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## «ФАРАБИ ӘЛЕМІ»

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## RATIONALE OF LANDSCAPE MAPPING FOR PLANNING THE ADAPTIVE-LANDSCAPE AGRICULTURE SYSTEMS

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Improving the efficiency of agricultural production, the competitiveness of its products on the world and domestic markets remains a critical task. In this regard, in recent years, as a result of measures taken by the Government, there has been a steady tendency to stabilize the agricultural sector of the economy, and the agri-food program has set the task of transferring the republic's agricultural production to sustainable economic development in a market economy [1]. This process is associated with the formation of a new agrotechnological policy based on the development and development of economically and environmentally sound farming systems of a new generation. It is agrotechnologies, as integrated systems of crop cultivation, that should become the foundation of modern agriculture and crop production instead of the traditionally recommended sets of separate, sometimes not interconnected methods and measures (crop rotation, tillage, the use of fertilizers and protective equipment) [2,3].

The concept of "farming system" has a complex and controversial history. The following is used as an official definition: "Agriculture systems are a set of interrelated agrotechnical, reclamation and organizational measures aimed at the efficient use of land and other resources, preservation and improvement of soil fertility, and obtaining high and sustainable crop yields" [4]. It is too general and completely non-environmental. Given these shortcomings, the foreign scientific consultant of this project, Professor V.I. Kiryushin developed a methodology that allows you to build models of farming systems, weighted not only in the physical space, but also socio-economic, taking into account a certain set of authors [5, 6].

- public (market) needs (product market, livestock needs, product processing requirements);
- agroecological requirements of crops and their environment forming influence;
- production and resource potential, levels of intensification;
- household structures, social infrastructure;
- product quality and habitat, environmental restrictions.

Based on this approach, the definition of the farming system is formulated: the adaptive-landscape farming system (ALFS) is a land use system of a certain agroecological group, focused on the production of products of economically and environmentally determined quantity and quality in accordance with (market) needs, natural and productive resources, providing stability of the agrolandscape and reproduction of soil fertility.

The soil composition of natural landscapes that are part of agricultural systems is one of the first to undergo changes. The geological composition, the surface of the earth, groundwater and groundwater, which are characteristic of every landscape of the land cover, are also subject to change. Thus, the natural data and the wealth of the landscape, on the one hand, on the other hand, agricultural production interacting with each other, make up a single agrolandscape system.

A similar, newly formed agrolandscape ecological center (core) is an agrocenosis or an inoculum cultivated grain. The natural structure of such an ecological complex has undergone an irreversible change. Because:

- natural phytocenoses that develop and take root over the centuries disappear, and instead crops grown by hand, other types of vegetation grow;
- formed harmful fauna and weeds suitable for new agrocenoses in cultivated lands;
- erosion and deflation due to a change in the mechanical composition of the exiled layers of land, their stability will weaken;
- as a result of the continuous use of fertilizers, herbicides, pesticides, the quantitative indicators of microorganisms and mesofauna drop sharply (sometimes disappear), the qualitative composition suddenly changes;
- fluid natural biogeochemical processes change, the direction is destroyed;
- tribal structures in natural landscapes are deteriorating like morphological units in the agricultural complex;
- due to the above-mentioned phenomena, various degradations of landscape territories occur (drought, erosion, deflation, etc.), and space also develops rapidly.

Today, the agricultural science of Kazakhstan has specific recommendations and suggestions, the development of which in production can be a means of increasing the agricultural sector of the economy.

Among them are new varieties and hybrids, modern technologies for the production of crop products, machine complexes, and zonal farming systems.

At the same time, it should be noted that the republic's agro-technological policy lags behind highly developed countries. Given the huge natural resource potential in the country's agro-industrial complex, having fertile lands and occupying the sixth place in the world in terms of humus reserves, the yield of the main food crop – wheat is more than 3 times lower than the European average half as much as the world average [7,8]. The reason for this is the insufficiently high science intensity of agricultural technologies, the low level of application of agrochemicals, the huge flows of fertilizers abroad, the lack of an effective system for introducing modern achievements of agricultural science, and their lack of demand. In this regard, in developed countries, already in the 90s of the last century, differentiation of farming systems began in relation to various agroecological conditions. At the same time, the obvious necessity of adapting farming systems and agrotechnologies to different levels of intensification of production, economic structures, and further to the market of agricultural products was realized [9]. This coincides with the UN decision in Rio de Janeiro in 1992 related to a new global environmental management paradigm that is consistent with the Dokuchaev's idea of land use, taking into account the type of terrain and its in-depth identification on a landscape basis [10].

Thus, agrolandscape farming should become the basis of the essence of the state agrotechnological policy of Kazakhstan. By the way, such a political strategy exists in every sovereign state, and for our republic, the adaptive-landscape system of agriculture is important, associated with diverse and very different agronomic territories. With the transition to adaptive landscape farming system (ALFS), our State can radically change its agricultural policy in the new social conditions.

Developing new approaches to the design of ALFS, it is undoubtedly impossible to ignore previously developed and used projects of zonal farming systems. Some of them, with appropriate additions and clarifications, can be effectively used in parallel with the new, while others require significant adjustments. In this regard, the available soil maps and regionalization maps of the land fund of Kazakhstan can serve as the basis for the formation of a land valuation project and the creation of an agrolandscape farming system [11].

The adaptation of agriculture to local conditions has evolved over the centuries and is a historical process. In many countries of the world in one or another modification, it has survived to this day. At the same time, a very common type of elementary landscapes is the choice of land by relief, expositions and other indicators. His scientific understanding was reflected in the works of V.V. Dokuchaev, who, based on the analysis of the contradictions of intensification of agriculture, substantiated the landscape approach to land use [12].

The development of adaptive landscape highly productive agriculture includes improving the structure of cultivated areas, studying the adaptability of crops and placing them taking into account the natural and economic conditions of the economy based on agroecological zoning of arable land [13].

The basis of the landscape approach is the creation of ecologically balanced sustainable agrolandscapes that ensure environmentally friendly farming.

Methodologies have been proposed for the formation of adaptive landscape farming systems that correspond to six leading factors: social needs, agroecological requirements, production intensification conditions, environmental conditions, household structures, and environmental requirements [14, 15].

At the same time, the development of models and projects of adaptive landscape farming systems should be timed to specific regions. It is in this direction that we see the prospect of the formation of a new generation of agricultural systems in the republic. Ideally, this should be systems dedicated to certain categories of agrolandscapes, optimized in accordance with the factors listed above.

To build models for such systems, extensive scientific material is needed, through which system connections should be established.

After gaining sovereignty in our Republic, the socio-economic situation has sharply changed and the aggravated environmental contradictions necessitate the further adaptation of agriculture not only to natural conditions, but also to new production relations. Therefore, the hitherto developed methods of developing and designing agricultural systems no longer meet the requirements of the time, soil-cartographic materials do not adequately reflect the geological-geomorphological, lithological, microclimatic features of the territory and the structural diversity of the soil cover with respect to which the agricultural system should be improved.

For the development and development of adaptivistically-landscape farming systems, an agroecological assessment of land is envisaged, which differs significantly from the traditional system by a new approach to the agroecological typology of land, due to the requirements of adaptive-landscape farming systems (ALFS). Since the initial ALFS requirement is determined by the most important systematizing principle – the agroecological needs of plants and their environment-forming influence, the typology is based on the agroecological type of land, i.e. territory homogeneous in terms of cultivation or crops close to environmental requirements. This is the basic and most important requirement. The next requirement is an environmental

address that is created for a specific agroecological group of lands: flat, erosive, overdried, etc. And finally, the requirement for a system of agriculture as landscape means that the agroecological group of lands is an agrolandscape in its structural and functional hierarchy with its inherent features of energy and mass transfer [14].

To develop adaptive-landscape farming systems and agricultural technologies for crop cultivation, it is necessary to create soil-agrolandscape maps based on agro-industrial soil groups. In this case, the map should have a clear agroecological orientation, and as an initial structural unit have an elementary area of agrolandscape.

For conducting soil-landscape mapping and compiling soil-agrolandscape maps, the use of modern GIS technologies is of great importance.

The term “adaptive” means the adaptation of the agricultural system to the whole range of designated conditions, and “agrolandscape” means that it is being developed in relation to a specific category of agrolandscape, transformed through the prism of agroecological assessment into an agroecological group [5]. At the same time, the links of farming systems are formed, incorporating the following elements:

- agroecological types of land (i.e. plots homogeneous in terms of cultivating a crop or group of crops with similar agroecological requirements);
- elements of technology (methods of cultivation, sowing, etc.) differentiated in accordance with the elementary range of the agrolandscape (i.e., elements of mesorelief limited to elementary soil structures);
- organization of the territory, taking into account the structure of the landscape and the conditions of its functioning [6].

The development of the scientific foundations of a new generation of agricultural technologies based on adaptive landscape farming is based on the theory of plant production process management, development of the genetic fund of agricultural crops, optimization of agricultural landscapes, plant nutrition theory, optimization of the phytosanitary state of agroecosystems.

The development of agricultural technologies is based on:

- justification of state agrotechnological policy and state order for scientific support;
- agroecological assessment of crops, the creation of plants with specified parameters of productivity, quality and sustainability;
- development of models of the production process, assessment of systemic relationships between elements of agriculture, natural and productive resources;
- the creation of models of agrolandscape farming and agro-technology packages for various environmental conditions, levels of intensification and specialization of farms;
- the formation of automated geographic information systems of various levels and the development of land assessment methodology, the design of adaptive-landscape systems of agriculture and agricultural technologies;
- development of agricultural requirements for machines and tools [15].

The developed agricultural technology requires a production testing system in various zones, regions of the adaptive landscape farming system, as well as its registration and certification.

The system of mastering agricultural technologies is based on the creation of: technological centers for the development of agricultural technologies at regional research institutes, universities of agricultural profile, demonstration polygons of technologies of various levels of intensification, close to production conditions; network of advisory points.

The material and technical security of agricultural technologies includes the creation of conditions for maximum economic and social hindering technological transformations and technical policies in the agricultural sector.

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