ANNOTATION

the dissertation work of Dukenov Zhenis on the topic:
«Improvement of measures aimed at restoring tugai forestes of the
Syrdarya River floodplain», submitted for the degree of
Doctor of Philosophy (PhD) under the educational program
8D08302 – «Forest resources and forestry»

Relevance of the research topic. Forest ecosystems are one of the most important components of the biosphere and have great global ecological, social, and economic significance. Within forestry, tugai forests occupy a special place. In the scientific system of forestry, issues related to the formation processes of tugai forests are of particular importance, since forest regeneration is impossible without understanding these processes.

The territory of the Republic of Kazakhstan is divided into zones including forest-steppe, steppe, semi-desert, desert, and mountain forests. Tugai forests do not belong to these zones, as they are intrazonal forest formations located in the floodplains of rivers flowing through desert regions of the country. They are referred to as intrazonal because they are not independent natural zones, but rather scattered vegetation formations within vast desert areas that sharply differ from the dominant desert flora background. These forests preserve features of Tertiary flora and represent unique relict plant species native to Central Asia.

Modern tugai forests of Kazakhstan consist of tree, shrub, and herbaceous communities growing in the floodplains of southern rivers such as the Syr Darya, Chu, Ili, Karatal, Lepsy, Aksu, and Charyn. Their total area is approximately 400 thousand hectares, of which about 150 thousand hectares are covered with forest vegetation.

Tugai forests are distinguished by their specific microclimate and unique ecosystems located within desert landscapes. They are often referred to as «oases» among deserts. According to their formation characteristics, tugai forests are classified into dense tugai forests, mixed meadow tugai forests, shrub tugai forests, reed communities and sandy dune formations.

In tugai forests, the dominant tree species include: *Salix sp, Elaeagnus angustifolia L, Populus diversifolia Schrenk, Populus pruinosa Schrenk*, shrubs *Tamarix ramosissima Ledebour* and *Halimodendron halodendron Pallas C.K. Schneider*.

The grove forests are of great importance in soil protection, water protection, and shoreline strengthening. In many cases, they play a beneficial role, providing biological drainage in wetlands.

As a result of river flow regulation, water withdrawal for irrigation, frequent fires, uncontrolled logging, the spread of forest pests and diseases, and unregulated year-round grazing, the areas of these unique forest formations are steadily decreasing. Over the past forty years, the influence of direct anthropogenic factors (logging, haymaking, fires)

and indirect factors (river flow regulation) has significantly altered not only the area and species composition of tugai forests, but also forest and vegetation conditions in river floodplains. The natural dynamics of tugai ecosystems have been severely disrupted.

The formation of tugai forests depends on many factors, including the physical and chemical properties of soils, moisture availability, hydrological regimes of rivers, decline in groundwater levels, and limited natural regenerative capacity of plant species. The general trend of this process is toward increased salinization and aridification. A widespread loss of typical native tugai tree species is observed, not only at the level of individual groups but also entire communities and forest formations. Tree-shrub tugai forests are being replaced by various species, and areas are increasingly occupied by herbaceous and halophytic communities that were previously less widespread.

The reduction of tugai forest areas has led to the loss of valuable, rare, and relict species of plants and animals, as well as unique biocenoses of high genetic value. It has also resulted in a decline in the water-protective, water-regulating, shoreline-protective, and ameliorative functions of tugai forests, deterioration of human living conditions, and in some cases the complete cessation of certain types of economic activity.

In this regard, the importance of comprehensive scientific research aimed at studying the condition of tugai forests and developing measures for their conservation and restoration is increasing. Therefore, the relevance of the present research is extremely high. The results obtained will contribute in the future to the expansion and conservation of forest areas in regions occupied by tugai forests.

Objects of research. The selected research object is the Baltakol Forestry, which belongs to the Municipal State Institution «Otyrar Forestry and Wildlife Protection» under the Department of Natural Resources and Environmental Regulation of the Turkestan Region in southern Kazakhstan. Experimental plots were established and studied in compartments 130, 131, and 132 of the 16 th rotation of tugai forests within the Baltakol Forestry.

Purpose of the study. The purpose of the study is to improve measures aimed at restoring tugai forests in the floodplain of the Syr Darya River in Kazakhstan, which have been severely affected by anthropogenic factors in recent decades.

Research objectives:
– to analyze scientific literature related to the study of tugai forests;
– to assess the natural-climatic and organizational features of tugai forest management in the region;
– to determine the relationship between climatic factors and the annual growth dynamics of the main forest-forming tree species using dendrochronological methods;
– to assess the current condition of tugai forests using GIS technologies;
– to identify the forest pathological condition of tugai forests in the region and determine the distribution level of pests and diseases;
– to study the natural regeneration of the main forest-forming tree species in tugai forests and promote natural regeneration processes;

– to investigate the hydrological conditions of the Syr Darya River floodplain, including groundwater levels and soil moisture;

– to study soil conditions of experimental plots, establish forest plantations using different methods, monitor their growth and survival, and improve planting techniques.

Research methods. The methodological basis of the research includes general and specialized scientific methods used in forest science. According to the methodology of E.N. Pilipko, route-based and detailed geobotanical studies were conducted in the Syr Darya River floodplain to determine vegetation growth conditions and typological classification of togai forests. Sample plots were established following the methods of V.N. Sukachev, T.P. Motovilova, and S.Z. Zonna.

The hydrological regime was studied based on local project data and Kazhydromet information, and soil morphological, physical, and chemical properties were assessed according to the methods of E.V. Arinushkin, A.F. Vadyunin, and V.A. Korchagin.

Forest pathological studies were conducted to assess sanitary conditions and pest outbreak areas, and tree resistance was determined using the scale of A.Ya. Ogorodnikov.

Dendrochronological studies were carried out following the methodological guidelines of S.G. Shiyatov, E.A. Vaganov, A.V. Kirdyanov, V.B. Kruglov, V.S. Mazen, M.M. Naurzbayev, and R.M. Khantemirov.

GIS technologies were used to assess tree species distribution and forest condition. Multispectral images from RapidEye satellites were applied to obtain information on forest canopy structure. Forest classification was performed using the Random Forest method, and fire-damaged areas were assessed using NBR and ΔNBR indices (Meng et al., 2016; Immitzer et al., 2012; Plakman et al., 2020; Pal, 2005).

Forest plantations were established in spring and autumn using various methods, and their survival rate, growth, and condition were assessed through monitoring. During spring and autumn inventories, the survival rate, growth, and condition of plantations were determined based on total counts of planted seedlings within experimental plots.

The reliability of the research results is ensured by an integrated methodological approach, long-term observations, repeated measurements, and the combined use of traditional and modern research tools.

Main provisions submitted for defense:

– comprehensive study of natural and climatic conditions of the research area;

– analysis of the current and past condition of tugai forest areas in the Syr Darya River region;

– dendrochronological study of the main forest-forming tree species to determine the impact of natural and climatic factors;

– assessment of spatial distribution and condition of tugai forests using GIS technology;

– determination and assessment of forest pathological conditions of tugai forests;

– study of natural regeneration of main forest-forming tree species and development of methods to support natural recovery;

– determination of groundwater levels and soil moisture indicators;

– monitoring growth and development of main forest-forming tree species under various agrotechnical options and improvement of effective methods.

Scientific novelty of the research.

For the first time in Kazakhstan, a study aimed at improving measures for restoring tugai forests in the floodplain of the Syr Darya River was conducted.

For the first time, GIS technologies were applied to assess the condition of tugai forests.

Dendrochronological analysis of the impact of natural-climatic factors on the main forest-forming tree species was carried out for the first time in this region.

Experimental planting of forest-forming tree species using moisture-retaining substances and growth stimulants was implemented and evaluated for the first time.

Practical significance of the research. Currently, the reduction of tugai forest areas represents a critical issue. Forest degradation is increasing, the distribution area of trees and shrubs is steadily shrinking, and growth conditions of tugai forests are deteriorating under the influence of various factors. The practical significance of this research lies in its potential to ensure sustainable restoration of tugai forests, establish forest plantations on degraded lands, expand forested areas, provide habitats for wildlife, improve environmental conditions in the region, and address other pressing ecological problems.

Compliance with scientific development directions and state programs. The dissertation work was carried out within the framework of the scientific and technical program of the Kazakh Research Institute of Forestry and Agroforestry named after A.N. Bukeikhan LLP «Development of scientific foundations for the preservation and improvement of the stability of forest ecosystems in the southern regions of Kazakhstan» BR 10263776 and is fully consistent with the Strategy for the Conservation and Sustainable Use of Biological Diversity of the Republic of Kazakhstan until 2030, as well as state programs provided for in the Address of the President of the Republic of Kazakhstan «Kazakhstan in the New Situation: Period of Action» dated September 1, 2020 (Section 7 «Ecology and Biodiversity Protection»).

Implementation of research results. The measures and recommendations developed as a result of the research were tested and implemented in production within the tugai forest areas of the Municipal State Institution «Otyrar Forestry and Wildlife Protection» of the Turkestan Region. The obtained results and methods are also recommended for forestry institutions, private farms, and other interested organizations located in regions with tugai forests.

Approbation of the work. The main scientific results of the dissertation research were presented and discussed annually at meetings of the Department of Forest Resources, Game Management and Aquaculture of the Faculty of Forestry and Land Resources of the Kazakh National Agrarian Research University. The research results were presented at international scientific and practical conferences, including the «Seifullin Readings-19» conference dedicated to the 110th anniversary of M.A.

Gendelman (Astana, 2023) and the international conference «Forest Resources as an Integral Part of the Green Economy» dedicated to the 85th anniversary of the prominent scientist, Doctor of Economic Sciences, Professor, Academician of the National Academy of Sciences of the Republic of Kazakhstan S. Baizakov (Almaty, 2025).

Description of the doctoral candidate's contribution to publication preparation. Within the framework of the dissertation, the doctoral candidate directly participated in obtaining research results, analyzing data, and formulating conclusions. The author also actively contributed to the publication of research results in national and international scientific journals.

Based on the dissertation materials, 8 scientific articles were published, including 2 articles in journals indexed in the Scopus database, 4 articles in journals recommended by the Committee for Quality Assurance in Science and Higher Education of the Ministry of Science and Higher Education of the Republic of Kazakhstan, and 2 articles in international scientific and practical conference proceedings.

Structure and volume of the dissertation. The total volume of the dissertation work is 151 pages. The work consists of an introduction, 6 sections, conclusions, recommendations for production, a list of used literature and appendices. The dissertation materials consist of 20 tables, 58 figures, 6 appendices. The list of used domestic and foreign literature consists of 121 sources.