

**Research and Production Center  
"Renewable Energy Sources"  
State Energy Institute of Turkmenistan**

Project proposal on the topic:

**Increasing water security by  
cultivating microalgae in  
drainage waters**

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## Overview of drainage waters in Turkmenistan

- ✓ Currently, about 6 billion m<sup>3</sup> of collector drainage waters are formed in Turkmenistan, and taking into account transit drainage waters of neighboring countries - 11 billion m<sup>3</sup>;
- ✓ Qualitative indicators include total mineralization of the dense residue, the amount of the main ions (HCO<sub>3</sub><sup>-</sup> SO<sub>4</sub><sup>-</sup>, Cl<sup>-</sup>, Ca<sup>++</sup>, Mg<sup>++</sup>, Na<sup>++</sup>K<sup>+</sup>), water hardness, and its physical indicators (temperature, smell, taste, color);
- ✓ Mineralization of oasis drainage waters varies from 2-6 to 15-25 g/l.
- ✓ Pollutants in drainage water formed as a result of applying fertilizers to irrigated fields are nitrites, nitrates, sulfates.

## Total amount and mineralization of drainage water by velayats

Velayat                      Volume of drainage water of different mineralization levels, g/l                      Total drainage water by velayat

Велаят	Объем КДВ различной минерализации, г/л					Сумма КДВ по вelayатам
	<3	3-5	5-10	10-15	>15	
Ахалский	261,0	-	5,7	54,5	305,9	627,1
Марыйский	67,9	-	959,6	184,9	-	1212,4
Лебапский	1241,3	-	-	-	-	1241,3
Дашогузский	2334,9	5197,3	-	-	-	7532,2
Всего по стране	3905,1	5197,3	965,3	239,4	305,9	10613

Ahal

Mary

Lebap

Dashoguz

Total

*Topic of scientific work:*

## **Developing technology for using drainage water to cultivate microalgae for energy purposes**

- ✓ Cultivating microalgae in drainage waters solves energy, environmental and water security issues;
- ✓ Microalgae accumulate what we think of as pollutants. For example, biogenic elements are the main nutrient required for algae to grow;
- ✓ Microalgae can accumulate from 20 to 60% lipids;
- ✓ Microalgae are capable of purifying drainage water and at the same time producing fertilizers and other products needed by farmers;
- ✓ Microalgae create additional water resources.

# Project goal

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- ✓ Contribute to the supply of irrigation water to water-poor communities for crops in arid zones of Turkmenistan through biological treatment of drainage water using local microalgae

## Project tasks

- ✓ Improving methods for evaluating drainage water quality and microalgae biomass using new cosmic ray neutron sensing (CRNS) technologies.
- ✓ Studying the possibilities of cultivating local microalgae in drainage waters formed in irrigated areas of the Murghab oasis to reduce pollutants.
- ✓ Developing technology for cultivating microalgae in drainage waters, ensuring maximum biomass productivity.

## Benefits of isotope hydrology for the project

- ✓ Determining the extent to which drainage waters are contaminated with toxic substances;
- ✓ Assessing the level of biogenic elements in drainage water;
- ✓ Assessing the level of microelements in drainage waters;
- ✓ Presence of trace amounts of pesticides;
- ✓ others.

## Key barriers to isotope hydrology

- ✓ Lack of specialists with the necessary qualifications
- ✓ Lack of technical capacity
- ✓ Insufficient infrastructure to increase nuclear knowledge;
- ✓ Financial barriers
- ✓ Regulatory barriers
- ✓ Motivational barriers
- ✓ Administrative and management barriers

## Ways to eliminate barriers. Capacity building

- ✓ Building national capacity during the implementation of isotope hydrology projects at the institute;
- ✓ Increasing the capacity of researchers to evaluate and monitor collector drainage waters of the Murghab oasis using isotope methods and hydrochemical analysis;
- ✓ Study trip to international centers to study the activities of scientific hydrological laboratories;
- ✓ Practical training for the use of modern laboratory equipment based on nuclear technologies.



## Ways to eliminate barriers. Technical measures

- ✓ Creating the Center for research in the field of water resources using nuclear technologies
- ✓ Purchasing a set of laboratory equipment for isotope hydrology;
- ✓ Analytical tools for fast and cost-effective detection of contaminants in drainage water;
- ✓ Kapel-105, 105M capillary electrophoresis system (to measure cations and anions in drainage water samples);
- ✓ Aurora M90 inductively coupled plasma mass spectrometer (to measure microelements);
- ✓ ALPHA Fourier transform infrared spectrometer (to measure chlorophyll, lipids, proteins and others);

# Expected results

- ✓ Increased capacity of national specialists in the field of isotope hydrology;
- ✓ A laboratory for hydrochemical and isotopic analysis of drainage water created in the Research and Production center “Renewable Energy Sources” of the State Energy Institute of Turkmenistan;
- ✓ Equipment to measure protein, lipids and chlorophyll in local microalgae grown in drainage water purchased;
- ✓ Research results tested on a specific farm;

# Thank you for attention!

