Name of the project: No. AP19679749 "Mapping of shelterbelts, their impact on productivity and water resources, expansion prospects, using geospatial technologies in the Akmola region"

Relevance: For a long time, forest-belt field-protective plantations effectively performed the protective functions assigned to them. Their ecological and ameliorative functions in the fields were especially important, which prevented the occurrence of wind and water erosion, contributed to the redistribution of precipitation, transferring them into soil runoff, and improved the biodiversity of the region. In the dry steppe zone, on the endless fields of grain cultivation, forest strips effectively retained snow or ensured its uniform distribution, which contributed to the accumulation of moisture, which is so necessary for growing plants. They played an important role in the formation of agroforestry landscapes, microclimate and the ecosystem as a whole. One of the main purposes of field and soil-protective forest belts was to increase crop yields. In the last three decades, support for the development and care of existing forest belts has ceased, which has led to their degradation, drying out, and fires. Moreover, many local residents cut down trees in forest belts along roads and fields for firewood.

Climate change, intensification of anthropogenic emergency events, displacement of the boundaries of natural and climatic zones, change of vegetation formations, expansion of desertification processes, strong variation in the amount of precipitation with peaks of floods and droughts, and an increase in forest fires, affect the ecosystems of rural regions. In this connection, the sustainable development of rural areas, associated with the sustainable development of the agro-industrial complex and the safety of agricultural products, is an urgent and long-term task that requires great efforts to improve technologies, methodologies, resources and analytics of agricultural production standards. With the proposed research project, we propose to analyze the practice of using, creating forest fields and soil protection belts, taking into account the accumulated experience and omissions from previous years.

Purpose: Study of the field-protective potential of forest belts with a model assessment of crop yields using geoinformation technologies for remote sensing in the pilot region of Akmola region to further support the sustainable development of rural areas of Kazakhstan in cooperation and adaptation of international experience with experts from Germany, Canada, China.

Expected results:

1. Characteristic fields will be selected and 20 experimental plots will be laid to study the effect of forest belts on crop yields and a comparative analysis of yields in fields with windbreaks and in plots without them will be carried out.

2. A field survey of the condition of existing and previously operating field and soil protection forest belts on the lands of former collective farms and state farms, current farms and peasant farms of the Akmola region will be carried out.

3. A comparative analysis of changes in the indicators of the main climatic factors (air temperature, precipitation, duration of the growing season, wind strength and direction) for the period from 1960 to the present will be carried out.

4. Domestic and foreign literary sources and departmental materials on the creation and care of shelterbelts, their impact on the formation of the ecosystem and agricultural landscape of the region will be studied and summarized.

5. Soil pits will be laid according to a special technique at different distances from the forest belts in order to study the uniformity of the distribution of precipitation and the selection of an assortment of trees and shrubs.

6. The current standards for the placement of longitudinal and transverse strips, for tillage, for planting seedlings will be revised due to changed conditions and brought into line with new technologies, applied machinery, machinery and equipment.

7. Cartographic materials of the selected farms will be studied and the spatial location and areas of forest belts will be determined.

8. The design of forest belts, species composition, service life, technology, agricultural technology and the period of creation of shelter belts will be studied.

9. A technology will be developed for growing shelterbelts of various designs from durable, drought-resistant, salt-tolerant tree and shrub species (5-6 species each), including fruit species with their various combinations and placement and the use of growth biostimulants.

10. Field and collected archival data will be processed in combination with geoinformation data from remote sensing of the earth in the study region and are available on a single open access geoplatform integrated on the basis of UNDP ELSA https://www.unbiodiversitylab.org/, which is part of several pilot projects, supported by the UN on sustainable land development, the effective use of modeling of natural, including forest and water resources of Kazakhstan.

11. The data on the geoportal will be used by users for modeling, including for analytical studies such as processes of analytical hierarchy by soil, land use, topography, with the definition of hydromodule segments, taking into account input data such as slope, drainage density, rainfall, distance to the fault , distance to the riverbed, lithology, groundwater level, land cover, soil texture to identify potential locations for the accumulation of drainage water.

12. An effective land use scenario model will be developed with an assessment of soil and water resources, using the Soil Water Assessment Tool (SWAT) of the USDA, US Department of Agriculture, with an analysis of an effective irrigation system, a sustainable land use system, modeling the shelter potential of forest belts with an assessment of yield modeling according to the geoportal.

13. International cooperation will be expanded with experts from Germany, Canada, China on draft hydro-environmental bases and future forecasts for reforestation in the face of climate change.

14. Kazakhstani specialists will participate in the expansion of cooperation projects, partnerships for the restoration of degraded lands for land monitoring and modeling, platforms for interdisciplinary research on sustainable development with Germany, the USA, Canada, China.

15. Based on the results of the research, a dual training program will be prepared in cooperation with international experts for bachelors, masters and doctoral students, with practical training for specialists in agriculture, forestry, ecology and departmental institutions, as well as environmental and design organizations.

16. Events will be held to share research results and experience with interested individuals and organizations, researchers will make presentations at exhibitions, seminars, conferences, and meetings of environmental organizations.

17. A recommendation will be developed on the creation of shelterbelts in the conditions of the Akmola region.

18. 2 articles will be published in peer-reviewed scientific journals indexed in the Science Citation Index Expanded Web of Science database and (or) having a CiteScore percentile in the Scopus database of at least 35 (thirty-five) and 1 article in a peer-reviewed foreign or domestic publication recommended CSHE RK.

Sarsekova Dani Nurgisaevna - project leader, Doctor of Agricultural Sciences, Professor. She has significant experience in research, organizational work in the field of forestry, cooperates with leading scientific centers of foreign universities (China, Turkey, Germany, Poland, Czech Republic, Latvia, Sweden, USA, Italy, Mongolia). She is a member of the editorial board of the journal "International of Forestry Faculty" (Turkey), an international expert in scientific analytics (England, London). Author of more than 200 scientific and methodological works, textbooks, electronic textbooks, monographs, has a patent and a number of recommendations for production.

H index Scopus 4 H index WoS 2 Researcher ID: N-7706-2018 ORCID https://orcid.org/0000-0003-0537-4936 Scopus Author ID: 56403235500

Research team:

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1. Economic assessment of ecosystem services in the Ile-Balkhash pilot area (2017), through UNDP.

2. Preparation of Terms of Reference for the development of "standard projects" for private afforestation. Representative office of GIZ in the Republic of Kazakhstan. 2017.

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Information about the main publications is presented on online platforms

https://scholar.google.com/citations?user=2l_kD90AAAAJ&hl=en,
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H index - 14 Researcher ID - F-7522-2013 ORCID 0000-0002-0386-888X Scopus Author ID - 57192105897

Kumar Navneet - Senior Research Fellow, Foreign Scientific Consultant, Doctor of Engineering, works as a Senior Research Fellow at the Center for Development Studies (ZEF) at the University of Bonn (Germany). Main research topics: water and natural resource management and geoinformatics. Specific topics include the application of remote sensing and GIS technology in agricultural water management, integrated hydrological modeling, climate change, land degradation, risk and impact assessment, irrigation, etc. Dr. Kumar has been involved in several projects in Africa and Asia (Uzbekistan, Algeria, Ethiopia, India, Mali and Nigeria).

He is currently a guest editor for the journal Sustainability.

(https://www.mdpi.com/journal/sustainability/special_issues/Earth_Geospatial_Technologies) and member of the Water Journal Thematic Council.

Website (personal profile): https://www.zef.de/staff/navneet_kumar.

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1. "Environmental assessment of the state of roadside areas adjacent to the main highways of the city of Astana" under the budget program 217 "Development of science", priority "Rational use of natural resources, processing of raw materials and products." 2015-2017

2. "Landscape and environmental assessment of the state of green spaces in the city of Astana and suburban areas, ways to optimize the landscaping system" within the budget program 217, MES RK, 2018-2020.

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Zhagpar Karimzhan - senior researcher, the head of the Black Sea Fleet "EL-RUKHY". Member of the research group at the LLP " A. Bukeikhanov Kazakh Research Institute of Forestry and Agroforestry" KAZNIILKhA, Shchuchinsk. 2012-2014 led the organization and monitoring of planting of seedlings of various species on the lands allocated by the state for the purpose of afforestation in the villages of Dorogovka, Zerenda district, Akmola region. 2017-2018 supervised the planting of pine seedlings, created under the private afforestation project

within the framework of the regional program of the German Society for International Cooperation (GIZ) on sustainable land use, considering climate change for economic development in Central Asia and the Committee for Forestry and Wildlife (CFWF) of the Republic of Kazakhstan. near the village of Dorogovka, Zerenda district, Akmola region. 2019-2020 managed a project within the framework of the Global Environment Facility Small Grants Program (GEF SGP) Development of private forest plantations in the Zerenda district of Akmola region and local potential in the field of agroforestry (EL-ORMANY public forest nursery). 2022-2024 manages a project to equip greenhouse equipment for landscaping and promote environmental education in the Akmola region with the support of the Japanese Embassy in Kazakhstan.

Samarkhanov Kanat Baurzhanovich – Senior Researcher, Candidate of Geographical Sciences, PhD majoring in Cartography and GIS, Deputy Director of R&D of GEOID LLP. More than 20 years of experience in scientific projects. Owns methods of processing data from remote sensing of the Earth and GIS, programming. Author of 10 publications in peer-reviewed international scientific journals and 1 copyright certificate for software.

H index 6 (124 citations) Researcher ID: S-2590-2017 https://orcid.org/0000-0001-9799-8695 Scopus Author ID: 57196121772 SciProfiles: 360496

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H index Scopus 2

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Kuanyshbaev Nurbolat Kairatuly - researcher, Master of Agricultural Sciences by the educational program "6M080700 - Forest resources and forestry". He is the leading agronomist of the production and agronomic service of LLP "Zhasyl Zher".

Kitaibekova Sara Orazbekovna – Junior Researcher, Master of Agricultural Sciences, Senior Lecturer at the Department of Forest Resources and Forestry, NCJSC S. Seifullin KATRU. She has an experience in research, educational and organizational work in the field of forestry and educational programs. Collaborates with leading scientific centers of foreign universities (Turkey, Poland, Czech Republic, Hungary, Morocco, Kyrgyzstan, Uzbekistan, Bulgaria). She is a member of the editorial board of the journal (language editor) "Silva World" (Turkey), an international expert of the educational project of the EU Erasmus + program "Strengthening higher education in the water sector to ensure climate resilience and security in

Central Asia" (2023-2026).). Author of more than 40 scientific and methodological works, textbook.

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Zhumabek Bakytbek - junior researcher, doctor of PhD, senior lecturer of the department "Soil science and agrochemistry" NCJSC S. Seifullin KATRU. He is a specialist in the field of efficient use of soil and increasing soil fertility. He is the author of more than 29 scientific studies and a participant in scientific projects in the field of soil science and agrochemistry.

h- Index 1

Olzhaeva Aigerim Bekkazievna – senior laboratory assistant, Master of Agricultural Sciences, Doctoral Candidate of "Forest resources and forestry" department, NCJSC " S. Seifullin KATU". She was a member of scientific projects in the field of forestry and ecology.

Information for potential users: Events will be held to exchange experience and research results with interested individuals and organizations, researchers will make presentations at exhibitions, seminars, conferences, and meetings of environmental organizations.

Additional Information:

Based on the results of the research, a dual training program will be prepared in cooperation with international experts for bachelors, masters and doctoral students, with practical training for specialists in agriculture, forestry, ecology and departmental institutions, as well as environmental and design organizations.