Standard of Eurasian Economic Union (EAEU) is harmonized with the EU Council Regulation No 834/2007 of June 28, 2007 "On Organic Production and Labeling of Organic Products", as well as with the IFOAM basic standards. These standards form the regulatory basis for the production, identification and certification of organic products. [Chukhlantsev, 2019]. At the same time, purposeful efforts are now needed to ensure international recognition of the standards adopted in Russia and in the EAEU.

Several important initiatives, including in connection with the preparation and adoption of Federal Law No. 280-FL, are being implemented at the level of the President of the Russian Federation and the Government of the Russian Federation. Thus, during the preparation of the Message to the Federal Assembly, the President, Vladimir Putin, instructed the preparation of measures necessary for the speedy creation and promotion of the Russian brand of environmentally friendly (organic) products to foreign markets. These measures are important for strengthening the export potential of organic products from Russia. In the meantime, according to experts, the organic brand of the country is only being formed, and not finished products come to foreign markets from Russia, but mostly raw materials, which are estimated at € 10-12 million per year [Labykin, 2019].

Along with the obstacles listed above, in Russia considerable restrictions also remain on the side of market demand. They are due to the insufficient income of the main part of the population for the consumption of organic products, the price of which is usually higher than traditional foods in developed countries by 30-50%, while in Russia the price gap is 200-300%. In this case, the most acute is the problem of balancing supply and demand in the regional context. This is because the supply of organic food is formed mainly in regions with the most favorable conditions and resource potential for its production. And the demand for more

[8] http://www.consultant.ru/document/cons_doc_LAW_304017/

expensive products is mainly concentrated in large cities. And until recently, it was presented mainly in the network retail premium segment [Nesterenko, Pakhomova, 2016; Nesterenko and Shagalkina, 2019; Arkhipova and Kulagina, 2018].

Based on the projects, conducted on this issue, the published results and the unresolved problems, the attention in this paper will be focused on the conception of the development strategy for the organic agriculture in Russia and in its regions, keeping in mind the digital technologies opportunities. The authors proceed from the fact that when determining the strategic priorities for the development of organic farming in Russia, it is necessary to take into account the diversity of natural and climatic conditions, as well as the discrepancies in the population's living standards in Russian regions. The differences between the regions of Russia in the quality and areas of agricultural land, as well as the availability of other resources, do not allow the use of unified approaches and tools for the development of this segment. Under these circumstances, it is more beneficial to develop the organic agriculture with respect to regional priorities and available production and social regional resources [Shcherbakova, 2017; Avilova, 2016; Grigorian et al., 2016; Nesterenko and Pakhomova, 2016].

The emphasis on the regional aspect can be argued by another circumstance. In the conditions of permanent delays with the adoption of federal legislation, the Russian regions were forced to develop and implement appropriate measures on their own initiative. Examples of this kind are the regional laws on organic farming developed in 2013-2014 in Ulyanovsk and Voronezh Regions, in Krasnodar Territory and several others. The country's regional experience in the development of organic agriculture is of interest and it can serve as a basis for developing differentiated strategies in the regions. However, these regional laws and correspondent regional experience were not based on the analysis of regional production and natural resources within the context of the strategy of the sustainable development of agriculture in Russia as a whole.

For determining the strategy of the sustainable development of the organic agriculture it is today recommended to identify the main areas of the application of digital technologies, as argue the authors [Knoll, Czymmek, 2018]. We rely on in their study. Some of such publications examine the application of digital technology in agriculture in general [Skvortsov, et all, 2018].

So, the article will explore the prospects for the development of organic agriculture in Russia, with an emphasis on the task of justifying differentiated regional strategies. The main objectives of this paper will be the following:

- to complete the analysis carried out in the introduction on the ways of reduction of environmental impacts of agricultural production and on the prerequisites that Russia has for the development of organic agriculture;
- to identify strategic priorities for the development of organic agriculture in Russia, by considering the contemporary approaches to sustainable agriculture with an emphasis on the regional dimension of this concept;
- to set up areas of application of digital economy technologies and the opportunities they have for overcoming barriers to the development of organic agriculture;

- to reveal regions that have environmental, social and economic perspectives for the transition to the model of organic agriculture and to qualify different regional competitive strategies and corresponding product niches for organic agriculture development;
- to propose some recommendations for the modernization of Russian agrarian and environmental policy.

The environmental impact of Russian agriculture and the preconditions for the development of organic farming

As it was revealed in introduction, the environmental impact of agriculture in Russia can be further strengthened in the context of the implementation of the Governmental Program on the development of agriculture for 2013 – 2020, which implies the increase in agricultural production by more than 24 per cent. However, this program doesn't include directions that may stipulate the reduction of environmental impacts in the conditions of increasing agricultural production. The development of the economy, including the growth of agricultural production can lead to a considerable rise in greenhouse gas emissions by 2020. For example, over the past ten years, cereals production in Russia has been growing at an average annual rate of more than 10 per cent per year. In 2017 the cereal production in the country reached 131.143 million tons[9], among these 36.19 million tons were exported[10]. As for grain export, its increase is intended to compensate for the deficit of the federal budget caused by a decrease in export revenues from the sale of hydrocarbon raw material.

Assessing the ecological load of agriculture in Russia and its dynamics, it should be noted the increase in energy efficiency of agriculture as one of the important trends in the development of this sector. Certain efforts to raise the energy efficiency of the agricultural production are being taken in Russia and this is particularly significant for animal husbandry. The decline in energy intensity in this sector, and hence the reduction of GHG emissions, are linked to the transition of several technological processes to the use of energy resources produced by processing agricultural waste. For example, Belgorod Region possesses stations to produce biofuels from livestock waste, which simultaneously solves the problem of waste disposal of the largest livestock complexes.

We have already paid attention to the significant opportunities that the country has in the field of organic farming development; it is possible to talk about 17, 6 mil hectares, which are suitable for organic farming. The objective of escalating agricultural production, specified by the Russian Government, focuses on the need for reclamation of these unutilized land. As a result, considerable investments in soil purification will accompany both organic agriculture and industrial production of agricultural products. Forest areas are also a potential reserve to develop of organic production. In 2015 up to 8.3 per cent of all organic products in Russia were wild plants. In prospect, this niche can be developed by involving the population of rural areas and certification of these areas.

At the same time, experts rightly warn that the advantages that the country has in terms of developing organic agriculture should be promptly realized. So far, not only the volume of

[9] https://data.worldbank.org/indicator/AG.PRD.CREL.MT,
[10] https://www.statista.com/statistics/244263/exports-of-cereals-by-russia-2002-2013/

organic food production is extremely small in the country, but due to an underdeveloped certification system, already produced products cannot be recognized as organic ones either in the domestic or, especially, in international markets. Several large foreign producers operating in Russia and having the intention to launch organic product lines, such as Danone, faced a shortage of raw materials. The situation is similar with network retail, which today is ready to allocate the shelves of its stores for organic products and to conduct independently PR campaigns. As for international markets, to enter them, as already noted above, it is important above all to intensify efforts to recognize Russian standards for organic products by IFOAM, whose standards are the basis for the formation of national standards in all countries [Labykin, 2019].

The success of the development of organic production, experts draw attention, is to a large extent related to the speed of the measures being implemented, until the global market is saturated and organic products bring increased margins. Today, it is necessary to intensify attention to the production of organic food at all levels: both from the executive and legislative branches of power in the center and in the localities, and from agricultural producers. Among the most important today is the task of developing at the federal level and in the region's strategies for the development of organic agriculture, justifying their priority areas, determining the amount and sources of funding, information and consulting support measures, etc.

The prerequisites for the development of organic agriculture and the ways of their realization, as well as the role of this model of agricultural production in reducing the environmental burden will be in the focus of the authors and further, including when detailing the strategy for the development of organic production in a regional context.

Research methodology and strategic priorities for the development of organic agriculture in Russia

The condition for solving the tasks facing Russia to ensure the dynamic and effective development of the organic segment of agricultural production is the application of a well-thought out methodology. This issue is the subject of discussion in the scientific literature. Some authors in this context focus on the problems of low-carbon agriculture [Smith, 2007; Davidson, 2009; Long et al., 2011; Norse, 2012, de Moraes et al., 2017]. They consider organic agriculture as a key direction for the transition to a low-carbon economy in the agricultural sector. According to de Moraes et al. [de Moraes et al., 2017], low-carbon agriculture is based on three principles: low carbon dioxide (CO_2) emissions from land use and land use change and in response to agricultural best management practices; high CO_2 mitigation through agricultural production systems based on agricultural best management practices; high carbon sequestration potential with the adoption of integrated crop-livestock-forestry-systems.

This approach, focusing on environmental goals as the highest priority, and proposing means worthy of attention to achieve them, still seems too narrow. The concept of organic production 3.0 is more in line with modern integrated concepts of agricultural development. This concept was proposed by Strotdrees, which launched the idea of organic production 3.0 in 2011 [Strotdrees et al. 2011]. Arbenz defined Organic 3.0 as a modern, innovative agricultural system that holistically integrates ecology, economy, society, culture and accountability into local and

regional context [Arbenz et al. 2017]. Altieri considered the opportunity of Organic 3.0 to have an impact on solvation of tasks of climate change mitigation [Altieri et al., 2015]. The most important challenge for organic agriculture is to move from a purely agricultural perspective towards organic production as an agri-food system. Among the characteristic features of this system Rahmann et al. stressed down the following [Rahmann et al., 2017]:

1) production of healthy and safe food in volumes enough to meet the needs of the growing population;

2) reduction of pollution and greenhouse gas emissions derived from food production, processing, trading, and consumption;

3) development of food chains driven by renewable energy and recycled nutrients;

4) adoption to climate change and mitigating greenhouse gas emissions;

5) protection of soils, water, air, biodiversity and landscapes;

6) incorporation of current and emerging ethical systems, food habits, lifestyles and consumer needs

As follows from the listed characteristics, the concept of Organic 3.0 include the culture of innovation; continuous improvement towards the best practice; diverse ways to ensure transparency and integrity; inclusive of wider sustainability interests; empowerment from the farm to the final customer; true value and cost accounting.

The concept of organic production 3.0 needs some modernization in the context of the digital revolution. Several authors, studying the impact of the 4th industrial revolution and related digital technologies on organic agriculture, have developed the concept of organic production 4.0. This concept deserves serious attention and it will serve as the methodological basis for the subsequent analysis as well. Knoll and V. Czymmek, in this regard, note that «... digitization makes it possible to collect, store, analyze, and communicate large amounts of data. By digitizing farms, a network of different sensors can analyze the nutrient content and the soil texture in real time. This information can be evaluated, and the plant distribution can be managed across all networked farms. This leads to the right field being used for the right plant at the right time» [Knoll, Czymmek, 2018]. The use of digital technologies is not only the basis of the precision farming model, but, as was noted partially earlier, it contributes to the transparency of business processes, which is especially important to maintain high product quality and consumer confidence in organic products. In the following analysis, we will continue to explore the possible applications of digital technologies in organic production.

However, let's go back to the concept of Organic 3. Among the above listed characteristics and the tasks solved by Organic 3.0, it is important to focus on economic, social and environmental objectives. It is easy to see that these goals are central to the contemporary concept of sustainable development.

Let's start with the social dimension of the problem of sustainable development of organic agriculture. Agriculture, being the fundamental activity of humankind, is traditionally considered as an economic activity with important social functions. It provides a significant part of the world population with jobs and income. The social dimension must also be considered when assessing the economic efficiency of production and consumption of organic food, including the positive effects of environmentally friendly products on the health of the

population, especially children. Furthermore, forcing the development of this sector can have a positive impact on the social situation in rural areas by involving local people in production processes and preserving a traditional way of life [Schulze et al, 2015; Nesterenko, Pakhomova, 2016, Singh et al, 2019].

At the same time, the social effects of organic production are not unambiguous. We should bear in mind that the industrial model of agrarian production provides a significant improvement in working conditions and standards of well-being of rural workers in general. We cannot ignore numerous examples of violating the law on minimum wage by eco-farmers to ensure their price competitiveness with conventional farms as well (http://www.zeit.de/2016/13/landwirtschaft-oekobauer-mitarbeiter-ausbeute).

In this regard, it is worth to pay attention on computerization and robotization, which have significant potential in reducing the need for workers, including those engaged in manual operations. Robotization of agriculture animal husbandry, is currently gaining ground in domestic enterprises which use the organic production model and it can bring tangible effects through monitoring animal health, controlling the quality of milking and milk, rational use of feed, etc. Computerization and robotization not only reduce costs and increase the efficiency of animal husbandry, but in addition these technologies can help solve the problem of a shortage of skilled labor in rural areas [Skvortsov, et all, 2018].

Comparison of the conventional and the organic agricultural models must consider the actual goal of increasing the production of food due to population growth and the raising life standards as well. In this context specialists pay attention to the higher economic efficiency of the conventional model of agricultural production, including its higher productivity [Schulze et al, 2015; Christen, 2013; Schulz, 2012]. In Russia, agriculture faces the challenges of growth in the domestic demand for food as well. Moreover, as already have been noted, it must increase the export potential by almost 80 per cent to cover the loss of budget revenues in the face of declining raw material export orientation. In addition, the industrial model is characterized by a moderate consumption of energy resources in comparison with organic production, if we consider the lower productivity and yield of the latter[11].

At the same time, a comparison of the economic efficiency of traditional and organic farming models will be incomplete without considering the opportunities available in precision farming methods. So, according to some estimates, the Green Revolution with new methods of genetic modification, provided an increase in labor productivity, which allows each farmer to feed about 155 people. By 2050, the global population will reach about 9.6 billion, and food production must effectively double from current levels. With new technological advancements in the agricultural revolution of precision farming, each farmer will be able to feed 265 people on the same acreage[12].

As for ecological dimension, despite earlier beliefs, many studies have shown that organic agriculture does not have absolute environmental benefits [Schulze et al. 2015; Williams et al. 2006; Schulze 2014]. For example, in the case of grazing cattle, in the way it is required by

[11] https://attra.ncat.org/attra-pub/summaries/summary.php?pub=301

[12] https://www.ey.com/en_gl/advisory/how-digital-agriculture-and-big-data-will-help-to-feed-a-growing-world (дата обращения: 31.10.2019)

organic agriculture, the level of greenhouse gas emissions is higher than with stabling. So, ecological aspects of the problem require in-depth study. From one side, agriculture is one of the sectors that are most vulnerable to adverse climate impact. Experts estimate that global food production could drop by 17 per cent for each degree of temperature rise because of extreme weather events (drought, flooding, etc.)[13]. From the other side, agriculture must ensure the reduction of the burden on the environment in terms of greenhouse gas emissions in the context of the decisions taken at the conference in Paris. According to The Third Biennium Report of the Russian Federation, a share of GHG emissions from agriculture is approximately five per cent (fig.1). Simultaneously, this sector has a significant potential in reducing GHG emissions, for example, due to the use of precision farming, organic technologies, ets. These conclusions are correct for Russia's agriculture as well.

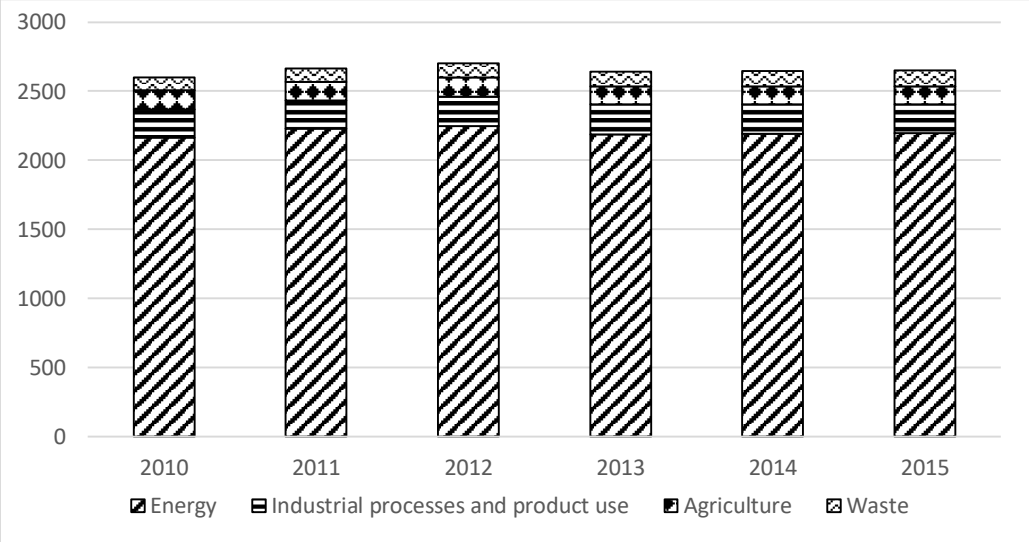

Fig. 1 GHG *emission structure in Russia* (URL: http://unfccc.int/files/national_reports/biennial_reports_and_iar/submitted_biennial_reports/application/pdf/386415_russian_federation-br3-1-3br.pdf)

These mixed results allow us to conclude that it is beneficial to apply different models to agriculture development and to elaborate balanced strategies for Russia and its regions. This can be achieved addressing to the contemporary conception of sustainable development, including "European Initiative for Sustainable Development in Agriculture" with its goal to merge the advantages of traditional industrial methods with the requirements of the organic agriculture. The concept of integrated farming, developed within the framework of this initiative, is directly oriented to the tasks facing the agricultural enterprises. This concept, while supplementing with the capabilities that are inherent in digital technologies, may be useful for Russian businesses involved in agricultural production. According to this concept, integrating farming is a sustainable production system which allows farmers to optimize their farm management, to raise further awareness and continually improve everyday practice on a farm

[13] http://www.arc2020.eu/2015/12/what-will-the-paris-agreement-mean-for-farming-food/

to meet future environmental, economic and social challenges and hence achieve parallel progress in all dimensions of sustainable development[14].

If summarized, "The European Initiative for Sustainable Development in Agriculture" demonstrate a holistic view at the economic, ecological and social challenges to society and a balanced way of development goals and strategies at the international, national, regional, as well as at the micro (namely, business) levels. Based on this concept, it's possible to show that the conventional agriculture has not negligible advantages compared to ecological agriculture, especially if the attention is drawn to the above-mentioned global task to supply the increasing world population with food and to provide for these people proper job quality and living conditions.

The development of a balanced and differentiated approach to agricultural production can also be observed when addressing the question of its place and role in softening global climate problems. In modern conditions agriculture faces the need to increase the volume of an agri-food production while considering the tasks of managing a climate change. In this context, attention should be paid to the concept of climate-optimized sustainable development of the industry. The main objectives of this concept are: the steady increase in a productivity and a profitability of agriculture; adaptation and increased resilience to the climate change; the reduction and/or termination of greenhouse gas emissions where possible. Climate-optimized sustainable development is one of eleven corporate priority areas for resource mobilization within the framework of FAO's strategic objectives. It is consistent with the concept of sustainable nutrition and FAO agriculture. And it supports FAO's goal to make agriculture and forestry, as well as fishing, more productive and sustainable[15].

As for Russia, the growth of agricultural production leads not only to a higher level of greenhouse gas emissions but also to a significant environmental burden in terms of soil quality, biodiversity and other aspects. However, the problem of the development of sustainable agriculture, as already noted, is more multilateral and it includes a social dimension as well. It's not reasonable to ignore the fact, that in rural areas there are many social problems including unemployment, low level of education and lack of young people. The long-term crisis in this sector in Russia has led to the migration of many young people to the cities.

The formation of adequate institutional conditions for the development of agriculture, primarily for its organic model is one of strategic tasks. The Federal Law "On Organic Products and Amendments to Certain Legislative Acts of the Russian Federation", adopted in August 2018 and coming into force on January 1, 2020, N 280-ФЗ, as already partially noted, requires a system of regulatory documents ensuring its practical implementation. Russia´s national standard of organic agriculture (GOST R 56508-2015) approved by 2015, June 30, needs international acceptance, especially from the European Union. Under these circumstances, best international practices need to be applied along with the EU experience to coordinate the agricultural and environmental policy, which is currently being adapted to the target settings of the Paris agreements. These are the following documents, which are developed and consistently implemented in the EU: Action Plan for the future of Organic Production in the European Union

[14] http://sustainable-agriculture.org/integrated-farming/
[15] http://agropraktik.ru/blog/1005.html.

(European Commission Brussels, 24.3.2014. COM (2014) 179 final) which also contributes to the objectives set out in the Europe 2030 Strategy. In line with this document, the Common Agricultural Policy and the 7th Environment Action Program 2020 require attention. Notice, that in Russia there are no analogues of several of the above-mentioned documents, making it difficult to conduct an effective public agricultural policy based on the principles of sustainable development. However, the government draft plan of measures for the ratification of the Paris Agreement and its implementation is now being developed and we consider it as a positive signal. Ministry of Agriculture in Russia also takes part in elaborating of the Action plan to reduce greenhouse gas emissions.

The sustainable development of agriculture involves achieving a balance between the supply side and the demand side for agricultural products, as was briefly noted above. This is especially important in the case of organic production. Regarding the magnitude and the structure of the effective demand for the organic products, several published articles have focused on obtaining more accurate estimates of these parameters. They analyze such problems as a willingness to pay the extra price for organic food, differences in the perception between local and foreign organic products, trust as a factor of choice, etc. The organic food consumer's focus on the local products related not only with trust to the local production processes, but also with a willingness to support local producers. In the case of Russia this thesis is confirmed by Shcherbakova (2017) with the example of the population of the Komi Republic. Consumers are more likely to buy organic products driven by trust in production processes, including those in terms of quality of the environment in a region. The consumer's willingness to pay a price premium for organic products was researched, for example, in surveys, conducted among the population of Russian regions [Honkanen and Frewer 2009, Popova et al. 2010; Kravchenko et al., 2019; Scherbakova et al., 2018; Komarova and Beresneva, 2019]. The data received indicates their willingness to purchase more expensive environmentally friendly products. However, it is worth noting that this is a characteristic of consumers with high earnings. As for consumers with an average income, not to mention low-income consumers, the condition for the formation of their demand for organic products is a more active social policy in the country. Among the priority measures in this area is the reduction in the sharp differentiation in the incomes of the population (we recall that the Gini coefficient for incomes is about 14 in Russia), as well as the pension reform.

Analyzing the task of balancing the supply and demand for organic products, one should also turn to new opportunities that arise due to the active development of digital platforms in the economy, as well as in its agricultural segment. Digital platforms in the modern economy can perform various functions facilitating market transactions between different business entities [Richter, Pakhomova, 2018]. They facilitate the promotion of organic food by organizing networking between producers and consumers, reduce the number of intermediaries due to the spread of direct sales from the manufacturer. Digital platforms can combine manufacturers from different regions with minimal transaction costs, which is important for organic products, the production of which is often localized in some regions, and demand can be formed in completely different ones. It is necessary to pay attention to the fact that these opportunities are realized in practice. So, since 2016, the largest Russian digital platform

PROD.CENTER has been functioning, which is focused on producers and buyers of agricultural products. Based on this platform, various products of livestock breeding and crop production, as well as poultry, fish, vegetables and fruits, are traded. Another example is the Foofza, digital logistics platform, which brings together more than 100 small and medium-sized farmers, greenhouse complexes throughout Russia and makes it possible to directly contact manufacturers with wholesale buyers: restaurants, cafes, hotels, small shops. All these circumstances are important to keep in mind when analyzing the sustainable development of organic agriculture in a regional context.

Selection of regions corresponding to environmental, social and economic parameters for the transition to the model of organic agriculture

Russia is characterized by a great diversity of geographic and cultural landscapes, which create many opportunities and risks for sustainable development of agriculture. The geographic location of Russian regions, diversity of landscapes and climatic conditions require the development of differentiated strategies for sustainable development of organic model of agriculture.

To differentiate the regions while choosing priority organic clusters, we distinguish the following consumer parameters: the quality of the environment in a region, availability of unutilized agricultural land and availability of labor force. Geographical closeness to large cities with high living standards is relevant only for those segments of organic agriculture in which perishable products are produced.

The main goal of the study in this section is to identify promising regions for the development of organic agriculture, which not only possess the production resources of the required quality, but also where the level of environmental pollution is relatively low. We have analyzed the transition to the organic agriculture by implementing the methods known in the international arena, for various Russian regions. Below we describe this method in brief. The authors identified factors, contributing to the development of organic agriculture and further have identified regions which have the greatest potential for the development of organic agriculture. The strategy of differentiation of the development of organic farming should be based on existing opportunities and barriers related to the environmental situation in the regions, the availability of production resources and the possibilities of its support from the regional authorities.

As for production, the drivers of transition to organic farming are the availability of unutilized agricultural land and the number of unemployed people in rural regions. In addition, it is necessary to consider the impact of an environmental situation in the regions on the quality of organic products. To assess the quality of the environment in the regions, we also used data from an integrated environmental index, which is calculated by Russian non-governmental organization “Green Patrol”[16]. This index is formed by integrating the parameters that characterize the level of atmospheric pollution, the level of water pollution, the degree of soil degradation, protected natural territories, biodiversity, and climate changes.

[16] URL: http://greenpatrol.ru/ru/stranica-dlya-obshchego-reytinga/ekologicheskiy-reyting-subektov-rf?tid=310&order=field_nature&sort=asc

At the first stage of our research, we assess the ecological situation in the regions of Russia and select regions where the quality of the environment corresponds to or exceeds the average level in Russia based on data of NGO “Green patrol”. Ecological rating of Russian regions is carried out because of generalization of information from various sources, including social media, authorities, public and expert organizations, economic entities and initiative groups of citizens. The scores obtained by rating are relative, and they depend on the indicators reached by all rating participants in the reporting period. Thus, the positions of a specific region in the index may differ from period to period with constant indicators due to changes in the indicators of other regions. Below we consider the indicators used in rating in detail:

- The atmosphere − an indicator that reflects the level of air pollution in the Russian regions (more precisely, in the subjects of the Russian Federation); this indicator also considers emergencies associated with the pollutant emissions, modernization of gas treatment facilities, etc.;
- Water resources - an indicator shows the state of natural waters (seas, rivers, lakes, groundwater, etc.), the quality of drinking water in the Russian Regions. This indicator also shows the quality of treated wastewater discharged into water bodies, construction and modernization of treatment facilities, etc.;
- Land resources − an indicator demonstrates the state of the land resources in the subjects of the Russian Federation, processes of soil degradation and reclamation and application of environmentally friendly technologies for land use;
- Specially protected natural areas − an indicator reflects the number and area of specially protected areas in a region, their condition, events related to their protection, and level of funding;
- Bio-resources − an indicator reflects the state of all biological resources of a region, for example, hunting or fishing stocks, increasing or decreasing of their diversity, quality and quantity;
- Climate - an indicator that reflects the climate change in a region of the Russian Federation. This indicator also considers natural disasters associated with extreme weather conditions (typhoons, hurricanes, droughts, forest fires, floods).

Starting from 2008 the ecological rating "Green Patrol" is formed quarterly. For the analysis and selection of regions, the authors have used data from spring of 2019. The average environmental index is 47 (out of 100) among all regions. The regions with an index below the average have been excluded from further analysis. Since one of the factors of consumer confidence in organic products is the environmental quality in the production area, therefore regions with a higher environmental quality have a higher priority for the development of organic production. Thus, regions with a suitable level of the environmental index are following: Kabardino-Balkaria, Karachay-Cherkess Republic, Republic of Adygea, Jewish Autonomous Region, Tambov Region, Altai Republic, Magadan Region, The Republic of Ingushetia, Kursk region, Komi Republic, Kostroma region, Altai region, Kamchatka Krai, North Ossetia Alania, Tyva Republic, Chechen Republic, Belgorod region, The Republic of Dagestan, Republic of Kalmykia, Ulyanovsk region, Ryazan Oblast, Mari El Republic, Stavropol region, Pskov region, Sakhalin region, Chuvash Republic, Republic of Karelia,

Vladimir region, Murmansk region, Penza region, Kaluga region, Kemerovo region, Chukotka, Ivanovo region, The Republic of Khakassia, Amur region, Krasnodar region, Perm krai, Astrakhan region, Tver region, The Republic of Sakha (Yakutia).

The task *of the second stage* of the study is to differentiate the regions according to two parameters: an area of unutilized agricultural land and an unemployment rate in rural territories of regions. Regions that are the part of the relatively clean group with an average annual environmental index above the average were then divided into four groups according to two parameters: the first is the area of unutilized agricultural land, the second is the level of unemployment in rural terrain.

A production process without mineral fertilizers is one of the requirements of organic agriculture. As already noted, Russia has got significant areas of unused agricultural land, so it is an important reserve for the development of organic farming. According to the Russian agricultural census in 2016, 17628,8 thousand hectares of agricultural land is not used for its intended purpose. That is 12 per cent of all agricultural land in the country (142659,7 thousand hectares). Agricultural land can be declared as unused after it stayed unutilized for three years. So, we can use these data for the analysis of the potential for development of organic agriculture. However, despite the improvement of soil quality due to the absence of mineral fertilizer, the physical properties of unutilized land deteriorate due to wind- and water-erosion, shrubs and other weeds. So, every year the quality of unutilized agricultural land degrades. And the restoration of the quality of such lands requires significant additional costs, which reduces the attractiveness of their use for organic production purposes. To solve the problem of unutilized land in the country, in 2011 a special Federal Law has been adopted in Russia that makes it possible to withdraw land in case of its improper use and return to agricultural circulation. Consistent implementation of the norms of this law will allow transferring these lands to more efficient owners, perhaps, for the purposes of organic production.

According to the statistical data, we divide all regions into two groups: regions with more than average value of unutilized agricultural land and regions with less than one[17]. The average value of unutilized agricultural land is 160 thousand hectares (among the abovementioned regions).

Table 1 Area of unutilized agricultural land in Russian regions, 2016

Area of unutilized agricultural land	Names of regions
More than 160 thousand hectares	Astrakhan region, Republic of Kalmykia, The Republic of Dagestan, Chechen Republic, Tver region, Penza region, Altai Territory, Pskov region, Amur region, Ulyanovsk region, Vladimir region, Perm Territory, Mari El Republic, Ryazan region
Less than 160 thousand hectares	Stavropol region, Jewish Autonomous Region, Kemerovo region, Tambov Region, Krasnodar region, Kaluga region, Altai Republic, Kursk region, Kostroma region, Ivanovo region, Belgorod region, The Republic of Sakha (Yakutia), Republic of Khakassia, Republic of Adygea, Tyva Republic,

[17] http://www.gks.ru/free_doc/new_site/business/sx/vsxp2014/vsxp2016.html

	Republic of North Ossetia-Alania, Chuvash Republic, Karachay-Cherkess Republic, Republic of Karelia, Sakhalin region, Republic of Ingushetia, Komi Republic, Kamchatka Territory, Kabardino-Balkaria, Murmansk region, Magadan Region, Chukotka Autonomous Region

At the third stage we consider social factors. Social factors of development of organic agriculture are bounded with an unemployment rate of rural people. Organic technologies are known to be more labor-intensive; therefore, one cannot ignore the availability of labor in analyzed regions.

Organic agriculture impacts social sphere of rural territories in different ways. We define several factors.

1. The development of entrepreneurial activity through the diffusion of new organic technologies. Products are to be produced in accordance with organic requirements. Not only new scientific knowledge in the field of botany, biology, agronomy is necessary but also new organic technologies including organic innovations. As a result, organic farms tend to be more innovative than conventional farms.

2. The employment of unskilled workers. Currently, the serious social problems of the rural population are associated with the migration of young people to cities due to a high level of unemployment. The crisis period in agriculture that lasted for several years has led to the degradation of the workforce in this sphere. Organic farms can provide workplaces for people in a plant producing, in dairy farms, in the harvesting of wild plants. It must be marked that harvesting of wild plants is widely used both in organic agriculture in Russia and in conventional agriculture.

3. Development of the natural way of life in rural territories. The popularization of natural rural culture in eco-settlements can save a Russian national culture. Organic farming diffuses the way of production without chemical fertilizers and other chemical resources. Thus, it goes back to traditional for Russian people natural technologies of food production.

The definition of promising regions for the development of organic production also assumes an analysis of the level of unemployment of rural population in regions. The state of employment in agriculture and unemployment of rural population is shown in table 2. In Russia it is equal 8% in 2017. We grouped regions into two groups in accordance to the level of unemployment (Table 2).

For the analysis of the unemployment rate, the data for the year 2015 was taken, which are now the most relevant. The use in the study of data on the state of the environment, unutilized agricultural lands and the level of unemployment of Russian regions for different time periods, as already noted, is justified, along with the availability of data, their weak variability in several positions. The desire of the authors to conduct research based on the most relevant data is also determined by the intention to use the obtained results to justify the strategic trends in the development of organic agriculture in Russia.

Table 2 Groups of Russian regions according to the unemployment rate of rural population, 2017

№	Unemployment rate in rural territory of regions	Names of regions
1	More than 8 per cent (average in Russia)	Republic of Ingushetia, Tyva Republic, Karachay-Cherkess Republic, Republic of North Ossetia-Alania, Republic of Dagestan, Republic of Adygea, Chechen Republic, Altai Republic, Altai Territory, Kabardino-Balkaria Republic, Jewish Autonomous Region, Republic of Kalmykia, Republic of Karelia, Astrakhan region, Pskov region, Komi Republic, Perm Territory, Kemerovo region, Kamchatka Territory, Murmansk region, The Republic of Sakha (Yakutia), Amur region, Ulyanovsk region
2	Less than 8 per cent (average in Russia)	Ryazan region, Stavropol region, Kostroma region, Vladimir region, Penza region, Sakhalin region, Mari El Republic, Republic of Khakassia, Tver region, Kursk region, Ivanovo region, Tambov Region, Kaluga region, Magadan Region, Chuvash Republic, Belgorod region, Chukotka Autonomous Region, Krasnodar Territory

Resource: http://www.gks.ru

Integration of ecological, economical and social parameters of these regions allows us to identify regions where the development of organic agriculture is of the highest priority. We distinguished four groups of regions that comprise in descending order regarding organic agriculture development (Fig.2).

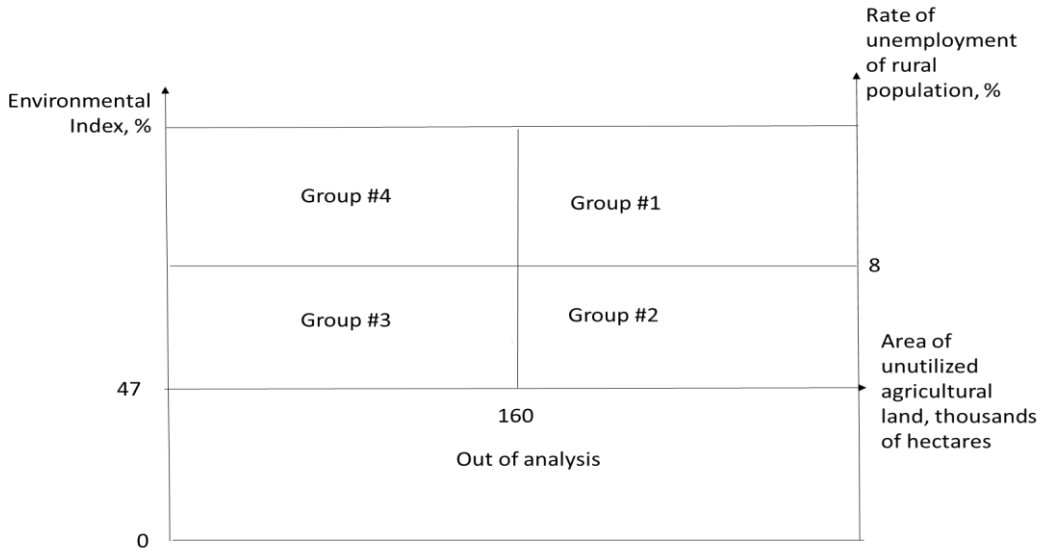

Figure 1 Grouping of Russian regions according to environmental, productive and social parameters. Source: completed by authors

The group #1 combines the following regions: Republic of Dagestan, Chechen Republic, Altai region. Jewish Autonomous Region, Republic of Kalmykia, Astrakhan region, Pskov region, Perm region, Amur region, Ulyanovsk region. Geographical spread of these regions is shown on the Fig.3.

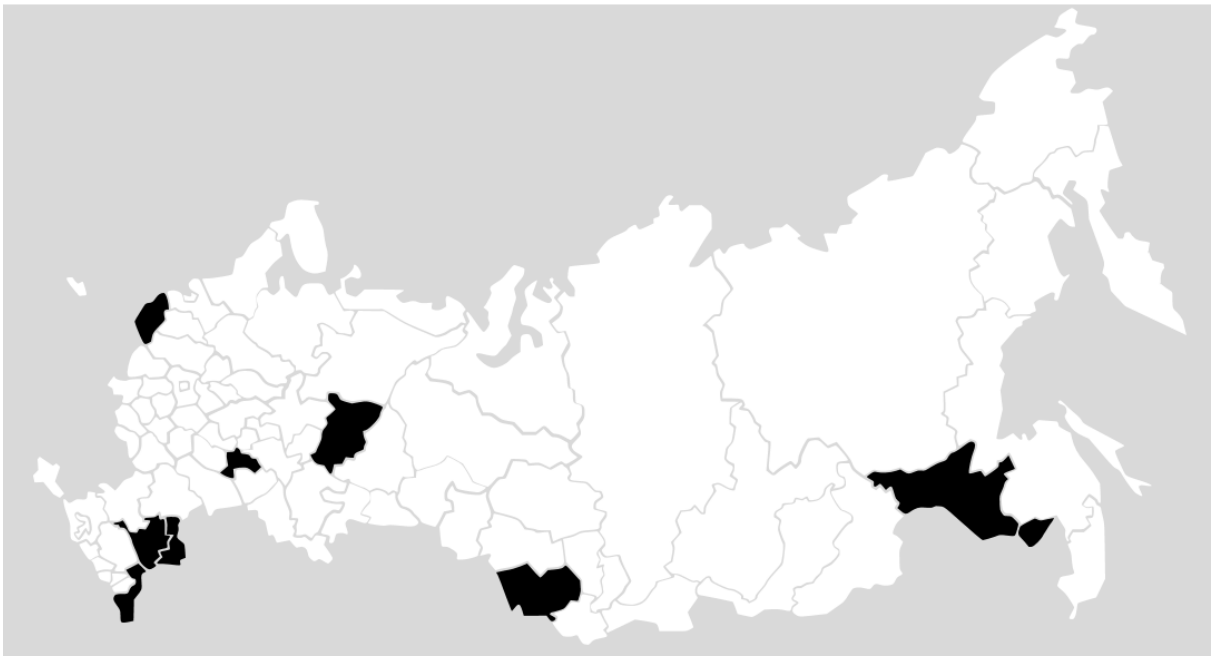

Fig. 2 Russian regions with large area of unutilized agricultural land and the rate of unemployment of rural population more than average in Russian (group#1)

As it's shown in the Fig.2, regions of the group #1 are characterized by a high level of unemployment of rural population and they have huge areas of unutilized agricultural land (more than 160 thousand hectares). They have the maximum potential for the development of organic agriculture, which makes it possible to produce products in large volumes.

The group #3 has an opposite state with the minimal potential for development of organic agriculture among chosen regions. This group consist of following regions: Republic of Ingushetia, Tyva Republic, Republic of North Ossetia-Alania, Karachay-Cherkess Republic, Republic of Adygea, Altai Republic, Kabardino-Balkaria, Republic of Karelia, Komi Republic, Kemerovo region, Kamchatka Territory, The Republic of Sakha (Yakutia), Murmansk region. Geographically it's shown on the Fig.4.

Fig. 3. Russian regions with area of unutilized agricultural land lower than average in Russia and the rate of unemployment of rural population lower than average in Russian (group#3)

The medium state in the context of potential of development of organic agriculture have regions in group#2 and group#4. The group#2 has got a lower level of unemployment rate of rural population with large areas of unutilized agricultural land. The group#3, in opposite, has got a high level of unemployment of rural population and not large area of unutilized agricultural land. As a result, regions in these groups have a relatively low potential for organic farming. Regions from group #2 and group #4 occupy an intermediate position between group#1 and group#3. These two groups combine the following regions: Ryazan region, Stavropol region, Penza region, Vladimir region, Mari El Republic, Tver region, Kostroma region, Sakhalin region, Krasnodar region, The Republic of Khakassia, Kursk region, Tambov Region, Ivanovo region, Kaluga region, Chuvash Republic, Magadan Region, Belgorod region, Chukotka Autonomous Region (Fig. 5). In a productive aspect, these regions have the medium potential for the development of organic production.

Fig. 4 Russian regions with a medium potential for development of organic agriculture (groups #2 and #4)

To reveal product specialization of each group of Russian regions it is necessary to clarify product niches of organic agriculture. Product differentiation with a regional definition is useful for the further analysis of strategy development of organic agriculture in the Russia. In accordance with the types of products, as well as their role in the supply chain, the authors identify the following niches: 1) organic raw materials for further processing in the food industry and related industries; 2) fresh organic products of short shelf life without processing; 3) wild collection.

The niche of organic raw materials for the further processing in food industry and other related industries needs much agricultural area and labor. This niche includes organic raw materials for the food, chemical, light industries and certainly for agriculture. The supply chain in this niche can be long because the shelf life of these goods is not short. The location of production of raw materials doesn't matter for the end consumer, just an ecological state of region of production. Since in this niche a processor plays a key role in the supply chain, the volume of production is restricted only by a processor's capacities and it is not limited by the level of effective demand. Moreover, organic raw materials can be delivered for export like conventional ones. The products of this niche can be distinguished into the following categories: organic products for further processing in a food industry (berries, fruits, vegetables, meat and milk for conservation), cereals for processing and packaging (wheat, rye, rice, beans), medicinal plants for chemical industry (medical and cosmetic products from organic raw materials), organic animal feeds for organic farms, organic textile material.

The niche of organic food of short shelf life needs production processes oriented on keeping freshness. Production of organic fresh food for the end consumers requires short supply chain. These are meat and dairy products, fresh vegetables and fruits, berries and mushrooms. A distinctive feature of food in this group is its short shelf life. Requirements for organic food suggest the absence of chemical preservatives, improvers and dyes. Hence, the shelf life of

organic products is much shorter than that of conventional products. A basic reason for buying organic food is a desire to consume healthy environmentally friendly food. Children, as well as adults with specific diseases, are also included in the consumer group for which healthy diet is required. The next reason to be certified is trust in the quality of products which can be provided by a direct production process control, as well as the location of the production in an environmentally friendly region.

The third niche is "Organic wild collection". This group of products is allocated to a separate niche, as a production process is limited to a wild plants harvest, its packaging and transportation. Currently, up to eight per cent of all areas certified in accordance with organic requirements in Russia is occupied exactly for wild collection. We see good prospects for the development of this niche since large areas of the country are covered with environmentally friendly forests. Ehis, in turn, requires large labor force. Large areas of unutilized agricultural land are not required, therefore, for the implementation of this niche of organic agriculture, the regions of Group 1 are more suitable.

The differentiation of regional strategies for organic agriculture: results and discussion

Basing on the study, we can confirm the assumption that the strategy for the development of organic agriculture in Russia should be implemented considering the geographical, economic and social parameters of its regions. Distinguishing four groups of regions allows us to focus the development strategy on individual product niches: food with short shelf life and minimum processing, organic raw materials for food and other related industries, and harvesting of organic wild plants and fruits. Such differentiation will enable not only to fully adapt supply chains to the capabilities of its members but also to solve several environmental and social problems.

The large-scale production of organic raw materials is possible. The main limiting aspect, in this case, is a processor's capacity. At the same time, this niche has a great export potential, as the market for organic products in the world is constantly growing. Russia can occupy a certain market share by selling organic raw materials. Large areas of unutilized agricultural land, which provide a considerable reserve for development of agriculture in Russia as a whole, can be used for organic farming. In this context, with an increase of production in agriculture the costs of reclamation of soil can be considered unavoidable. By using a large amount of manual labor in this product niche, unemployment in rural areas can be reduced.

According to the specific features of this niche regions from the group # 1 (namely, Republic of Dagestan, Chechen Republic, Altai region. Jewish Autonomous Region, Republic of Kalmykia, Astrakhan region, Pskov region, Perm region, Amur region, Ulyanovsk region) are more suitable. If we can see on the Fig.3, many regions take place near state border so development of the export trade with organic raw materials can be organized with minimization of transport costs.

Harvesting of wild plants and fruits is a perspective niche of organic agriculture, because most of territory of Russian Federation is covered with environmentally friendly forests. In this case, the production process consists of harvesting the ripened fruits and plants and selling them to further processors. The export potential for organic wild plants in our country is quite high,

especially in the Asian region. For implementing this niche, large agricultural areas are not required, major production areas are in a forest zone. Because of the seasonal involvement of the population for harvesting, the problem of unemployment in the respective regions may be partly solved. Carrying out regional differentiation in the development of organic agriculture makes it possible to specify organizational activities both from state and business points of view. Regions from the group # 3 (namely, Ryazan region, Stavropol region, Penza region, Vladimir region, Mari El Republic, Tver region, Kostroma region, Sakhalin region, Krasnodar region, The Republic of Khakassia, Kursk region, Tambov Region, Ivanovo region, Kaluga region, Chuvash Republic, Magadan Region, Belgorod region, Chukotka Autonomous Region) could provide organic wild collection especially most of them are covered by forests.

Development of organic food production with minimal processing and short shelf life is possible in the form of organizing small organic farms because of requirements to be close to consumers delivering small volume of fresh food. This form of organization allows, on the one hand, to minimize risks associated with production processes and changes in consumer preferences, as well as financial risks due to small production volumes. On the other hand, it can provide an impetus to the development of innovative entrepreneurship in rural areas through the exchange of positive experience not only in the organic production sector but also in agriculture. In addition, small organic farms carry out the function of preserving and transferring traditional Russian rural culture using old recipes and methods of farming in production processes. Regions from group # 2 and group # 4 could be more suitable for development of this product niche. The significant part of these regions is in European part of Russia which is characterized by high effective demand on organic food. Moreover, institutionally European part of Russia is more developed for organic market.

Scheme of product niches of organic agriculture considering regional differentiation is shown on the Fig.6.

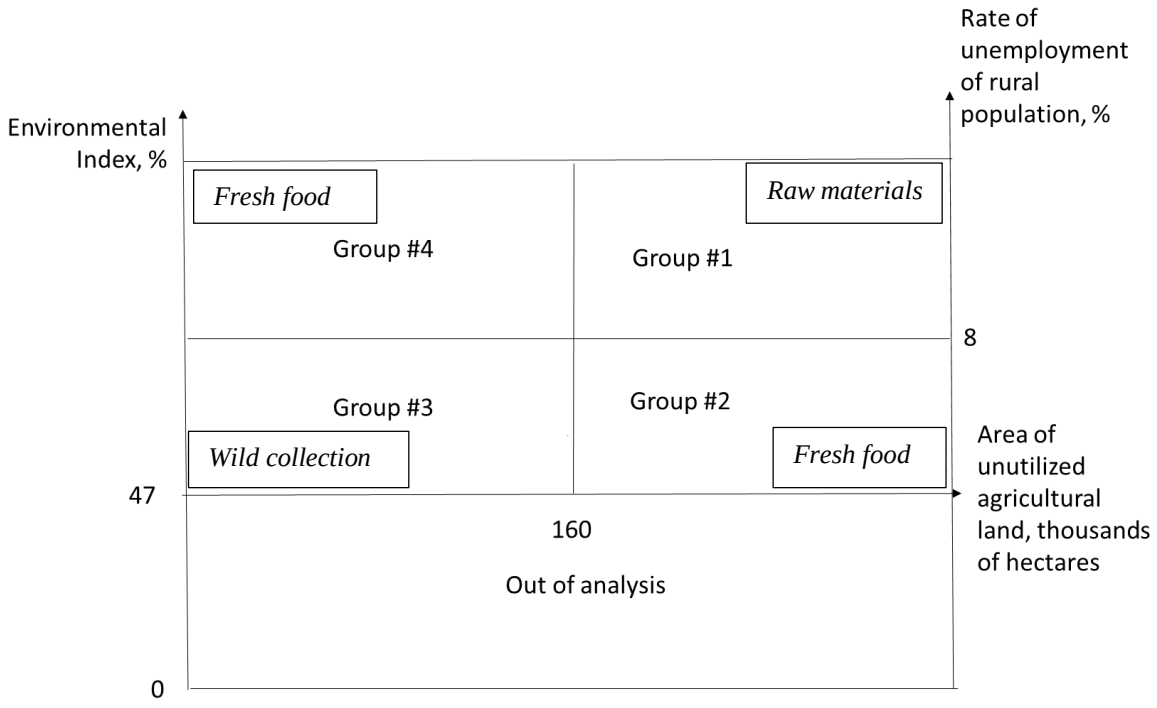

Fig. 5. Product niches of organic agriculture according to regional differentiation

Summary and outlook

The analysis confirmed the importance of agriculture through the example of Russia to achieve the objectives of the Paris agreement on climate and the formation of a stable low-carbon economy oriented to the expanded use of alternative energy and the integrated introduction of technological, organizational institutional and marketing innovations. For the agricultural sector, an important role in achieving these goals is assigned to the dissemination of the principles of organic agriculture, which, at the same time, must be applied in a balanced manner, considering the fulfilment of this sector's entire range of economic, social and environmental functions. The authors based their research on the modern model of organic farming, "organic farming 3.0", which is characterized by a shift in emphasis from a purely agricultural perspective to organic production as an agri-food system. An important role in the formation of the methodological basis of the study was also given to the "European Initiative for Sustainable Development in Agriculture" with its goal to merge the advantages of traditional industrial methods with the requirements of the organic agriculture. The answers to current climate and environmental challenges should be the zone of responsibility not only for the model of organic production but also be consistently addressed within the traditional industrial sector of the Russian agrarian economy.

A successful implementation of the strategy for sustainable development of organic production, however, is less beneficial without the targeted use of digital technologies. The main areas of their application and the effects obtained include the following:

- cloud computing and large databases technologies, which contribute to the development of precision farming as a key component of the forth wave of modern, digital, revolution; precision agriculture means application of precise and correct amount of different resources (water, fertilizer, pesticides etc.) at the correct time to the crop to increase its productivity, maximize its yield and, as a result, to improve overall environmental performance;
- industrial Internet and of high-resolution satellite data, which allow not only to organize online monitoring of the quality of the interconnected technological chains of organic production, but also can contributes to the transparency of business processes, and, as a result, can maintain high quality and consumer confidence in organic products;
- computerization and robotization, which have significant potential in reducing the need for workers engaged in manual operations and the shortage of highly qualified personnel in rural areas;
- active development of digital platforms that facilitate the promotion of organic food by organizing networking between producers and consumers; such platforms reduce the number of intermediaries, combine manufacturers from different regions with minimal transaction costs, help to realize economies of scale and at the same time can reduces the gap between the supply and the demand for organic products in the regional context, etc.

The strategic development of agriculture should aim at its intensive development to meet the growing population's food needs and increase the country's export earnings with targeted

environmental measures. These measures should be coordinated with the tasks arising from the Paris Climate Agreement in 2015 to prevent irreversible climate change and environmental degradation. Of importance in this context are the agriculture-servicing branches, including the production of mineral fertilizers, which are among the priority in terms of reducing greenhouse gas emissions.

The article focused on the model of organic agriculture, which plays a special role in reducing the risk of irreversible climate change and the risks of environmental pollution. For its accelerated development it is necessary, firstly, to form adequate institutional conditions that support this rapidly developing segment of agricultural production. The preparation of a package of regulatory documents that ensure the implementation of the Federal Law "On the Production of Organic Products" (N 280-FL) has in modern conditions the greatest relevance. Secondly, in determining the strategic priorities for the development of organic agriculture, it is necessary to consider the diversity of natural and climatic conditions prevailing in different regions of the country, as well as the availability of appropriate production and socio-economic resources. And thirdly, to achieve the goals of sustainable development, it is recommended to fully realize the potential of digital technologies.

Considering the three dimensions of sustainable development, the paper justified three groups of indicators, namely, ecological, economic and social, which formed the basis for classifying regions of Russia to identify those that have the most favorable conditions for the development of organic agriculture. Further, the authors suggested possible grocery niches for the development of organic agriculture and the supply chains corresponding to these niches, which can find effective application in the groups of regions that were defined in the article. The recommendations resulting from the analysis carried out in the article may be of interest both for business and for regulating bodies in charge of developing strategies for the organic agriculture in Russian regions.

This study also made it possible to identify several thematic areas that could be analyzed in subsequent publications. For sustainable development of organic agriculture, as noted in the article, it is essential to balance the supply side and the demand for organic products. Considering the importance of ensuring this balance, the focus of the article was still on the supply side. As for the formation of a stable demand for organic products, this problem needs further study in its various aspects. These include ensuring the availability of organic food, including through effective social policies and reducing an unjustified differentiation in the incomes of various segments of the Russian population. The organic food segment also needs special marketing research to increase its export potential.

The next issue regarding the development of organic agriculture is to predict dynamics of GHG emissions. It cannot be said that production of organic products does not have any negative impact on the environment. Data on the level of environmental burden of organic farms in comparison with traditional farms is provided in several papers [Williams, 2006; Schulze, 2014, 2015]. There is an ambiguous impact of organic agriculture on the level of GHG emissions. In this regard, it is of interest to simulate these emissions while implementing the strategy of agricultural development, including the organic sector.

There is a significant ongoing discussion in the Russian scientific literature regarding the

need for the government support for organic agriculture. Critics are concerned about the inability of this sector to solve the food security problem and provide the population of the country with domestic environmentally friendly food. Their position is explained by the lower productiveness of organic agriculture in comparison with traditional. In terms of solving environmental problems, organic agriculture becomes not only a supplier of more expensive environmentally friendly food, but also initiates a significant number of innovations related to the development of environmentally friendly technologies.

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