

Brief information about the project

Name of the project	AP26104923 - Water and land resources monitoring and forecasting for sustainable agricultural development in the Talas River basin in the context of climate change
Relevance	Dynamic climate changes may lead to catastrophic consequences in the territory of the Zhambyl region and for its population. A significant decrease in atmospheric precipitation over the past 60 years has led to a reduction in the volume of water resource reserves of the Talas River. As a result of an increase in average annual temperatures and other factors, a reduction in the area of glaciers is observed in the basins of the Talas and Asa rivers by 54.1 km² or 43.9% of the 1950s area, the volume has decreased by 1.875 km³ or 49.4% of the 1950s volume. A sharp decrease in moisture during the growing season is having a profound impact on agriculture in the Talas River basin, potentially leading to socially negative consequences. In 2023, a lack of irrigation water resulted in significant losses, reduced harvests in the Talas River basin, and a consequent decline in living standards. The lack or inadequacy of irrigation water leads to soil salinization in irrigated areas. Secondary salinization is characterized by anthropogenic factors. Long-term irrigation leads to the accumulation of groundwater, which is naturally saline due to the presence of saline parent rocks. This process is exacerbated by the absence of natural groundwater flow or the lack of a developed drainage network. A significant portion of the Talas basin's soils are perspiratory, and when irrigation water decreases, groundwater inflow occurs, concentrating salt deposits on the soil surface. Thus, a decrease or lack of irrigation leads to a loss of soil fertility. Climate change and its consequences in the form of reduced water resources require a fundamental change in approaches to modern agricultural production in the Talas River basin. This means significant financial investments are required to implement modern technologies in irrigated agriculture, fertilizer use, and agricultural practices. Such problems cannot be resolved overnight. Therefore, a set of measures is necessary during the transition period that take into account the dynamic fluctuations in climate indicators that mediate the reduction in water resources. Therefore, using modern research methods, it is necessary to monitor the condition of croplands and their dynamics, and determine the land's resilience to anthropogenic pressure. It is also necessary to study the dynamics of water resources, the causes of their fluctuations, and possible solutions.
Purpose	Based on remote sensing data and field research, conduct monitoring of water and land resources and provide forecasts for their use to support sustainable development in the Talas River Basin under climate change conditions.
Objectives	- Retrospective analysis of climatic and hydrological data; - Collection of modern and archival remote sensing (RS) data, as well as cartographic materials; - Conducting field studies, including soil sampling and physical-geographical description of key sites; - Data collection and formation of an information-analytical database;

	- Development of methodology and creation of thematic maps: soil map of the Talas River basin, GIS maps based on the calculation of index indicators NDVI, NDWI, NDSI, EVI, RVI, SAVI and GDVI; - Conducting field studies, including soil sampling and physical-geographical description of key sites; - Analysis of the dynamics of irrigated lands based on cartographic and satellite data; - Development of an appropriate machine learning model for the interpretation of climatic, hydrological and socio-economic indicators; - Development of AquaCrop and InVEST models for assessing changes in land use; - Conducting field studies, including soil sampling and physical-geographical description of the studied sites; - Development of the SWAT model for assessing and forecasting trends in changes of Talas River runoff in the period from 2020 to 2100; - Publication of articles in accordance with the requirements of the конкурсной документации (competition documentation).
Expected and achieved results	Measures will be developed for the use of land and water resources under dynamic changes in climate indicators in agricultural areas of the Talas River basin, for the implementation of which the following research developments will be presented: a model for forecasting the development of agricultural lands using hydrological, climatic and socio-economic indicators, a retrospective analysis of the use of water resources, as well as Earth remote sensing (ERS) data, degradation criteria taking into account climate and water changes, a series of maps displaying vulnerable areas of irrigated and floodplain lands of the Talas River basin.
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Usage	Ministry of Agriculture of the Republic of Kazakhstan, local authorities, farms/peasant households and scientific organizations.
Priority compared to real-world alternatives	The presented project differs from existing similar projects in its applied nature. A combined analysis of water and land resource conditions, climate change indicators, and irrigation water volume dynamics will enable the substantiation of resource use forecasts. The study's results propose scientifically based measures for the sustainable development of agriculture in the Talas River basin, given dynamic climate change.
List of publications with links to them	-
Patents	-