

# Needs and gaps assessment of the higher education programmes in the field of groundwater in Central Asia



This policy brief, prepared by UNESCO Almaty under the Governance of Groundwater Resources in Transboundary Aquifers (GGRETA) Project in the Pretashkent Transboundary Aquifer, summarizes a survey conducted among universities, practitioners and recent graduates in Central Asia involved in groundwater science and applications. It explores the current curricula and study tools that countries apply in groundwater higher education programmes, and identifies needs and gaps.



## Educational institutions

The following research institutes and universities in Central Asia offer groundwater educational and research programmes and participated in the survey.

**Kazakhstan:** Kazakh Agrarian University; Satbayev University; Dumaty University; Eastern Kazakhstan Technical University.

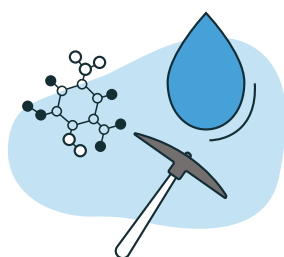
**Kyrgyzstan:** Kyrgyz State University of Geology, Mining, and Development of Natural Resources; The American University of Central Asia.

**Tajikistan:** Center for Innovative Development of Science and New Technologies under the National Academy of Sciences; Institute of Water Problems, Hydropower, and Ecology under the National Academy of Sciences; Tajik State University; University of Central Asia.

**Uzbekistan:** Tashkent State Technical University; National University of Uzbekistan; Tashkent Institute of Irrigation and Agricultural Mechanization Engineers.

Some other universities in Central Asia have programmes relevant to groundwater, but they are less prominent or less focused, and were not included in the survey.

The annual number of **students graduating from groundwater programmes is about 30** per country, while the number of **recruited graduates is about 10** per country, thus, supply exceeds demand in the job market. Other graduates (with no clear recruitment pathway) usually find jobs in other sectors.



## Study programmes

Natural and engineering sciences prevail in the curricula of most universities and include: physics, geophysics, chemistry, hydrogeology, geology, earth materials and geochemistry, geo-statistics, remote sensing, geodesy, hydrology, climate science, groundwater data collection, interpretation and modelling, and field methods in geology and hydrology. Groundwater governance is usually studied for Master or Doctorate degrees. Presentation skills, teamwork, critical and analytical thinking, and communication skills are included in the curricula of some universities.

Groundwater studies require **special software skills**, including programming languages (Python, C++), surface and groundwater modelling software, geochemistry, geo-information systems (ArcGIS), and software for geological modelling. Most universities use **AutoCAD** and **ArcGIS** in their work.

The American University in Central Asia has the most extensive software set in its curriculum. Other universities have a basic, but insufficient, range of software. There is a gap between software training given at universities in Central Asia and the demand from employers, who often require suitable knowledge of programming languages, geological and environmental modelling tools, geology and mine planning software, geo-exploration and 3D mine design, and aquifer analysis software.

Considering demand from the mining sector in Central Asia, including international companies, **the following additional skills and subjects** are recommended for groundwater students and graduates: professional English; structural geology; mineralogy; surface water and groundwater monitoring; petroleum hydrogeology; fundamentals of geotechnics and geomechanics; hydrogeochemistry; drilling and well maintenance; stratigraphy; geomorphology; groundwater exploration; time series analysis; and landscape and environmental sciences, including groundwater protection and water supply.



Fieldwork is an essential part of the curriculum and covers field training on geochemistry, geophysics, and water quality sampling. **More field practice is recommended** in the following areas: well drilling, surface water and groundwater monitoring, hydrogeological and geological mapping, and remote sensing. Work in the labs — where students are trained to conduct physical and chemical analysis of groundwater — is another important part of the curriculum. Fieldwork and lab activities each take around 15 per cent of the curriculum.

Internships are often part of the educational programme. Some universities assign students to organizations. Others encourage their students to look for internships or engage them in ongoing partnership programmes.

Exchange programmes for university teachers and guest lecturers are lacking, and most participants in the survey suggest that universities would be willing to collaborate with each other. Practitioners in the survey from mining and other sectors would be willing to give lectures or participate in experience exchange. Students exchange is practiced, but interest in further expansion is great.

## Career prospects and job opportunities for groundwater students in Central Asia



Mining



Oil and gas  
exploration and  
extraction



Urban planning,  
environmental  
assessments



Science and  
research



Mapping and  
support for  
decision-making



## Common challenges

Practitioners and potential employers indicate a low level of practical knowledge, skills, and critical and analytical thinking as common challenges of new grads. Their poor performance in groundwater sampling, monitoring and analysis is linked to limited field and lab work. Poor skills in professional English and specialized software are additional barriers for graduates' entry into competitive job markets.

Salaries of hydrogeologists are usually lower than the salaries of geologists and geophysicists, and students have less motivation to pursue a career in this field.

Science and research are lagging behind modern needs and technical advances as noted by the survey in Kazakhstan and Kyrgyzstan. Critical and analytical thinking is not yet common among students, and the level of their professional English and the access to international literature are inadequate.

Outdated educational programmes and technical capacities for lab and field work have some impact on the quality of student training in Kazakhstan, Kyrgyzstan and Tajikistan. In Uzbekistan, these factors are less evident. Weak knowledge and use of modern software hinders groundwater management in Tajikistan.

In general, weak coordination and communication between educational institutions and employers is reported in all countries, and inconsistency between the curriculum and job market needs has a high impact in Kazakhstan, where the mining sector is prominent. In Kyrgyzstan and Uzbekistan, this gap between the curriculum and the job market is not a factor.



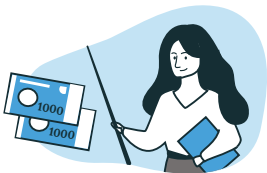
## Recommendations

The countries of Central Asia need to better define their groundwater resources and their current and prospective uses, and to ensure their sustainable use and protection for future generations. Groundwater resources are used by industries, farms, cities and villages. Governments need to improve groundwater monitoring and reporting capacities, and systems of licensing and management. These steps will increase demand for groundwater specialists and for more groundwater educational programmes.

The following recommendations were suggested by practitioners and educators.



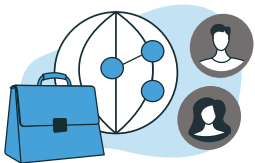
- Increase attention to groundwater-related issues by governments, the private sector, and universities.
- Connect students and lecturers to research institutions and the private sector .
- Organize regular meetings with potential employers to improve educational programmes in light of job market demand.
- Promote internships for students.



- Increase financial support for updating educational materials, purchasing software, making teachers' salaries attractive, providing stipends for young talents, and retaining high-quality teaching staff.
- Increase motivation of young people by supporting young talents and career.



- Improve lab and fieldwork equipment.
- Procure and upgrade modern software to teach and study groundwater.
- Blend traditional and new knowledge and improve coherence of educational programmes.



- Organize and strengthen professional English courses.
- Promote exchange programmes for teachers and graduate students in the world's leading groundwater universities.



- Popularize groundwater-related careers and job opportunities.
- Expand courses on sustainable development and rational use of groundwater.