Analysis of natural agro potential for territorial organization of agriculture in the Samara region

E V Samokhvalova, V G Kutilkin and S N Zudilin

Samara State Agrarian University, 2, Uchebnaya Street, Kinel, Samara region, 446442, Russia

E-mail: kinel_evs@mail.ru

Abstract. The research is conducted in order to improve territorial organization of agriculture in context of the implementation of use strategy of adaptive-landscape land basing on the assessment and analysis of spatiotemporal structure of natural agro-potential of the territory. The results of dynamic statistical modeling of the standard crops yield in administrative regions of the Samara region are used. A mesoscale comprehensive assessment zoning of the territory is made: seven mesozones are allocated according to compliance of standard yields with crop productivity factors (correlation coefficients with many indicators 0.7-0.9), and assessed districts in them with the most uniform conditions (coefficient of variation within 10%). Assessed zoning is made in administrative contours of Samara region, and it forms geographic basis for solving agro-production issues of organizing adaptive-landscape land use system and crop rotations design. The basis of field crop rotations in innovative technologies in central and southern districts of Samara region are grain-fallow and grain-fallow-cultivated field crop rotations with the optimum specific weight of "black" fallow and winter crops in them. In forest-steppe area grain-fallow-grass-cultivated and grain-cultivated rotations with full and green-manured fallows, perennial grasses and leguminous crops are promising. For their implementation, an analysis of agricultural crops appropriate placement in assessed mesozones is carried out. Crops location according to soil and climate territory specification makes it possible to solve problems of preventing soil and agro-landscapes degradation most effectively, taking into account environmental effect of crops and agro-technologies.

1. Introduction

Agriculture is often called “production under the open sky”, since the bulk of products are created directly in natural conditions. Famous Russian scientist V V Dokuchaev pointed out that “Soil and climate are the main and most important factors of agriculture, the first and inevitable conditions of yields” [1].

Normal plant production activity and high yields are possible only with a constant influx of solar energy, heat, water, nutrients, carbon dioxide and oxygen. These factors determine living conditions and yield of agricultural crops, quality and cost of products. Therefore, a comprehensive account of the factors influence is necessary to ensure a flexible agrotechnic, appropriate to resources of the region and a specific farming enterprise [2, 3].

Predominant soils in the region are black soil. Their area is 2.833 million hectares, which is 97.5% of the total number of arable land. The soil cover is dominated by black soil: leached – 618000 ha or 21.80%, typical – 706000 ha (24.92%), ordinary – 542000 ha (19.13%), southern – 867000 ha or 30.60%. Its distribution over the territory is subject to the laws of zonality with a gradual decrease in
the level of fertility from northern to southern districts [4]. Distribution of climatic resources also has zonal features [5].

According to peculiarities of climate and soil, as well as specialization of production, the territory of the Samara Region is divided into three natural-economic zones: the northern, central and southern. Main agroclimatic indicators of the zones are given in table 1.

| Indicators                                           | Soil-economic zones       |
|------------------------------------------------------|---------------------------|
| Average temperature, °C                              | Northern  | Central  | Southern |
| Sum of active temperatures above 10 °C               | 2200-2400 | 2500-2600 | 2600-2800 |
| Annual precipitation, mm                            | 350-500   | 350-400  | 270-350  |
| Stock of productive moisture in 0-100 cm soil layer in the spring, mm | 150-200   | 125-150  | 100-120  |
| Number of days with dry wind                        | 39-45     | 49-64    | 68-89    |
| Hydro-temporal coefficient                          | 1.0-1.1   | 0.8-0.9  | 0.6-0.7  |
| Frost-free period duration, days                    | 132-145   | 144-152  | 148-154  |

Amount of heat and frost-free period duration quite ensure cultivation of most crops. Required amount of active temperatures for grain crops is 1250-1750, corn for grain – 2100-2900, peas – 1050-1500, soybeans – 2400-2600, sunflower for seed oil – 2400 °C. Although, of course, the degree of provision of a number of crops with heat varies by zones.

The main limiting factor in the Samara Region is aridity of climate, which increases from the northern zone to the southern one. An acute lack of moisture and too high temperatures during the crop germination period and during growing season are extremely undesirable [2, 6]. They cause a premature transition of nitrogenous substances and carbohydrates from stalks, leaves and spikelet scales into grain, which leads to coagulation of proteins, weakness and decrease in grain mass of cereals [7].

All this justifies specialization of zonal farming systems based on soil and climatic resources [8]. However, the experience of their development has shown the need for a deeper and more detailing differentiation of systems in relation to various agro-ecological conditions [9, 10]. Recently the need to adapt farming systems and agrotechnologies to different levels of production intensification, agroclimatic, landscape and other terrain conditions has become increasingly obvious [11]. Developed balanced adaptive-landscape farming systems [12, 13], systems of precision farming [14, 15], well taking into account peculiarities of natural resources of the territory and organically “fitting” into natural ecosystems.

The aim of our work is a comprehensive assessive mesozoning of the Samara Region for solving the issues of territorial organization of agriculture in framework of the adaptive-landscape land use strategy. The main tasks include assessment and geo-information analysis of the natural agro-potential of the territory, rationale identifying of assessive mesozones and development of the most complete use of appropriate resources.

2. Conditions and methods

Macroscale (interregional) zoning of climate, allocation of natural-agricultural zones are the subject of many works by S S Sapozhnikova, D I Shashko, P I Koloskov and others [16]. In particular, it has been established that the territory of the Samara Region is located within three natural zones – forest-steppe, steppe and dry-steppe. It is shown that their bioclimatic potential (BCP) causes the differentiation of agricultural production.

In [17] climate properties were used as a basis for mesoscale assessive zoning. As a result, seven
agroclimatic subzones were distinguished on the territory of the Samara region [18]. The data obtained, however, do not take into account soil fertility factors, that limits their use for practical purposes. To solve the problems of the adaptive-landscape farming organization a complex assessment of bioclimatic potential and soil is necessary.

As part of the natural-agricultural zoning of the territory, it is distinguished districts reflecting the landscape differentiation (soil-forming rocks, climate, relief, hydrography), and soil districts. The results obtained for the Samara Region (described, for example, in [4]) reflect the continuity of these factors spatial distribution, but also have some discrepancies, especially noticeable in the forest-steppe zone.

We have analyzed the natural agricultural potential using GIS-technologies based on dynamic-statistical imitation of normative (actually eventual) productivity of the main grain crops (winter and spring wheat and spring barley) [19]. Normative productivity is calculated in the nodes of a regular spatial grid with a 10 km pitch in many year-cases, which provides "flexibility" in reflecting spatiotemporal structure of factors and availability for plants.

Mesoscale complex zoning of the territory was carried out in two stages. First, the analysis was made by maximizing correlation of the normative productivity with a set of indicators of soil and climatic resources, and corresponding boundaries of the mesozons were determined. Considering significant dispersion of indicators in the assessive mesozones, at the second stage, some of them were divided into parts again according to the principle of similarity and difference in indicators of climatic and soil resources conformity.

3. Results

Geoinformational analysis of the results and their correspondence to soil and climatic characteristics distribution, to the landscape peculiarities revealed the expediency of separating seven natural agricultural mesozons in the Samara region (Figure 1). Four mesozones are allocated within the boundaries of the forest-steppe natural zone of the region, two – in the dry steppe zone, and the steppe zone is represented as a whole. Their position is quite consistent with the characteristics of the landscape. Spatial correlation coefficients of normative productivity average value in the mesozones with many soil and climatic indicators turned out to be higher than 0.7 (soil bulk density, humus content and soil productive moisture stock, sum of air temperatures above +10 and below –10 °С, precipitation of warm and cold periods).

Figure 1. Complex mesoscale natural-agricultural zoning of the Samara Region.

Administrative districts: 1 – Chelno-Vershinsky, 2 – Shentalinsky, 3 – Klyavlinsky, 4 – Koshkinsky, 5 – Sergievsky, 6 – Isaklinsky, 7 – Kamyshtinsky, 8 – Elkhovsky, 9 – Pokhvistnevsky, 10 – Syzransky, 11 – Shigonsky, 12 – Stavropolinsky, 13 – Krasno-Yarsky, 14 – Kinelsky-Cherkassky, 15 – Privolzhsky, 16 – Bezhenchucksky, 17 – Volzhsky, 18 – Kinelsky, 19 – Bogatovsky, 20 – Borsky, 21 – Khvorostiansky, 22 – Krasnoarmeyovsky, 23 – Neftegorsky, 24 – Pestravsky, 25 – Bolshe-Glushitsky, 26 – Alekseevsky, 27 – Bolshe-Chernigovsky.

Later it was found that in the steppe zone a complex of soil and climatic conditions provides the greatest spatial variability of the normative productivity, where each factor enhances the effect of the
other. As a result, in terms of the degree of manifestation of this condition, the fifth mesozone is presented in four parts. Their borders correspond approximately to position of the ancient valley of the Volga River (5a), the interfluve of the Samara and Bolshoi Kinel rivers (5c), the districts of the Trans-Volga region with flat terrain in the central part of the Samara Region (5b) and with undulating ridges on the spurs of the Obshchiy Syrt in the south eastern part of the area (5d).

In the forest-steppe zone, conditions are generally more favorable, the differentiation was carried out on the basis of the ratio of the conformity coefficients of climate and soil resources. In accordance with this, conditions of the first mesozone (corresponding to the slopes of the Bugulmino-Belebeevskaya Upland) are divided into two parts — the northeastern part with the greatest heights and deep irregularity of the relief (1a), and the southern part with lower elevations and relatively flat relief (1b).

As a result, the forest-steppe zone is represented by five mesozones: 1a (Chelno-Vershinsky, Koshkinsky and Elkhovsky districts), 1b (Sergievsky, Isaklinsky, Pokhvistnevsky and Kinel-Cherkassky districts), 2 (Shentalinsky, Klyavlinsky and Kamyslinsky), 3 (Stavropolsky and Krasnoyarsky), 4 (Syzransky and Shigonsky districts). Four mesozones were distinguished in the steppe zone: 5a (Privolzhsky, Bezenchuksky and Khvorostyansky districts), 5b (Volzhsky and Krasnoarmeysky), 5c (Kinelsky, Bogatovsky and Borsky), 5d (Neftegorsky and Alekseevsky districts). There are two mesozones in the dry steppe zone: 6 (Bolsheglushitsky and Pestravsky districts) and 7 (Bolshchechernigovskiy district). Their characteristics are shown in Table 2.

Table 2. Generalized characteristics of assessive mesozones of the Samara Region

| Nature zone | Mesozone | Normative crop productivity, c/ha | Soil humus content, % | Soil productive moisture stock (August), mm | Sum of the temperatures, С | Rainfall for April–October, mm |
|-------------|----------|----------------------------------|----------------------|--------------------------------------------|--------------------------|--------------------------------|
|             |          |                                  |                      |                                            | Below +10 °C, Under –10 °C |                                 |
| Forest-steppe | 1a       | 23.1                              | 5.6                  | 125                                        | 2133                     | 1183                           | 350 |
|              | 1b       | 26.2                              | 5.5                  | 100                                        | 2300                     | 1130                           | 312 |
|              | 2        | 24.7                              | 6.0                  | 108                                        | 2167                     | 1200                           | 317 |
|              | 3        | 21.6                              | 4.7                  | 100                                        | 2350                     | 1010                           | 325 |
|              | 4        | 19.3                              | 3.7                  | 75                                         | 2400                     | 1001                           | 300 |
|              | 5a       | 17.0                              | 4.0                  | 75                                         | 2500                     | 1059                           | 300 |
|              | 5b       | 20.9                              | 5.0                  | 88                                         | 2450                     | 1126                           | 325 |
|              | 5c       | 19.6                              | 3.7                  | 100                                        | 2400                     | 1148                           | 317 |
|              | 5d       | 17.7                              | 3.8                  | 75                                         | 2500                     | 1193                           | 350 |
| Dry steppe  | 6        | 16.0                              | 3.6                  | 50                                         | 2500                     | 1137                           | 275 |
|              | 7        | 11.3                              | 2.8                  | 50                                         | 2600                     | 1125                           | 250 |

4. Discussion
The largest actual eventual productivity estimated on moisture supply was in the forest-steppe zone. Productivity of winter wheat in the forest-steppe was 31.8 c/ha, in the steppe – 26.5, in the dry steppe – 23.1 c/ha; winter rye – 30.4; 26.4 and 23.2; spring wheat – 24.4; 21.0 and 17.5; barley – 27.5; 24.0 and 20.2; corn for grain – 54.5; 48.8 and 42.0; millet – 25.6; 25.2 and 18.6; buckwheat – 17.0; 14.9 and 12.4; peas – 23.4; 20.5 and 17.2; sunflower – 21.1; 19.0 and 14.8; soybean – 18.6; 16.2 and 13.2 c/ha respectively.

However, the actual level of crop yields, in addition to agricultural techniques, precipitation is affected by temperature and soil fertility. Therefore, productive soil moisture and precipitation during crop growing season are used in different zones and mesozones of the region in different ways. This is evidenced by the data in table 3 (according to data of Rosstat http://www.gks.ru). So, for example, the
average yield of millet turned out to be the highest in the steppe and dry steppe zones, but estimated productivity on moisture - in the forest-steppe zone.

Table 3. Average yield (c/ha) of grain crops and sunflower (2012-2018)

| Natural zone, mesozone, district | Winter wheat | Winter rye | Spring wheat | Oat | Con for grain | Millet | Buckwheat | Peas | Sunflower | Soybean |
|----------------------------------|--------------|------------|--------------|-----|--------------|--------|------------|------|-----------|---------|
| 1a                               | 25.0         | 20.4       | 16.9         | 16.9| 16.3         | 34.6   | 10.5       | 8.6  | 18.2      | 17.4    | 6.5     |
| 1b                               | 21.6         | 20.7       | 15.5         | 16.6| 15.7         | 34.4   | 9.7        | 9.4  | 14.3      | 13.8    | 7.2     |
| 2                                | 20.8         | 19.8       | 17.1         | 15.7| 15.8         | 26.0   | 11.2       | 8.5  | 13.5      | 11.2    | 3.0     |
| 3                                | 23.0         | 18.0       | 18.0         | 18.6| 16.7         | 43.0   | 13.3       | 9.2  | 17.0      | 14.6    | 10.6    |
| 4                                | 23.0         | 13.9       | 16.8         | 15.9| 15.6         | 32.8   | 8.0        | 10.8 | 15.1      | 13.0    | 9.3     |
| **Average**                      | **22.7**     | **18.6**   | **16.9**     | **16.7|** **16.0**    | **34.2**| **10.5**   | **9.3**| **15.6**   | **14.0**| **7.3** |
| 5a                               | 25.0         | 21.8       | 14.3         | 15.5| 15.9         | 33.7   | 10.4       | 6.3  | 14.5      | 13.6    | 12.6    |
| 5b                               | 24.6         | 16.7       | 14.2         | 13.4| 14.2         | 37.0   | 10.7       | 9.0  | 12.0      | 14.9    | 8.3     |
| 5c                               | 22.6         | 18.4       | 14.9         | 12.6| 10.7         | 27.5   | 11.8       | 7.6  | 14.0      | -       | -       |
| 5d                               | 21.2         | 18.0       | 14.9         | 12.6| 10.7         | 27.5   | 11.8       | 7.6  | 14.0      | -       | -       |
| **Average**                      | **23.4**     | **18.7**   | **14.9**     | **14.0|** **13.8**    | **32.6**| **11.2**   | **7.8**| **13.8**   | **13.0**| **9.9** |
| 6                                | 22.7         | 20.7       | 14.0         | 13.0| 13.3         | 31.0   | 12.8       | 8.3  | 11.9      | 13.2    | 8.6     |
| 7                                | 21.5         | 18.1       | 11.3         | 11.3| 11.4         | 28.6   | 13.0       | -    | -         | 12.1    | -       |
| **Average**                      | **22.1**     | **19.4**   | **12.6**     | **12.2|** **12.4**    | **29.8**| **12.9**   | **8.3**| **11.9**   | **12.6**| **8.6** |

Analysis of table 3 shows that the yield of winter crops is less dependent on natural zones. At the same time, there are noticeable differences in yields by mesozones. Thus, the highest yield of winter wheat (27-28 c/ha) was recorded in Koshkinsky, Stavropolsky, Bezenchuksky and Chelno-Vershinsky districts. For winter rye the maximum yields (20-25 c/ha) were obtained in Koshkinsky, Bezenchuksky, Privolzhsky and Bogatovsky districts. The lowest grain yield of winter crops (wheat 17.4, winter rye – 14.3 c/ha) was recorded in Isakinsky district.

The yield of spring crops significantly differed not only by mesozones, but also by zones. Average in forest-steppe zone yield of spring wheat was 16.9 c/ha, which is 2.0 and 4.3 c/ha higher than in the steppe and dry steppe zones, respectively. Approximately the same pattern was observed at spring barley and oats. The increase of barley yield from its location in the forest-steppe zone compared to the steppe conditions was 2.7-4.5, and oats – 2.2-3.6 c/ha. The maximum yield of spring wheat (17-21 c/ha) was obtained in Stavropolsky, Koshkinsky, Kinelsky, Elkhovskiy, Kamyszinskoy districts; spring barley (17-22 c/ha) – in Stavropolsky, Koshkinsky, Pokhivistynskiy, Klyavlinsky, Bezenchuksky districts; oats (17-21 c/ha) – in Koshkinsky, Stavropolsky, Privolzhsky, Pohivistynskoy districts. The lowest yields of early spring cereal crops were observed in the more southern districts of the region. The minimum yields of barley and oats are noted in the Bolshe-Chernigovsky district: 11.3 and 11.4 c/ha, respectively.

The yield of corn for grain also changed markedly in zones and mesozones of the region. The maximum crop yield (42-55 c/ha) was obtained in Privolzhsky, Stavropolsky, Volzhsky –, Bogatovsky districts. The worst indicators for corn yield (20-27 c/ha) were obtained in Khvorostyanovsky, Klyavlinsky, Bezenchuksky, Alekseevskiy, Borsky, Shentalinsky districts.

The maximum yield of millet grain (13-19 c/ha) was observed in Krasnoyarsky, Bogatovsky, Bezenchuksky, Kinel-Cherkassky, Bolshe-Chernigovsky districts, i.e. in areas where the air temperature is much higher. And in the northern districts, yield of this crop was declining, and in some areas this crop was practically not cultivated. In Isakinsky district the crop yield was 5.7 c/ha (mesozone 1b).
The yield of buckwheat in the region is low and it was the highest (10-13 c/ha) in Shigonsky, Krasnoyarsky and Bogatovsky districts. The crop yields below 8.0 c/ha were observed mainly in the southern most arid areas of the region.

The highest yield of moisture-loving pea crop (16-20 c/ha) was found in Koshkinsky, Stavropol, Elkhovsky, Syzransky, Privolzhsky, Chelno-Vershinsky districts, and the lowest – mainly in the southern arid districts (Khvorostyansky – 11.4, Bolshe-Glushitsky – 12.5 c/ha) –

The highest yield of sunflower (15-20 c/ha) is observed in the central part of the region – in Koshkinsky, Stavropol, Chelno-Vershinsky, Sergiyevsky and Bezenchuksky districts.

In terms of soybean yield, the following areas should be noted: Privolzhsky – 20.7 c/ha (part of the sown area is irrigated), Stavropol – 14.2, Kinel-Cherkassy – 10.4 c/ha. In the southern and northern districts of the region, the culture is cultivated restrictedly.

The crop yield data in the districts are differentiated by territory and generally reflect the patterns of distribution of the natural-agricultural zones’ and their assessive mesozones’ resources. But differentiation of crop yields is expressed in varying degrees, which is associated with their biological characteristics. Also the clarity of the picture reduced by impact on the production yields of socio-economic factors (capital supply, level of agrotechnic and others). All this suggests that the development and implementation of adaptive-landscape farming systems must be differently and comprehensively take into account the soil and climatic conditions of each district, mesozone and agricultural enterprise [20].

5. Practical significance

Efficient use of basic production means, the preservation of soil fertility and nature as a whole is possible only with development and implementation of farming systems corresponding to the soil-climatic and economic conditions of farms.

Farming systems are a program, a tool for competent field cultivation, which allows more efficient production, rational use of land, equipment, science and advanced experience. There were great changes in the land use organization: part of farm lands was withdrawn, another part was abandoned for various reasons. As a result, land management and crop rotations are broken, and even practically absent in most farms now. Therefore, it is necessary to determine and remove all inconvenient (washed, stony, rubble, sandy and steep) and unused lands, if possible, to sow with meadow grass there. On the remaining arable land, within the boundaries of the old land management and taking into account new structure of sown areas, new correct crop rotations need to be developed and mastered, which will be the main means of improving the agriculture and all other agronomic measures. Feedback from the right crop rotation is the largest and almost not expensive.

In crop farming systems, crop rotations must tackle the tasks of not only producing the maximum amount of necessary marketable products, but also ensuring sustainable reproduction of soil fertility with significant savings in material and labor costs. In connection with this, the important components of such crop rotations should be the sowing of perennial grasses, repetitive and stubble crops, mixed and joint sowing. Under sufficient moisture conditions during the growing season, clean fallows should be replaced with full ones, which allow increasing the collection of products from 1 ha of arable land, or green manured fallows ensuring reproduction of soil fertility with low level of anthropogenic energy application. Only the correct placement of crops in crop rotations give the following average yield increases: winter wheat – 0.97; spring wheat – 0.71; corn – 3.2; sugar beet – 10.0; sunflower – 0.8 t/ha. Therefore, urgent and primary attention should be given to crop rotation, its development as the basis for the stabilization of arable land productivity [21].

In the steppes and dry steppes of the Middle Volga Region, the warrantor of the successful development of modern technologies for field crops cultivation is the field grain-fallow and grain-fallow-cultivated crop rotations with the optimum specific weight of "black" fallow. Such crop rotations ensure sustainable grain production, and are capable to maintain the high effective soil fertility with minimal expenditures on soil preparation, fertilizer and plant protection products on both winter crops and subsequent crop rotation.
According to data of Samara Research Institute of Agriculture, crop rotations with the optimum specific weight of "black" fallow and winter crops for different natural zones ensure the greatest yield of grain from a hectare of arable land. In average, over the years of research, the yield of grain from a hectare of arable land in grain-fallow-cultivated rotation with 22% of "black" fallow was 1.74 ton, in grain-cultivated – 1.52 and in grain-fallow-grass-cultivated – 1.35 ton/ha [21]. The basis of field crop rotations in innovative technologies in central and southern districts of the Samara Region are grain-fallow and grain-fallow-cultivated field crop rotations with the optimum specific weight of "black" fallow and winter crops. In forest-steppe area grain-fallow-grass-cultivated and grain-cultivated rotations with full and green-manured fallows, perennial grasses and leguminous crops are promising.

Studies show, that implementation of these crop rotations in the assessive mesozones of the region in dry and heat-provided areas (primarily 5d, 6 and 7, Fig. 1) is better for short-day drought-resistant (with deeply developed root system or sparingly consuming moisture) crops – sorghum, millet, corn, chickpea, rank, alfalfa, sunflower, etc., and in moisture-supplied areas (mainly 1-4, Fig. 1) – potatoes, rape, buckwheat, vetch. Light sandy fertilized soil (found mostly in areas 3, 4, 5c) can be used for the cultivation of winter rye, oats, potatoes, melons or pumpkins, sandy-colored sainfoin and yellow alfalfa. Medium loamy soils are more suitable for oats, millet, sorghum, buckwheat, barley, sunflower, soybeans, peas, potatoes. Heavy loam and clay structural soils are preferred for winter and spring wheat, barley, maize, winter rye, sunflower, wicked chickpea, yellow and white clover, alfalfa blue.

When selecting crops, it is also necessary to take into account soil erosion and salinity. So, on strongly washed soils (characteristic in district 1a) it is better to grow unfussy crops (oats, buckwheat, winter rye, yellow alfalfa, sandy sainfoin, yellow and white clover, etc.), and on saline soils (mainly in areas 5d, 6, 7) – yellow alfalfa, clover, chickpea, barley, canola, mustard and others.

Consequently, farmers need to know the peculiarities of natural conditions and the requirements of crops to them, which will make the best use of favorable conditions and weaken or eliminate the influence of unfavorable environmental factors.

6. Conclusion

Thus, the results of territory zoning differ from previous proposals because reflect features of mesoscale spatial distribution of soil cover and climatic factors in complex, taking into account supplying of the plant needs in environmental factors during the growing season. The use of physically substantiated methods of plant productive process modeling in the work, ensuring the “flexibility” of the reflection of the factors spatiotemporal distribution, as well as good agreement of the results with actual conditions confirm their reliability. This justifies the use of territory mesozoning as a necessary geographical basis for solving agro-industrial issues on formation of adaptive-landscape land use system.

An adaptive-landscape approach to land use management relies on use or creation of a set of conditions for the cultures that mostly satisfy biological needs by optimizing technologies and rational organization of territories. At the same time, development of crop rotations, ameliorative and anti-erosion measures, determination of sown areas structure, formation of technology for crops cultivation are carried out for types of agrolandscape.

Mesozonizing of the territory, performed in this work, reflecting the soil-climatic conditions of productivity formation is a geographical basis for solving these issues for land use design, production planning and land assessment.

It is important to justify the rational structure of crops and subsequent design of the crop rotation system in adaptive-landscape farming systems, make an objective determination of the normative crop productivity. Adaptive-landscape approach to the formation of crop rotations allows you to find the ecological niche of a particular culture, to select groups of crops that are close with their agro-ecological requirements to a certain category of land. Crops location according to soil and climate territory specification makes it possible the most effective solving problems of preventing soil and agrolandscapes degradation, taking into account environmental effect of crops and agrotechnologies.
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