Sustainable Development of Agriculture of Industrial Region: 
Ecological Aspect

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Abstract. The article is devoted to the environmental situation. The main indicators characterizing the development of agriculture in the Kemerovo region are considered. Such problems of the development of agriculture in the Kemerovo region as a decrease in the share of agriculture in the gross regional product, a decrease in the volume of agricultural production and acreage are identified. The results of laboratory monitoring of the physico-chemical indicators and the physicochemical parameters of the soil are confirmed that the territories with developed industrial production are mostly characterized by the failure to comply with the standards for the physicochemical parameters of the soil. The possible directions of ecologization of agriculture in the Kemerovo region are shown.

1. Introduction
The development of agriculture may contribute to the outflow of resources from the extractive industries. On the one hand, the reduction in the share of extractive industries in the structure of the gross regional product can often have a positive environmental impact on the region. On the other hand, the agriculture of industrial regions should also be environmentally friendly, its negative impact on the environment should be minimized. Living and working conditions of the population in industrial regions create increased requirements for the quality and safety of agricultural products. Thus, the development of agriculture in industrial regions affects a wide range of issues in the field of food and environmental security.

2. Literature review
In the global scientific community, at present, the greening of agriculture is receiving considerable attention. Issues of greening are widely covered by P. Koohafkan, M. A. Altieri, E. H. Gimenez [1], A. Hall, K. Dorai [2], P. C. Struik, T. W. Kuyper [3], D. Slavova [4], B. Pyakuryal [5]. A number of scientists, including D. Satterthwaite, G. McGranahan, C. Tacoli [6], I. C. De Jesús, M. S. Islam [7], A. Jambor, S. Babu [8], G. A. Huppé, L. Bizikova, and D. Roy [9], pay special attention to the peculiarities of the development of agriculture in industrial regions.

The impact of industrialization on agriculture is significant. However, modern scientists note that agriculture should now be flexible and environmentally friendly.

According to P. C. Struik and T. W. Kuyper, the society needs dynamic coalitions and flexible decisions, an agriculture demonstrating flexibility to cope with future change, and sustainability that is perceived as a moving target. The society needs different conceptualizations (but not definitions) of
sustainable intensification for different parts of the world, in different shades of green, but developing towards the richest green possible. We admit that current agriculture tends to become more industrial; in that process, it is likely that agriculture will become less sustainable, resulting in an increase in the sustainability gap. We do not need to accept that apparently the only form of further intensification involves increased (and sometimes more efficient) use of external input resources (capital, fertilizers, crop protectants) at the expense of the natural resource base [3].

As noted by A. Hall, K. Dorai, some major issues for concern currently are:
- nitrate and pesticide residue pollution arising from agriculture;
- loss of biodiversity due to pollution, agronomic practices such as mono-cropping, destruction of natural habitats, over-exploitation of natural stocks of fish and forests;
- soil nutrients, organic matter and natural resource degradation, including salinification associated with irrigation;
- agriculture’s carbon footprint – fossil fuel use in production of chemical inputs, in farming practice, in food processing and related agro-industries;
- transport of agricultural produce to distant markets;
- agriculture’s water use footprint – excessive water use in intensive agricultural production and competition with other uses, particularly drinking water as well as effects on water quality through pollution;
- agriculture’s contribution to climate change, both in terms of contribution of greenhouse gases CO2 and methane; and its role in climate change mitigation strategies (biofuel production, but also a range of bio-production systems with benign or beneficial environmental consequences, carbon sequestration) [2].

D. Slavova notes the following opportunities for greening at the present stage: maintaining and increasing farm productivity and profitability while ensuring the provision of food on a sustainable basis; reducing negative externalities and gradually leading to positive ones and rebuilding ecological resources (i.e. soil, water, air and biodiversity “natural capital” assets) by reducing pollution and using resources more efficiently [4].

Farming practices and technologies that are instrumental in greening agriculture include: restoring and enhancing soil fertility through the increased use of naturally and sustainably produced nutrient inputs; diversified crop rotations; livestock and crop integration; reducing soil erosion and improving the efficiency of water use by applying in minimum tillage and cover crop cultivation techniques; reducing the use of chemical pesticide and herbicide by implementing integrated biological pest and weed management practices; and reducing food spoilage and loss by expanding the use of post-harvest storage and processing facilities [4].

Currently, the number of supporters of organic farming is growing, but it is necessary to understand that its possibilities are very limited. The authors share the position of B. Pyakuryal [6], P. Koohafkan, M. A. Altieri, and E. H. Gimenez [1]. They note the following problems of organic farming such as environmental costs of transporting organic inputs to the farm. Therefore, to be sustainable, animal manures, composts, and other soil enhancers need to be produced in the farm itself.

Russian scientists are also paying attention to the problems of greening of agriculture.

According to I. N. Merenkova, it is necessary to start with the preservation of soil fertility and the transition to biologization of agriculture for the transition of agriculture to the path of sustainable (environmentally balanced) development. Extended reproduction of soil fertility can be achieved by the following measures: creation of an adaptive-landscape farming system; the use of soil and resource-saving technologies of tillage, primarily no-till; tining of eroded and sloping lands, including watercourses, prolesin perennial grasses, as well as conservation of certain areas for natural restoration of the soil; widespread use of green manure crops in crop rotation; use of crop residues as organic fertilizers; use of natural ameliorants to reduce soil acidity; reduction of pesticide load.

Voronin B. A., Chupina I. P., Voronina Ya. V., Chupin Yu. N., Mitin A. N. note the characteristics of agriculture as an industry. As they say, the specificity of the implementation of reproduction in agriculture is due to the fact that the reproduction of the natural-biological system (the land, plants and
animals) in comparison with other industries is of crucial importance. Consequently, in this area of social and production relations, it is important to ensure the unity of technology, biology, economics and ecology [11].

3. Research methodology
Monographic and economic-statistical methods of research are used in the article.

In this article indicators of the development of agriculture in the industrial region were examined, and indicators of soil pollution and the safety of agricultural products were examined.

4. Results and discussion
The high role of the issue of food security is determined by the fact that the UN considers food safety in the world as one of its main sustainable development goals.

In the 20th century, the main aspects of food security were physical, social and economic ones. Unfortunately, ensuring physical availability of food remains a pressing issue nowadays for some developing countries. However, for developed countries and countries with economies in transition, issues of food self-sufficiency and its quality are much more important.

The role of food self-sufficiency is explained by the requirements of state security. This principle is reflected in such international documents as the Concept for Enhancing Food Security of the CIS Member States and the Food Security Concept of the Eurasian Economic Community. The Doctrine of Food Security of the Russian Federation establishes the requirements for the thresholds of self-sufficiency in basic foodstuffs.

Ensuring food quality becomes important because it directly affects the level and quality of life of the population, its ability to work and reproduce.

Regions have different economic conditions, and therefore the possibilities of producing high-quality agricultural products are also very different.

Industrial regions face the greatest difficulties in ensuring high quality food. In addition, such regions often have problems with food self-sufficiency due to the low competitiveness of agricultural producers, their inefficiency, the functioning of agricultural enterprises in difficult environmental conditions. Therefore, it is especially important for industrial regions to find the right tools for the development of agriculture while maintaining its competitiveness and environmental friendliness.

A study of the agriculture of the industrial region is conducted on the example of the Kemerovo region.

The features of the functioning of agriculture in the Kemerovo region and the possibilities of its development are reviewed taking into account the environmental factor.

The Kemerovo region as a typical industrial region has features of functioning and development of agriculture, which include an insignificant and declining share of agricultural products in the structure of the gross regional product, a difficult ecological situation, geographical conditions less attractive for the development of agriculture than in agricultural regions [12, 13].

The share of agriculture in the gross regional product of the Kemerovo region in recent years has been fixed below 5%. And since 2014, despite the existence of state support for agriculture, its share has declined. In 2017, its share fell to 2.3%. The trend is shown in Figure 1.
Agricultural products in value terms increased in 2013–2014, but since 2015 the growth rate of the indicator has declined significantly. The trend is shown in Figure 2.

Over the past 5 years there has been an increase in the production of grain, potatoes and eggs, but the meat and dairy industry did not show significant growth. Sales of basic agricultural products are shown in Figure 3.
Another negative trend was the reduction of acreage by more than 5% over a five-year period. The reduction was observed for all types of acreage. The largest reduction was typical for crop areas occupied by feed crops, which poses a threat not only to the development of crop production, but also to the development and competitiveness of livestock (Table 1).

The most important direction in solving the problem of sustainable development of the agro-industrial complex at the current moment should be the provision of simple and extended reproduction of the natural fertility of the soil. Currently, the region is experiencing soil acidification, which is a serious threat to the development of agriculture, the quality of agricultural products and the health of people. Over the past 30 years, the area of acidic soils has increased by 3 times, the proportion of acidic soils of arable land in the Kemerovo region is more than 50%.

In addition, the Kemerovo region is characterized by widespread use of agrochemicals, which leads to soil pollution, natural waters and agricultural products with residual quantities of pesticides, resulting in an increased risk of adverse effects on human health and the state of environmental objects (Table 2).
Table 2. The results of laboratory monitoring of the content of pesticide residues in soils in 2013-2017.

| Indicators | 2013 | 2014 | 2015 | 2016 | 2017 |
|------------|------|------|------|------|------|
| The number of investigated soil samples | 36   | 57   | 46   | 31   | 39   |
| The proportion of samples containing pesticides, % | 0    | 11   | 29   | 3    | 18   |
| The proportion of samples containing pesticides in quantities above the maximum permissible level, % | 0    | 9    | 22   | 0    | 0    |

There is a regularly observed problem of exceeding the proportion of soil samples containing pesticides in the Kemerovo Region. The use of chemical plant protection products leads to a deterioration in the quality of food, residual quantities of pesticides are found annually in samples of soil and air, water, food raw materials and food. To reduce the degree of danger, a broader use of biological plant protection products is required, a reasonable use of pesticides is predominantly selective, a reduction in the use of persistent pesticides, and the use of agrochemicals less toxic to humans and animals.

In the current situation, it is necessary to create conditions for greening agriculture, which implies strict adherence to the rules and norms of land use, improving the culture of farming and animal husbandry, increasing the role of modern biotechnology and gradually reducing the chemicalization of agricultural production. Greening agriculture will improve the quality of food products, and in the long term, increase the life expectancy of the population.

It should be noted that there is a problem of non-compliance of samples with hygienic standards for physico-chemical parameters in the region (Table 3).

Table 3. Ranking of territories by specific weight of samples that do not meet hygienic standards for physico-chemical indicators, 2014-2017.

| Territory                              | 2014 density, % | 2014 rank | 2015 density, % | 2015 rank | 2016 density, % | 2016 rank | 2017 density, % | 2017 rank |
|----------------------------------------|-----------------|-----------|-----------------|-----------|-----------------|-----------|-----------------|-----------|
| Anzhero-Sudzhensk, Izhmorsky, Yaya districts | 6.0             | 9         | 3.7             | 9         | 4.06            | 7         | 2.0             | 4         |
| Belovo, Belovo district                | 0.4             | 1         | 0               | 1         | 11.6            | 15        | 7.4             | 11        |
| Berezovsky, Topki, Kemerovo Topkinsky districts | 0.7             | 3         | 0               | 1         | 1.41            | 2         | 7.4             | 11        |
| Kemerovo                               | 12.7            | 13        | 9.4             | 12        | 6.78            | 13        | 5.38            | 10        |
| Leninisk-Kuznetsky, Polysaev, Leninsk-Kuznetsky district | 6.6             | 12        | 4.4             | 10        | 6.27            | 12        | 16.8            | 13        |
| Mezdurechensk, Myski, Mezdurechensk district | 6.4             | 11        | 5.2             | 11        | 7.24            | 14        | 4.5             | 9         |
| Novokuznetsk, Novokuznetsk district    | 1.5             | 5         | 2.4             | 5         | 4.35            | 10        | 4.5             | 9         |
| Osninniki, Kaltan                     | 6.1             | 10        | 1.1             | 4         | 5               | 11        | 3.6             | 8         |
| Prokopevsk, Prokopevsky district       | 3.7             | 8         | 0.24            | 2         | 1.77            | 4         | 2.6             | 6         |
| Tashtagol, Tashtagolsky district       | 15.2            | 14        | 1.02            | 4         | 0               | 1         | 1.4             | 3         |
| Yurga, Yurginsky district              | 3.3             | 7         | 0               | 1         | 4.25            | 8         | 1.2             | 2         |
As it can be observed, the territories with developed industrial production are mostly characterized by the failure to comply with the standards for the physicochemical parameters of the soil.

Another problem proving the need for greening agriculture is the reduction of enterprises confirming product safety. For example, the share of a plant growing company that fully confirmed the safety of products from 2014 to 2016 decreased from 82.9% to 58.1%.

5. Conclusion

It is necessary to create an appropriate system of market regulators to change priorities in the allocation of resources, capital investments in the agro-industrial complex, and enhance the environmental role of costs. The problem of reducing acreage requires increased attention. Attention should be paid to land reclamation.

Enterprises and farmers engaged in organic agriculture should be provided state support, primarily in the form of subsidies, which will gradually reduce the negative impact of agriculture on the ecology of the region and increase the availability of organic agriculture products for the population. It is necessary to take care of the ecological aspect of agriculture, for this it is necessary to encourage enterprises to use waste treatment technologies. Kuzbass scientists have developed projects for deep processing and recycling of animal and poultry waste using innovative developments from Biocon, technology for producing high-protein feed additives from poultry-processing industry, Technology for producing protein feed additives from collagen-containing waste from BioL-SOW pig farms. The use of these technologies will simultaneously increase the efficiency of agriculture and reduce its adverse environmental impact on the environment.

One of the most important directions of development of agriculture and food industry at the current stage should be the development of processing technologies, which contributes to the achievement of the most important tasks: improving the competitiveness of agriculture and food industry and improving the quality of food produced in Kuzbass and its accessibility to the population.

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