



AL-FARABI KAZAKH NATIONAL UNIVERSITY



CONCEPT OF SUSTAINABLE DEVELOPMENT FOR WATER RESOURCES OF THE UNIVERSITY

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Sustainable water management is necessary to ensure the quality of our vital water resources in the face of increasing human demand for water, high levels of pollution and increasing spatial and temporal variability, related to climate change. An integrated approach to water resources management is recommended to address current water problems that are often interlinked with other environmental, economic and social problems.

The concept of sustainable development on water resources of NJSC « AlFarabi Kazakh National University» aims to ensure a balance between economic growth, social justice and environmental sustainability in relation to water resources, at both the regional and global levels. Education is a key dimension of the international response to the world water crisis and can stimulate behavioural change to create a more sustainable society in terms of economic viability, social equity and environmental protection. Water education is often linked to poverty eradication, adaptation to climate change, basic human rights, gender equality and indigenous cultures, among other key issues.

The contribution of al-Farabi KazNU to the achievement of sustainable development in water resources is reflected in two main directions:

1. Training of highly qualified hydrologists at bachelor, master and doctoral levels, competitive in the domestic and international labour market, which presupposes the integration of scientific and research and training in the educational process, implementation of the educational process on the credit technology of training on the basis of the principles of interdisciplinary and competency approach.
2. Conducting research in the field of rational use of natural resources, incl. water resources. In international practice, the training of hydrological specialists is determined by the objectives of scientific and industrial activities and the economic needs of the country.

In addition at Al-Farabi Kazakh National University to the recommendation of domestic and foreign specialists based on the experience of training specialists in the hydrology field, the directions selection and the disciplines list is made taking into account the requests of the main employers for specialists and priority research in the field of hydrology and water resources, determined by the National Academy of Sciences and the Ministry of Education and Science of the Republic of Kazakhstan for the future and curricula of foreign countries

The concept of sustainable development by water resources of the university is based on three principles:



Environmental integrity

- conservation of natural hydrological cycles and biodiversity

Social justice

- Equal and equitable access to water for all segments of the population

Economic efficiency

- Use of water resources in ways that (maximize) increase their economic value without damaging ecosystems

Political and legal aspects

1. *Standardization and regulation*: implementation of water quality standards, regulation of sanitation and water supply.
2. *Water law*: establishing an effective system of water rights that ensures a fair distribution mechanism and avoids conflict situations in water distribution and division.

Technological aspects

1. *Clean technologies*: application of technologies for efficient use and treatment of water.
2. *Infrastructure*: building and upgrading water and sanitation infrastructure on campus, incorporating sustainable materials and technologies.

Environmental aspects

1. *Protection and restoration of ecosystems*: address the restoration of degraded aquatic ecosystems and the conservation of sustainable ecosystems.
2. *Monitoring and research*: systematic data collection on the status of water and ecosystems.

Social aspects

1. *Education and Enlightenment*: training of personnel on the educational program «Hydrology», «Ecology», «Geoecology and environmental management», preparation of innovative educational program «Water diplomacy» and «Water safety» dissemination of information on the importance of sustainable water management among the population.
2. *Community participation*: Empowering local communities in water management decision-making processes.



Economic aspects

1. *Economic incentives*: the establishment of economic mechanisms for the efficient and sustainable use of water resources.
2. *Investment*: Attracting investment in sustainable water projects and research.

Implementation and monitoring

1. *Pilot projects*: implementation of scalable pilot projects to address water safety, transboundary water management to test the effectiveness of different approaches in watershed management.
2. *Monitoring and reporting*: regular data analysis to assess the effectiveness of current measures.

The concept is iterative and should be reviewed regularly to take into account new data, technologies and socio-economic conditions.

Basic principles of sustainable water development

1. Environmental integrity

This principle is to preserve natural hydrological cycles and the aquatic ecosystem on campus.

2. Social justice

Equal and equitable access to water for all, including vulnerable groups.

3. Economic efficiency

Maximizing the economic value of water without compromising ecosystems and social well-being. This principle includes the application of modern technologies to reduce water losses in water supply systems.

Each of these principles requires a balanced and well-developed approach that contributes to the long-term sustainability of water resources on campus.

Political and legal aspects of sustainable water development

1. Standardization and regulation

Implementation and maintenance of strict water quality standards as well as regulation of water disposal and water supply for sustainable use of water resources.



2. Water rights

An effective and transparent water rights system that ensures equitable distribution of water resources and takes into account environmental and social factors.

1. Maximizing water reuse. Reuse of building effluents after treatment can successfully address crisis situations in water-scarce regions. In many parts of our country, there are serious problems with water supply because of the scarcity of water resources, and as a result, water-saving technologies are becoming extremely important.

Technological aspects of sustainable water development

1. Efficient water supply

Application of modern technologies to minimize water losses in water supply systems and improve distribution efficiency.

- Action:
- Introduction of "smart" water monitoring and management systems.
- Use of low leakage materials for pipelines.
- Metrics:
- Water losses in water supply systems.
- Energy savings in water supply systems.

2. Sustainable use and treatment of wastewater

Wastewater treatment technologies should be energy efficient and allow for the reuse of water.

3. Policy of maximum water reuse in al-Farabi KazNU

Al-Farabi KazNU implements a policy of saving natural resources and makes a significant contribution to solving the problem or, at least, to alleviate it, appear to be the following measures:

Incentives to reduce water consumption;

- water regeneration;

Reuse of run-off and rainwater;

Reuse of already used water reduces pollution of natural wastewater bodies. Rainwater harvesting in baths or reservoirs, followed by planned use, prevents overloading of the sewer network in the event of heavy rainfall. In addition, if domestic sewage and sewage drains merge into a single sewer, it allows less dilution



of sewage, otherwise it would disrupt the biological cleaning phase. Depending on the quality of the end product, cleaning can be more or less difficult.

Secondary use is permitted provided that there is full environmental safety (i.e., no damage to the established ecosystem, soil and cultural plants) and no risk to the local population in terms of sanitation hygienically. Thus, it is very important that any such project comply closely with the health and safety regulations in force, as well as existing industry and agriculture regulations.

In most cases, pre-treatment is carried out to ensure that water can be reused. The choice of the degree of such cleaning is determined by the health and safety requirements and cost parameters. To organize the supply of secondary regenerated water after purification, a dedicated distribution pipeline is necessary.

In accordance with the University's water reuse policy, there are three main categories for the use of regenerated water:

- irrigation systems: watering of cultivated plants intended for the production of food for human consumption and pets, as well as non-food products, watering greenery plots, garden and park areas and sports facilities;

- Civil purpose: cleaning of bridges and sidewalks of settlements, water supply of heating and air-conditioning networks, water supply of secondary water distribution networks (separate from drinking water supply) No direct use of such water in civil buildings except toilet and toilet drainage systems;

- industrial use: supply of fire extinguishing systems, production circuits, washing systems, thermal production processes with the exclusion of applications involving contact of secondary regenerated water with food, pharmaceutical and cosmetic products.

Prior to reuse of regenerated water, a certain level of quality must be ensured, especially with regard to sanitary requirements.

Traditional treatment methods for discharge water are insufficient to ensure this quality.

Environmental aspects of sustainable development by water resources

This aspect includes scientific and innovative and educational integration in the field of:

- Protection and restoration of aquatic ecosystems;
- Developing measures to protect rivers, lakes and reservoirs from pollution and destruction,
- Management of water resources, taking into account the needs of all ecosystems;



- Adaptation of water systems to climate change, including the risk of droughts, floods and sea-level rise;
- Developing and implementing sustainable water management plans in the face of climate change.
- The University counts the reuse of water by accumulating water resources in special underground reservoirs of volumes of more than 500 m³.
- After mechanical treatment of drainage and wastewater, the Production Support Department waters the greenery on campus.

Each of these environmental aspects is necessary to create a sustainable, balanced and effective water management system that takes into account human and natural needs. The system must be flexible to adapt to changing conditions and challenges.

Social aspects of sustainable development by water resources

1. Access to clean drinking water

Ensuring sustainable and equitable access to clean drinking water for all segments of the population, including remote and low-income areas, through training on educational programs «Hydrology», «Ecology», «Geoecology and environmental management».

2. Public participation in water resources management

Involve citizens and communities in decision-making on water management. Organization of the conference, forums, round tables, blitz-reports at the international and national level, as well as development of training courses on the topic of water management.

3. Education and awareness

Raising public awareness and education on sustainable water management through the integration of sustainable water management into higher education programmes, media and social media campaigns.

The implementation of these social aspects requires an integrated approach, including close cooperation with the technological and environmental aspects of water management. Only through joint efforts can the sustainable and equitable use of water resources be achieved.

Economic aspects of sustainable development on water resources



This aspect includes:

- Assessment of the current status of water supply and establishment of a longterm modernization plan;

Implementation of technologies to improve water efficiency in all areas of the economy;

- optimizing the use of water resources to meet economic needs without affecting ecosystems;

- Preparation of an application for the competition for republican grant funding, international funds and organizations for funding scientific projects on water resources.

Economic aspects play a key role in the sustainable development of water resources. They should be integrated with technological, environmental and social aspects to create an integrated and sustainable water management system.

Plan for Minimizing Physical, Chemical, and Biological Changes in Aquatic Ecosystems

As part of the environmental dimension of Al-Farabi Kazakh National University's sustainable water resources development, a comprehensive plan has been established to minimize adverse physical, chemical, and biological changes in aquatic ecosystems. This plan aims to preserve and restore the natural state of water bodies, enhance ecosystem resilience, and promote the sustainable and rational use of water resources. Its implementation provides a bridge between strategic objectives and practical monitoring measures.

1. Physical Measures

- Restoration of natural riverbeds and shorelines on campus, including bank stabilization with vegetation to prevent erosion and degradation of riparian zones.

- Regulation of water withdrawal and flow control to prevent sudden fluctuations in water levels and safeguard aquatic ecosystems.

- Establishment of buffer zones, such as green belts along water bodies, to minimize anthropogenic impacts.

- Restriction of construction and engineering activities without prior environmental impact assessment on aquatic systems.

2. Chemical Measures

- Treatment of wastewater and industrial effluents before discharge into campus water bodies.

- Reduction in the use of chemical substances on campus, including pesticides, fertilizers, and agrochemicals.

- Regular monitoring of water quality to ensure early detection and mitigation of pollutants.



- Containment and neutralization of pollution sources, including petroleum spills and household chemical residues.

3. Biological Measures

- Conservation and restoration of native flora and fauna, including aquatic plants and microbial communities.
- Management programs to prevent and control invasive species that threaten biodiversity in water bodies.
- Creation of protected aquatic zones and reserves on campus to safeguard sensitive ecosystems.
- Educational outreach and community engagement, fostering awareness among students, staff, and campus residents about the importance of protecting aquatic ecosystems.

4. Integration with Technological and Monitoring Systems

- Deployment of environmentally sensitive water treatment and reuse technologies, ensuring minimal ecological impact.
- Establishment of a systematic monitoring program to track physical, chemical, and biological parameters of water bodies.
- Data-driven adaptation of management measures, allowing continuous improvement in ecosystem protection strategies.

5. Expected Outcomes

- Reduced degradation of riverbanks, shorelines, and natural watercourses.
- Improved water quality across campus and decreased chemical pollution.
- Preservation and restoration of biological diversity in aquatic ecosystems.
- Enhanced resilience of water ecosystems to anthropogenic pressures and climate-related changes.

This plan serves as a foundational step towards implementation and monitoring, linking strategic objectives with practical measures to ensure sustainable water management on campus.



Implementation and monitoring of sustainable development by water resources

1. Implementation phases

Identification of key stages in the implementation of the sustainable development strategy, from planning to implementation and evaluation of effectiveness.

- Action:
 - Develop a detailed implementation plan with clear deadlines and responsibilities.
 - Pilot projects to test the applicability of solutions.
- Metrics:
 - Respecting Deadlines.
 - Level of achievement of stated goals and objectives.

2. Monitoring mechanisms

Establish a tracking system for indicators to measure progress and effectiveness of implementation.

- Action:
 - Create a database for the collection and analysis of information.
 - Regular reports and audits.
- Metrics:
 - Accuracy and timeliness of data.
 - The results correspond to the original forecasts and plans.



3. Maximum water reuse at the University:

1. Employees of the Department of Industrial Support promptly and timely carrying out the repair of plumbing equipment.
2. Installed individual meters (meters) of water on the main and distribution engineering networks of the University to account for water consumption.
3. Near the sanitary units (sinks) there are reminders of the need to save money and it is advisable to use water.
4. Information on cooperation with global institutions on water security
5. Application of new alternative treatment and disinfection technologies that reduce the levels of microbes, nutrients and toxic substances in water.

3. Adjustment of the strategy

Change concept based on data and feedback.

- Action:

- Analysis of monitoring results to identify weak points.
- Adapting the strategy to changing circumstances.

- Metrics:

- The effectiveness of the changes.
- Matching changes to needs and realities.

Planning, implementation, monitoring and adjustment are key elements for the successful implementation of the concept of sustainable development of water resources. This process requires a comprehensive approach and active interaction of all structural departments of the university.