

**Research Article****Assessment of Regional Grain Farming Development for Sustainability****Generalov I G.\*, Kuchin N. N.\*, Suslov S. A.,\*****Ryabova I. V.\* and Kurilova A. A.\*\***

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**ABSTRACT.**

This study is aimed at evaluating the sustainability of the development of the grain economy in the Nizhniy Novgorod oblast' (the main agricultural in the zone outside the Black Earth Belt). In risky conditions for arable farming the main area of economic activity planning for the grain producers in the region is to reduce variations in yield of particular grain crops.

Methods. The article uses the data about the yield of grain and leguminous crops in the Nizhniy Novgorod oblast' with a breakdown into categories of farming units (agricultural organizations, peasant households (farming enterprises) and sole entrepreneurships, population farming households) over the last 20 years. These data are processed by analytical alignment.

Results. The largest deviation in the wheat yield from the average value is  $\pm 2.056$  hwt/ha, and it observed in population farming households, whereas the figure for all the categories of population farming households falls within  $\pm 1.556$  hwt/ha. The largest deviation in the rye yield from the average value is  $\pm 2.067$  hwt/ha, and it is observed in peasant households (farming enterprises) and among sole entrepreneurs, whereas the figure for all the categories of population farming households falls within  $\pm 0.911$  hwt/ha. The largest deviation in the parsley yield is  $\pm 1.478$  hwt/ha, and it is also observed in population households, whereas the figure for all the categories of farming units falls within  $\pm 1.289$  hwt/ha.

Conclusions. The material presented in the article has a practical significance because, according to the results of the study, the less sustainable grain production in the Nizhniy Novgorod oblast' is concentrated largely in population farming households. A higher level of sustainability is typical of agricultural organizations; however, their sustainability is more determinative for the sustainability of grain production in the Nizhniy Novgorod oblast'. That is why, agricultural organizations must still be the region's key production landmarks.

**Key words:** croppage, grain, variations in yield, grain yield, production sustainability

**Introduction**

The Food Security Doctrine of the Russian Federation places a high value upon ensuring the sustainable development of the national agricultural sector [1] because today's agribusiness is a complex system strategically important to the bolstering of the country's economy. The solution of the food problem and ensuring of Russia's food security depend largely on the sustainable development of grain production as the backbone segment of the AIC [2, p. 17; 3, p. 16; 4]. Representatives of the classical school of economics placed particular

emphasis on the significance of food commodities: it was that back in the 17<sup>th</sup> and 18<sup>th</sup> century land was considered the main factor of production and all economic relations hinged on its ownership, disposal, and utilization. That factor included agriculturally used areas (AUA), climate, water and forest resources [5, p. 80].

The special position of the farming sector in the national economy stems at least from the fact that there are around 80 economy branches, where agricultural products are used as vital resources. In its respect, the farming sector uses

products of more than 60 branches and various kinds of entrepreneurs and is, therefore, a major market outlet [6, p. 90].

The sustainability of agricultural production depends directly on the sustainability of plant raising because it forms the resources necessary to develop the other fields of the AIC and, therefore, ensures the financial and economic solvency of farm laborers.

In Russia grain and leguminous crops have traditionally enjoyed popularity in production and consumption. That is why, one cannot but agree with A. I. Altukhov, a prominent agricultural academician from the Russian Academy of Agricultural Sciences (RAAS), who points to an important fact that the sustainable development of grain economy must become one of the priority areas of state policy for the foreseeable and more distant future, which will help to strengthen Russia's global position [7, pp. 4-11]. In addition, it is necessary to emphasize that grain remains the only exported agricultural commodity [8, p. 3].

Grain production as a separate branch is connected not only to arable farming but to agricultural production in general; it is a source of vital foodstuffs for the population and a source of necessary raw materials for other branches of the AIC. Essentially, grain production is the basis of this entire complex and determines the level of its development [9, p. 103; 10, p. 125].

Nonetheless, the impact of soil, climatic, and agronomic factors leads to highly variable grain croppage by territory and in time [11, p. 15; 12; 13].

Russia's vastness facilitates non-uniform agricultural production in some of its territories [14; 15]. This problem is especially evident in grain production. The grain production in the non-Black Earth zone is highly unsustainable. Since the Nizhniy Novgorod oblast' is one of the regional leaders in this zone, the study is aimed at evaluating the sustainability of development of the grain economy of this oblast' as a major agricultural region of the non-Black Earth zone. In risky conditions for arable farming the main area of economic activity

planning for the regional grain producers is to reduce variations in yield of specific grain crops.

#### Materials and Methods

In this article the data on the yield of grain and leguminous crops for the last 20 years were used with a breakdown into categories of farming units and then subjected to analytical alignment. The territorial coverage of the study includes grain producers from the Nizhniy Novgorod oblast'. The variability of yield with a breakdown into categories of farming units for the last 10 years was assessed with respect to the main grain crops, including wheat, rye, and parsley. The sustainability degree was evaluated by four statistical variation indexes, including variation range, average absolute deviation, average square deviation, and quartile deviation. The computations were performed in Microsoft Excel.

#### Results

Each particular region has its unique characteristics; that is why, the sustainable development of an entire country can be ensured only by the sustainable development of its regions. The role of regions as economic subjects is steadily growing because all the problems impeding the country's transition to sustainable development clearly show exactly in the regions [16, pp. 34; 17].

To evaluate the sustainability of grain production, one has to take into account specific climatic and natural features of particular territories. For example, the Black Earth Belt cannot be compared with the other Russian territories because chernozem soils are much richer in humus than other types of soils.

Nonetheless, significant variations in yield have a serious impact on the development of regional grain markets and break the proportionate structure of grain production and consumption. The sustainable development of grain economy mirrors the impact of all the factors.

As noted by A. I. Altukhov, the functioning sustainability of the grain production subcomplex as a system is determined by the resistance of its different parts to directed internal and external influences and, ultimately,

largely depends on the resistance of the weakest link [18, p. 2].

The Nizhniy Novgorod oblast' as one of Russia's non-Black Earth regions is no exception. Its large extension from North to South conditions uneven and highly variable croppages.

There are three categories of farming units in agricultural production: agricultural organizations, population farming households, and peasant households (farming enterprises) and sole entrepreneurships [19, pp. 4-15].

The trends in the yield profile series were evaluated by analytical alignment.

The trends in the particular categories of farming units in the Nizhniy Novgorod oblast' defined by studying the yield profile for 1999-2017 are:

1. Agricultural organizations ( $y = 0.359t + 15.4$ )  
In the last 20 years the yield of grain and leguminous crops in the agricultural organizations increased by 0.359 hwt/ha on average.

2. Peasant households (farming enterprises) and sole entrepreneurships ( $y = 0.399t + 13.79$ ):  
In the last 20 years the yield of grain and leguminous crops in the peasant households (farming enterprises) and sole entrepreneurships increased by 0.399 hwt/ha on average.

3. Population farming households ( $y = -0.137t + 21.69$ ):

In the last 20 years the yield of grain and leguminous crops in the peasant households (farming enterprises) and sole entrepreneurships decreased by 0.137 hwt/ha on average.

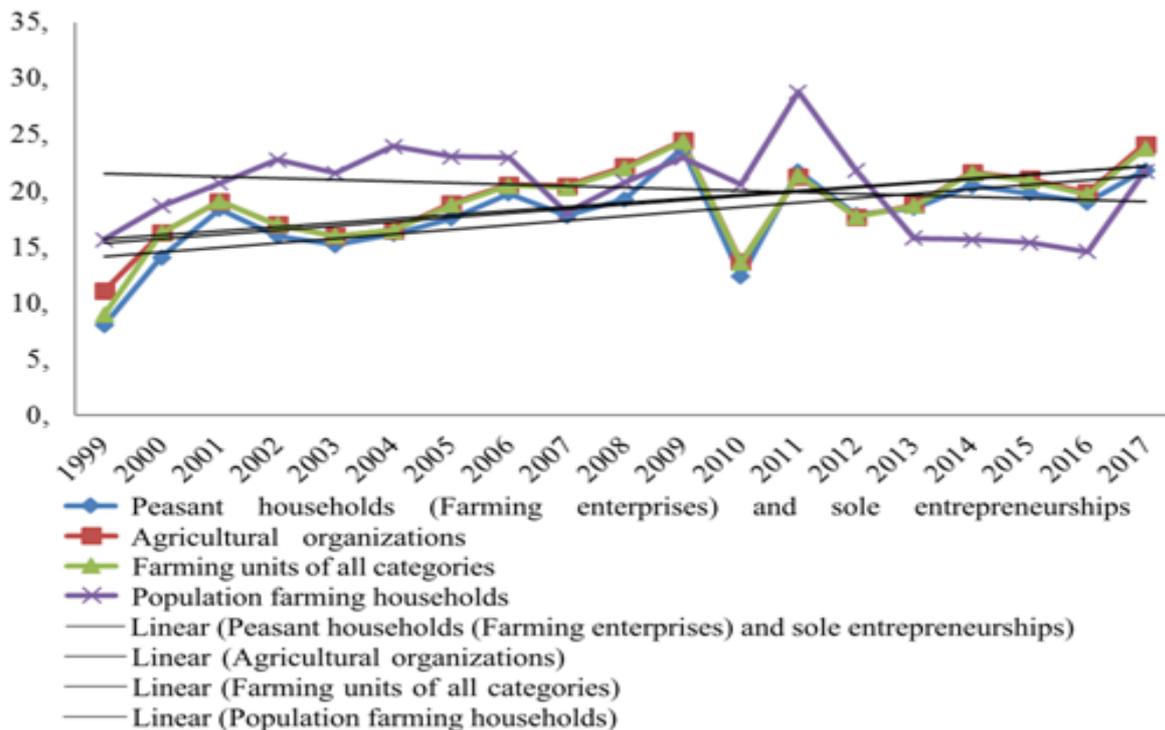
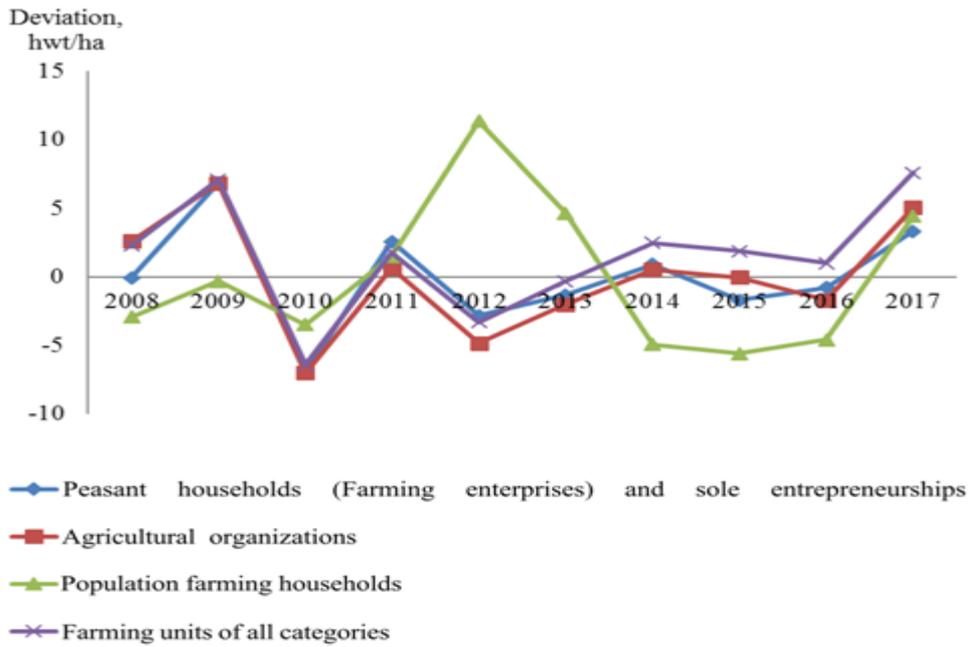


Fig. 1. Dynamics of the yield of grain and leguminous crops in the Nizhniy Novgorod oblast' in 1999-2017

Agricultural organizations are the main productive power of the Nizhniy Novgorod oblast'; that is why, the yield trend curve shows a proximal tendency for all the categories of farming units.

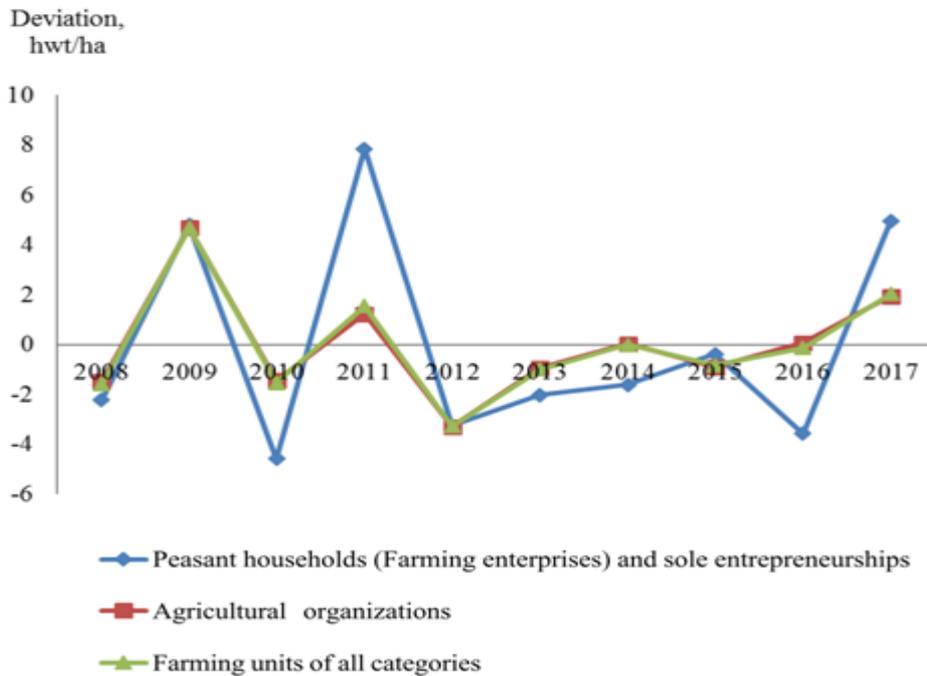
In some years the variability in the conditions for cultivating farming crops results in significant variations in the yield level. In years with unfavorable conditions a decreasing yield results in a significantly dropped supply in the market for plant raising foodstuffs [20].

The most painful issue for public production is the unsustainable production of such crops as wheat, rye, and parsley the demand for which is much higher than for other grain and leguminous crops.



**Fig. 2.** Dynamics of deviations in the wheat yield in the Nizhniy Novgorod oblast’ in 1999-2017

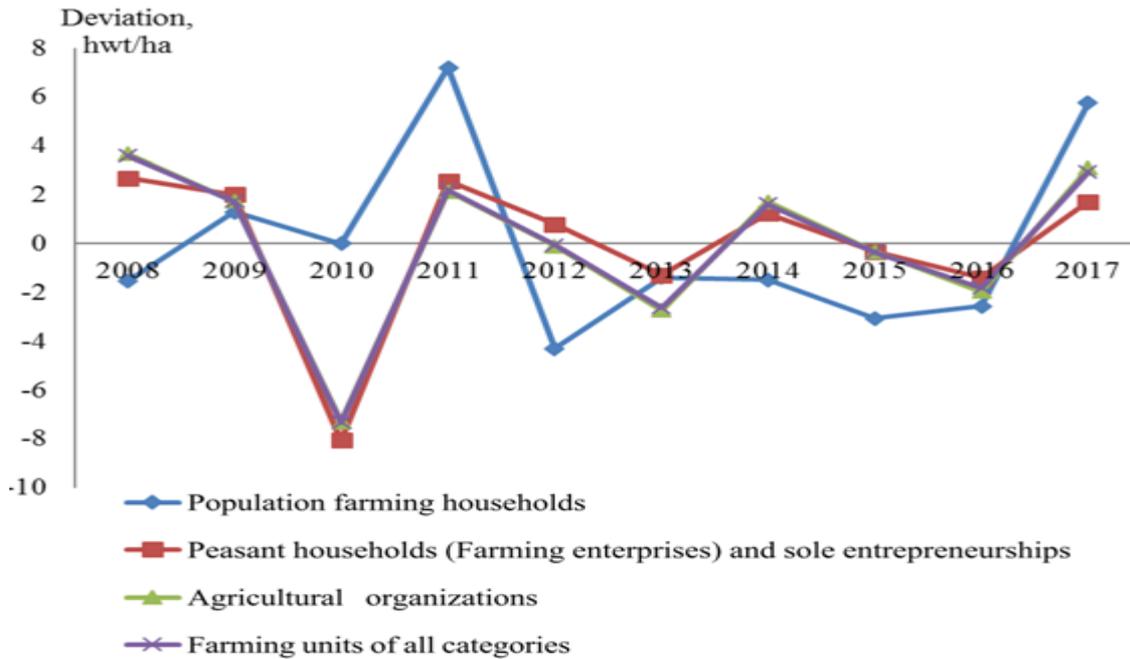
The wheat yield in all the categories of farming units rose from 2008 to 2017 by 0.313 hwt/ha on average, which is confirmed by the trend equation  $y = 0.313x + 19.2$ . The wheat yield tendency in the peasant households (farming enterprises) and sole entrepreneurships is more advanced than in all the categories of farming units taken together (Fig. 2).



**Fig. 3.** Dynamics of deviations in the rye yield in the Nizhniy Novgorod oblast’ in 1999-2017

The rye yield in all the categories of farming units dropped from 2008 to 2017 by 0.081 hwt/ha on average, which is confirmed by the trend equation  $y = -0.081x + 16.9$  (Fig. 3).

Note that, according to the deviation dynamics from Figs. 2 and 3, the certainty values did not exceed 10 % due to the abnormal weather in 2010 and 2012 when the Nizhniy Novgorod oblast’ suffered from a severe drought.



**Fig. 4.** Dynamics of deviations in the parsley yield in the Nizhniy Novgorod oblast’ in 1999-2017

The parsley yield in all the categories of farming units also tended to decrease in the considered decade. The average drop was 0.707 hwt/ha, which is confirmed by the trend equation  $y = -0.707x + 23.12$  (Fig. 4).

Each of the crops in question showed deviations in yield in the population farming households. The yield deviations in this category of farming units largely tended to exceed the average value. This tendency is explained by a high labor output of the population farming households.

To evaluate the volatility tendencies in the production of particular grain crops (wheat, rye), it is necessary to give a detailed interpretation. With this aim in mind, it is necessary to determine the time series variation in the given indexes.

**Discussion**

An important task in the study of sustainability is to identify the causes for the deviation of the actual values from the established current values.

According to certain economists, the scattering of features is inevitable in any statistical multitude. However, this scattering can result from various reasons: sometimes, it comes to possible internal variability; in other cases variability is also conditioned by chronic factors. The variation indexes together with the scattering center indexes provide an exhaustive characteristic of the position of strategic distribution [21, pp. 75-76; 22; 23].

The variability degree of the data in aggregate is evaluated by a number of statistical indexes such as variation range, average absolute deviation, average square deviation, and quartile deviation (Table 1).

The estimated distribution width of the wheat yield dynamics series in all the categories of farming units in the Nizhniy Novgorod oblast’ is 14.1 hwt/ha. The largest variation range is registered in the population farming households. The higher volatility of the wheat yield in the population farming units is confirmed by the attained average linear and square deviations of the wheat yield. The largest deviation from the average yield is  $\pm 2.056$  hwt/ha, and it is also observed in the population farming households, whereas the deviation in all the categories of population farming households falls within  $\pm 1.556$  hwt/ha.

**Table 1.** Variations in the yield of basic grain crops

Index	Variation range	Average absolute deviation	Average square deviation	Quartile deviation
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Wheat				
peasant households (farming enterprises) and sole entrepreneurships	13.7	1.827	2.283	1.522
agricultural organizations	14.6	1.947	2.433	1.622
population farming households	18.5	2.467	3.083	2.056
Farming units of all categories	14.1	1.867	2.333	1.556
Rye				
peasant households (farming enterprises) and sole entrepreneurships	12.4	1.653	2.067	1.378
agricultural organizations	8.2	1.093	1.367	0.911
Farming units of all categories	8.2	1.093	1.367	0.911
Parsley				
peasant households (farming enterprises) and sole entrepreneurships	10.8	1.44	1.8	1.2
agricultural organizations	11.7	1.56	1.95	1.3
population farming households	13.3	1.773	2.217	1.478
Farming units of all categories	11.6	1.547	1.933	1.289

The estimated variation range of the rye yield dynamics series in all the categories of the region's farming units is 8.2 hwt/ha. The variation values for the agricultural organizations exactly repeat the values for all the categories of farming units, which is due to the weak interest in cultivating the given grain crop among the other categories of farming units. The largest variation range is observed in the peasant households (farming enterprises) and sole entrepreneurships. The higher volatility of the rye yield in the peasant households (farming enterprises) and sole entrepreneurships is confirmed by the attained average linear and square deviations of the rye yield. The largest deviation from the average yield is  $\pm 2.067$  hwt/ha, and it is observed in the peasant households (farming enterprises) and sole entrepreneurships, whereas the deviation for all the categories of population farming households falls within  $\pm 0.911$  hwt/ha.

The estimated distribution width of the parsley yield dynamics series in all the categories of farming units in the Nizhniy Novgorod oblast' is 11.6 hwt/ha. The higher volatility of the parsley yield in the population farming households is confirmed by the attained average linear and square deviations of the parsley yield. The largest deviation from the average yield is  $\pm 1.478$  hwt/ha, and it is also observed in the population farming households, whereas the deviation for all the categories of population farming households falls within  $\pm 1.289$  hwt/ha.

## CONCLUSION

Sustainability makes it possible for arable farming to preserve itself as a socioeconomic system and must facilitate the transition of the grain production sector to the expanded reproduction of corn field and improve the supply of diverse in-house produced foodstuffs to the population [24, p. 56]. As noted in the Concept of Developing the Russian Grain Market in the Mid-term Perspective, grain production is the historical basis of the sustainable functioning of the national agrofood sector, serves as a system-forming branch for other branches of the national economy, determines the level of public food security, and is a specific indicator of the country's economic wellbeing [25, p. 4].

However, both, in the Nizhniy Novgorod oblast' and other regions of Russia, these goals are very hard to achieve because they are contingent on risky arable farming conditions. According to the results of the statistical analysis, the grain production in the population farming households is less sustainable. The grain production in the agricultural organizations is more sustainable however, their sustainability is more determinative for the sustainability of grain production in the Nizhniy Novgorod oblast'. That is why, these organizations must still remain the key production landmark.

The situation being what it is, to achieve the strategic goals contemplated in the Food Security Doctrine of the Russian Federation, the Concept of the Development of the Russian

Grain Market in the Medium Term, and Federal Law 4973-1 “On Grain”, the government of the Nizhniy Novgorod oblast’ needs to strengthen the measures of direct state aid to the agricultural organizations. In addition, a priority area for the Ministry of Agriculture must be to encourage the interest of other types of farming units (population farming units, peasant households (farming enterprises), and sole entrepreneurs) because the economic efficiency of producing grain and leguminous crops in these farming units currently tends to improve. The implementation of the proposed solutions to the problem will help develop a more sustainable grain production in the federal subjects, particularly in the Nizhniy Novgorod oblast’, which will be a major improvement in the national food security.

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