

EFFECTIVE AND ECONOMICAL METHODS FOR PREVENTING DROUGHT IN DIFFERENT REGIONS

Qulliyev Oxunjon Anvar o'g'li

Bukhara State University, Department of Economics

Abstract. This thesis examines the increasing problem of drought under current climate change conditions and its impact on agriculture, water resources, and regional economic development. It discusses effective and economically feasible methods for preventing and reducing the negative consequences of drought, including efficient water management, modern irrigation technologies, drought-resistant crops, rainwater harvesting, soil moisture conservation, and the expansion of green areas. The study also considers the importance of economic incentives, investment in water-saving technologies, financial support for farmers, and improved regional water management. The implementation of these measures can contribute to sustainable agricultural production, reduce water losses, and increase the economic resilience of drought-prone regions.

Keywords: drought, climate change, water resources, water scarcity, water-saving technologies, drip irrigation, drought-resistant crops, soil moisture, economic efficiency, agriculture.

Introduction

Drought is a complex natural and socio-economic phenomenon characterized by a prolonged period of insufficient precipitation and a significant reduction in available water resources. In recent years, climate change, increasing temperatures, population growth, and rising demand for water have increased the risk of drought in many regions. Water scarcity has a particularly serious impact on agricultural areas, where insufficient water can lead to lower crop yields, increased production costs, and reduced household incomes.

Preventing drought and reducing its consequences require not only increasing water supplies but also using existing water resources more efficiently. Therefore, the development of economically efficient and environmentally sustainable methods of water management is becoming increasingly important. The combination of modern technologies, appropriate agricultural practices, economic incentives, and effective water governance can significantly reduce the vulnerability of regions to drought.

Main Part

One of the most effective approaches to reducing the impact of drought is the **introduction of water-saving irrigation technologies**. Traditional irrigation methods often result in considerable water losses due to evaporation, infiltration, and inefficient

distribution. Drip irrigation allows water to be delivered directly to the root zone of plants in controlled quantities. As a result, water consumption can be reduced, while crop growth and productivity can be maintained.

Sprinkler irrigation is another efficient method that can be used in areas where water resources are limited. Although the installation of modern irrigation systems requires initial investment, these technologies can become economically beneficial in the long term because they reduce water and energy consumption and may improve agricultural productivity.

Another important measure is the **cultivation of drought-resistant crop varieties**. Growing crops that require large amounts of water in water-scarce regions is not always economically efficient. Therefore, farmers should select crop varieties that are adapted to local climatic conditions and are more resistant to high temperatures and insufficient moisture. Drought-resistant varieties can help maintain relatively stable yields even during periods of water shortage.

Soil moisture conservation is also an important component of drought prevention. Agricultural practices such as mulching, the application of organic fertilizers, minimum tillage, and improvement of soil structure can increase the ability of soil to retain moisture. When soil moisture is preserved for a longer period, the need for irrigation decreases. This can reduce water, energy, and labor costs for farmers.

Another economically beneficial method is **rainwater harvesting**. Special reservoirs, small water-storage facilities, and rainwater collection systems can be used to collect and store water during periods of precipitation. The stored water can subsequently be used during dry periods for agricultural production, livestock, and other purposes. This approach can provide an additional source of water and reduce pressure on existing water resources.

Modernization of irrigation infrastructure is also essential. Old and poorly maintained irrigation canals can cause significant water losses through seepage and evaporation. Repairing canals, lining them with appropriate materials, introducing closed-pipe systems, and installing modern water-control equipment can significantly improve water-use efficiency.

The development of **forest belts and shelterbelts** is another important measure. Trees can reduce wind speed, protect agricultural land from wind erosion, and contribute to the conservation of soil moisture. The establishment of shelterbelts around agricultural fields can reduce the drying of soil and improve local environmental conditions.

Economic mechanisms also play an important role in drought prevention. **Subsidies, preferential loans, and financial incentives** can encourage farmers to adopt water-saving technologies. Providing financial assistance for the installation of drip irrigation systems and other efficient technologies can reduce the initial

investment burden on farmers. In the long term, these investments can result in lower production costs and more stable agricultural incomes.

Agricultural insurance can also help reduce the economic risks associated with drought. Severe drought can cause significant crop losses and financial difficulties for farmers. Appropriate insurance mechanisms can compensate for part of these losses and improve the financial stability of agricultural producers.

The application of **digital technologies** provides additional opportunities for efficient drought management. Soil-moisture sensors, weather monitoring systems, satellite observations, and automated irrigation systems can help determine the actual water requirements of crops. By applying water according to real-time conditions, farmers can avoid unnecessary irrigation and reduce water and electricity consumption.

In addition, **public awareness and environmental education** are important elements of drought prevention. Farmers and local communities should receive information about water-saving technologies, efficient agricultural practices, and sustainable water management. Improving knowledge and awareness can encourage responsible water consumption and strengthen the ability of communities to adapt to drought.

Economic Efficiency

The economic efficiency of drought-prevention measures depends on the relationship between initial investment and long-term economic benefits. For example, the installation of a drip irrigation system requires financial resources at the beginning. However, reduced water consumption, lower energy costs, and more stable crop yields can make such investments economically beneficial over time.

Similarly, the use of drought-resistant crop varieties is a relatively inexpensive adaptation strategy because it does not necessarily require major infrastructure investments. Farmers can achieve better results by combining several measures rather than relying on a single method. For example, the simultaneous use of drip irrigation, drought-resistant crops, mulching, and rainwater harvesting can significantly reduce the risks associated with drought.

Practical Recommendations

The following measures are recommended for preventing and reducing the consequences of drought in different regions:

- widespread introduction of water-saving irrigation technologies;
- cultivation of drought-resistant and locally adapted crop varieties;
- reduction of water losses in irrigation canals;
- development of rainwater harvesting and storage systems;
- application of agricultural practices that conserve soil moisture;
- expansion of shelterbelts, forests, and green areas;
- provision of preferential loans and subsidies for water-saving technologies;

- development of drought monitoring and early-warning systems;
- improvement of agricultural insurance mechanisms;
- increasing farmers' and local communities' knowledge about efficient water management;
- introduction of digital technologies for monitoring soil moisture and crop water requirements;
- improvement of regional water-resource management and planning.

Conclusion

In conclusion, preventing drought and reducing its negative consequences are essential for the environmental sustainability and economic development of different regions. Under conditions of increasing water scarcity, the main objective should not only be to search for new water sources but also to use existing water resources efficiently and economically.

Water-saving irrigation technologies, drought-resistant crops, soil-moisture conservation, rainwater harvesting, improved irrigation infrastructure, and forest protection measures represent some of the most effective approaches to drought adaptation. At the same time, economic incentives such as subsidies, preferential loans, agricultural insurance, and investment support can increase the practical effectiveness of these measures.

Therefore, successful drought management requires an **integrated approach combining environmental, technological, agricultural, and economic measures**. Such an approach can help conserve water resources, stabilize agricultural productivity, reduce financial losses for farmers, and strengthen the resilience of regions to climate change and future drought events.

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