

ANNOTATION

Dissertation for the degree of Doctor of Philosophy (PhD) in
the specialty 6D060800 – «Ecology»

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Landscape and ecological planning of the Kyzylorda natural and agricultural system for the purposes of balanced land use

The dissertation work is aimed at solving the problems of balanced agricultural nature management in the Kyzylorda natural-agricultural system (NAS) based on landscape-ecological planning as a tool for solving environmental problems of agricultural land use.

The object of the research is the desert Kyzylorda natural-agricultural system of the Republic of Kazakhstan.

The subject of the research is modern natural-territorial complexes (landscapes at the level of species and tracts).

The purpose of the research is to carry out landscape - ecological planning of the desert Kyzylorda natural and agricultural system of the Republic of Kazakhstan for the purposes of balanced land use and increasing the level of population viability.

To achieve this goal, the following tasks were defined:

– to analyze the theoretical and methodological foundations of landscape-ecological planning of natural-agricultural systems and determine their significance in agricultural nature management;

– to study the domestic and foreign experience of landscape planning and adapt it for landscape - ecological planning of the natural - agricultural system;

– to identify the leading factors of landscape differentiation and to assess the structure of land use of the natural-agricultural system;

– to assess the anthropogenic disturbance and the landscape-ecological state of the natural - agricultural system;

– to develop functional zoning of areas of irrigated agriculture and pasture animal husbandry of the natural-agricultural system;

– to develop science-based requirements for landscape - ecological planning and propose the main areas of activity for the rational use of landscapes for agricultural development.

Research methodology. The theoretical and methodological platform of the research is the synthesis of systemic, natural history, landscape-ecological and GIS-technological approaches, including a set of leading principles and methods of landscape science, geocology, zoning, land management, etc. This research is an interdisciplinary direction. All stages of the study were based on regional and local characteristics of landscapes and their morphological parts. The cartographic method was the leading method of the study. Remote sensing data and GIS technology were used. One of the main forms of studying landscapes used for agricultural development were: field studies, including research methods in key areas using standardized forms; methods of field mapping and landscape profiling. To assess the landscape-ecological state of natural-agricultural systems, the following methods were applied: statistical; landscape-indicative and comparative-geographical; assessment of agricultural development, ecological state and anthropogenic disturbance of landscapes according to integrated and particular parameters; laboratory analyzes (soil, air, water); mathematical modeling and processing of geographical and statistical data, etc.

The sources of research materials were - archival, cartographic and literary materials; statistical materials - the Committee for Land Management of the Ministry of Agriculture of the Republic of Kazakhstan, the Agency of the Republic of Kazakhstan on Statistics, etc.; cartographic material (geological map of Kazakhstan, scale 1:500,000 (author: V.F. Bespalov, N.N. Kostenko); geomorphological map of Kazakhstan, scale 1:1,500,000 (author: A.V. Visloguzova, A.R. Medeu and others); soil map of the territory of the Kyzylorda region of the Republic of Kazakhstan, scale

1:300,000, vegetation map of Kazakhstan and Central Asia, scale 1:2,500,000 (author: N.I. Akzhigitova, S.A. Arystangaliyev and others); topographic base, scale 1: 500,000, 1: 200,000; landscape map of Kazakhstan, scale 1: 2,500,000 (author: L.K. Veselova, G.V. Geldyeva and others); stock Materials of JSC "Institute of Geography and Water Safety" MES RK Actual material obtained by the author in field studies (2015-2020) Remote sensing data including multispectral space images of Landsat, Sentinel, Alos, etc.

Relevance of the research topic. The conducted scientific research is within the framework of solving the problem of ensuring environmentally safe and balanced agricultural land use in the desert regions of Kazakhstan, is consistent with the adopted Programs for sustainable development and ensuring food security of Kazakhstan. The ill-conceived extensive system of conducting irrigated agriculture and pasture animal husbandry in conditions of limited water resources of the desert Kyzylorda natural-agricultural system contribute to the loss of the agro-resource potential of agricultural landscapes, the emergence of socio-economic and environmental problems. In addition to the low level of agricultural production and the development of degradation processes (deflation, decrease in soil fertility, etc.), in the studied region there is a low level of well-being of the rural population and an increased level of its migration. The solution of these problems is possible on the basis of landscape and ecological planning - a tool that takes into account both natural and socio-economic, as well as environmental aspects of nature management, and is used for the territorial organization of agricultural activities.

Scientific and methodological approaches and principles of landscape - ecological planning of natural - agricultural systems. The analysis of international experience, approaches and principles of landscape planning is carried out, methodological provisions for the analysis and assessment of the landscape - ecological state of the natural - agricultural system are considered.

The structural organization of landscapes and the modern system of land use of the desert Kyzylorda natural-agricultural system. It is established that the Kyzylorda natural - agricultural system is characterized by a complex spatial and structural organization of landscapes, which is conditioned by geographical location, geological and geomorphological features and the direction of development of physical and geographical processes. The qualitative and quantitative analysis of the spatial landscape structure of the natural - agricultural system made it possible to establish the patterns of distribution of landscapes in the rank of the type of tracts, their current state, and calculate quantitative parameters. Landscape maps of a scale of 1:200,000 have been compiled for the territory of irrigated agriculture and pasture use. The area of agricultural land in the natural-agricultural system is 10873.4 thousand hectares, of which pastures account for 10513.5 thousand hectares (96.69%). Pastures are common in all the selected landscapes and are used for pasture cattle breeding. Arable land in the structure of agricultural land occupies 174 thousand hectares (1.60%), hayfields 109.8 thousand hectares (1.01%), a deposit of 56.5 thousand hectares (0.52%), vegetable gardens 17.4 thousand hectares (0.16%) and plantings 2.2 thousand hectares (0.02%) of the territory and are confined mainly to the Syrdarya River valley.

Landscape-ecological state of the desert Kyzylorda natural-agricultural system. A comprehensive analysis of natural conditions and features of economic use in the Kyzylorda natural-agricultural system made it possible to assess anthropogenic disturbance and landscape-ecological state, to identify the main environmental problems: desertification of landscapes for agricultural development; degradation of floodplain and forest ecosystems; problems associated with the violation of the hydrological regime of the Syrdarya River; pollution of surface and ground waters, etc. It has been established that the tense ecological state of landscapes is observed on 11.3 thousand km² (5%) of the area of the natural-agricultural system and is observed within the valley landscapes used in irrigated agriculture, foothill plains in the east of the region and eolian plains in the south, used as pastures. The critical ecological state was noted on 31.6 thousand km² (14%) of the area of the region and is confined to the sea plains of the dried bottom of the Aral Sea. A series of assessment maps at a scale of 1:1,000,000 has been created, reflecting the degree of anthropogenic disturbance and the landscape and ecological state of the Kyzylorda natural - agricultural system.

Functional zoning of the desert Kyzylorda natural-agricultural system. For the purposes of balanced agricultural land use, based on the combined analysis of the results of assessments of anthropogenic disturbance, landscape and ecological condition, agricultural development of the Kyzylorda natural - agricultural system, its functional zoning was carried out, where the entire territory is divided into zones with different modes of agricultural nature management in order to achieve ecological and economic feasibility of using the territorial structure of natural complexes. Developed: schemes of landscape-ecological framework; flowcharts of the organization of irrigation arrays and pasture livestock, a series of multi-scale maps of functional zoning of irrigation arrays and pastures of the desert natural-agricultural system.

The main directions of sustainable development of the desert Kyzylorda natural - agricultural system. For the natural-agricultural system, the following have been developed: scientifically based requirements for rational use; landscape-ecological criteria for balanced pasture and irrigated land use; environmental protection measures, which are a system of actions aimed at reducing the degradation of landscapes for agricultural development and increasing the natural resource potential. A series of medium-scale maps has been created to standardize the agricultural load of livestock on pastures and establish a balanced land use structure.

Based on the results obtained, the following conclusions were made:

1. Landscape and ecological planning of the Kyzylorda natural-agricultural system is aimed at achieving a balanced agricultural land use and is the main methodological tool for solving the environmental and socio-economic problems of the desert region.

2. Analysis of the spatial landscape structure of the Kyzylorda natural-agricultural system made it possible to establish its main patterns, determine the background zonal level of natural-territorial complexes, the nature of the relative position of adjacent tracts, and establish the fragmentation and repetition of subdominant complexes. All of the above data made it possible to determine the direction of the transformation of natural complexes during land reclamation and pasture development and are the basis for landscape and environmental planning.

3. Functional zoning of the desert natural-agricultural system was carried out taking into account landscape features in order to determine the limitations of agricultural land use and develop a system of measures aimed at preserving the natural resource potential of the territory, is a management plan for the landscape-ecological and ecological-economic organization of natural-territorial complexes used for irrigated agriculture and grazing.

4. The developed scheme for carrying out landscape and ecological planning of the desert Kyzylorda natural-agricultural system of the Republic of Kazakhstan includes landscape analysis; assessment of agricultural development, anthropogenic disturbance, landscape and ecological state; development of a landscape-ecological framework, functional zoning, science-based requirements and measures for the rational use of the natural-agricultural system.

The scientific novelty of the research is determined by the following positions:

– for the first time, an assessment was made of the structural organization of landscapes of the zonal series for areas of regular irrigation (three irrigation arrays) and pasture use of the desert Kyzylorda natural-agricultural system for the purposes of rational agricultural nature management;

– for the first time for the desert Kyzylorda natural-agricultural system of Kazakhstan, a series of thematic medium-scale assessment maps aimed at sustainable agricultural development was compiled;

– for the first time, functional zoning of areas of regular irrigation and pasture use of the Kyzylorda natural-agricultural system was developed for the purposes of balanced land use and improving the standard of living of the population;

– for the first time, scientifically based requirements for landscape and ecological planning were developed and the main directions of activity for the rational use of landscapes for agricultural use of the desert Kyzylorda natural-agricultural system were proposed.

The main provisions to be defended:

1. Landscape and ecological planning is an important methodological tool for the territorial organization of balanced agricultural land use of the desert natural and economic system.

2. Landscape-ecological planning of the desert natural-agricultural system must be carried out on the basis of taking into account the regularities of the structural organization of landscapes and the modern system of agricultural nature management.

3. Violation of the ecological balance between natural-territorial complexes and agricultural impact leads to the degradation of the desert natural-agricultural system and a decrease in its natural resource potential.

4. Functional zoning (areas of regular irrigation and pasture use) of the desert natural-agricultural system makes it possible to identify zones with different modes of agricultural nature management and is the basis for balanced land use.

5. The implementation of science-based requirements for landscape-ecological planning and the main activities for the rational use of landscapes for agricultural development of the desert natural-agricultural system contribute to the elimination of existing environmental problems and is aimed at its stabilization.

Theoretical and practical significance of the work.

The theoretical significance of the results of the research is to obtain new scientific knowledge in the field of landscape and ecological planning of the natural-agricultural system for the purposes of balanced land use.

The practical value and significance of the research comes down to solving problems of balanced agricultural nature management by providing economic entities (especially farms), medium and small businesses, management structures with specialized environmental and geographical information: cartographic support, scientifically based requirements and recommendations. The results of the study will allow: to fill the lack of scientific and practical knowledge in the development of integrated plans for the development of the Kyzylorda natural-agricultural system in the context of food security; to carry out a functional delimitation of agricultural land; introduce targeted land use technologies adapted to certain landscape and environmental conditions.

The results of the dissertation research are implemented in:

1. LLP "Ecoservice-S" - "Map of anthropogenic disturbance of landscapes of the Kyzylorda natural-agricultural system", scale 1: 1,000,000 and "Map of environmental measures to stabilize the ecological state of landscapes for agricultural use of the Kyzylorda natural-agricultural system", scale 1: 1 000 000 (Act of implementation dated September 16, 2021 No. 04-2-12).

2. Public Fund "Farmer of Kazakhstan" - "Map of balanced agricultural loads (grazing) on the pastures of the Kyzylorda natural-agricultural system", scale 1: 1,500,000 and "Map of the ecological state of the Kyzylorda natural-agricultural system" scale 1: 1,000,000 (Act of implementation dated September 10, 2021 No. 01-3-16).

The work was carried out within the framework of the research work of the Ministry of Education and Science of the Republic of Kazakhstan on grant funding № 0115RK01652 (2015-2017) on the topic: "To develop the scientific basis for landscape planning of environmentally balanced land use in the context of food security in Kazakhstan".

The personal contribution of the author to the solution of the tasks of the dissertation research is:

– in assessing the structural organization of landscapes of the zonal series (Kazalinsky irrigation massif) of the desert Kyzylorda natural-agricultural system;

– in carrying out scientific research on the study of anthropogenic disturbance and the landscape and ecological state of the desert Kyzylorda natural-agricultural system, together with scientists from JSC "Institute of Geography and Water Security" of the Ministry of Science and Higher Education of the Republic of Kazakhstan;

– in the development and creation of a series of assessment thematic maps, functional zoning schemes for areas of regular irrigation and pasture use of the Kyzylorda natural-agricultural system;

– in the development of science-based requirements for landscape and environmental planning of the Kyzylorda natural-agricultural system;

– in conducting field research, preparing and publishing the obtained scientific results on the subject of the study in rating journals. The main provisions of scientific articles are reflected in the dissertation sections for the PhD degree.

Approbation of the study. The main results of the dissertation work were reported:

– at the International Conference dedicated to the 100th anniversary of the National Academy of Sciences of Ukraine: "Geographical science and education: from ascertaining to constructivism" (2018, Kyiv, Ukraine);

– at the 16th International multidisciplinary scientific geoconference: "SGEM 2016" (2016, Albena, Bulgaria);

– at the All-Russian Youth Conference with international participation: "Geographical research of young scientists in the regions of Asia" (2016, Barnaul, RF).

Based on the materials of the dissertation research, 9 papers were published, including 1 article in a journal included in the Scopus database, 4 articles in republican scientific journals from the list of the Committee for Control in Education and Science of the Ministry of Education and Science of the Republic of Kazakhstan, 4 articles in the materials of international conferences.

Dissertation structure. The dissertation is presented on 206 pages and consists of normative references, definitions, designations and abbreviations, an introduction, 5 sections, a conclusion and a list of references from 205 titles, 26 of which are in foreign languages; contains 25 tables, 61 figures and 20 appendices.