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# “QURILISHDA YASHIL IQTISODIYOT, SUV VA ATROF-MUHITNI ASRASH TENDENSIYALARI, EKOLOGIK MUAMMOLAR VA INNOVATSION YECHIMLAR” MAVZUSIDAGI RESPUBLIKA MIQYOSIDAGI ILMIY-AMALIY KONFERENSIYA TASHKILIY QO‘MITASI

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# Rainwater harvesting and treatment technologies: efficiency and prospects in the context of uzbekistan

**H.A. Kosimova[1], M.N. Abdukadirova[1]**
[1]Research Institute of Environmental Protection and Nature Conservation Technologies, Tashkent, Uzbekistan

Abstract: This article analyzes the importance, effectiveness, and future development prospects of rainwater harvesting and recycling technologies in Uzbekistan. In the context of limited water resources and climate change in the country, rainwater harvesting is an important factor in alleviating water supply problems. The study provides information on various technical solutions - water harvesting areas, filtration systems, and storage facilities, and assesses their environmental and economic effectiveness. It also discusses the possibilities of widespread implementation of these technologies in agriculture and the lives of the population and the problems associated with them. In conclusion, it is necessary to strengthen the regulatory and legal framework, technologies appropriate to local conditions, and public awareness campaigns to expand the use of rainwater in Uzbekistan.
Keywords: Rainwater, water harvesting, purification technology, secondary use, environmental sustainability.

## 1. Introduction

Nowadays, as water sources are becoming increasingly scarce, both wastage and pollution of water present serious challenges. It is important to foster a shift in people's attitudes and encourage the preservation of water. In this regard, the effective use and protection of water resources is one of the most pressing issues. I believe that everyone must approach this important task with equal responsibility [7].

Our President Shavkat Mirziyoyev also paid serious attention to this area, and in order to improve and alleviate the situation, Resolution No. PP-4040 was adopted on November 30, 2018. Accordingly, it includes the following goals: to introduce modern information and resource-saving technologies that ensure metering and monitoring in the water supply and sanitation sector, to equip consumers with modern equipment and devices that meter drinking water, to meet sanitary requirements in housing construction, including the design, reconstruction and construction of sewage systems together with drinking water supply systems, to strengthen the sustainability of the activities of water supply and sanitation enterprises by introducing a new policy that ensures full self-sufficiency in the supply and sale of drinking water, and to involve the private sector in the management and operation of water supply and sanitation facilities, to improve the system of training, retraining and advanced training of personnel in the water supply and sanitation sector based on advanced foreign experience, to introduce information and communication technologies and innovative solutions, as well as modern techniques for metering drinking water [10]. In addition, Resolution No. PP 4486 "On measures to further improve the water resources management system" was adopted on 09.10.2019. The purpose of this resolution is to ensure the comprehensive use and management of water resources, further improve the system of using water management facilities, ensure the effectiveness and development of irrigation and land reclamation projects, organize market relations and mechanisms in the water management system, as well as improve science in this area [8].

The Law of the Republic of Uzbekistan No. ZURQ-784 dated 22.07.2022, the Resolution "On Drinking Water Supply and Wastewater Discharge" is also expected to introduce significant changes in this area. The purpose of this Law is to regulate relations in the field of drinking water supply and wastewater discharge [9].

## 2. Relevance of the topic

Rainwater, as a natural atmospheric source, plays a vital role in maintaining the water balance and ecological stability of a region. This water resource:

increases soil moisture;
recharges groundwater;
optimizes urban drainage systems;
serves as a source for reuse in technical and domestic needs.

Atmospheric precipitation is a significant part of the hydrological cycle, helping retain soil moisture, support plant growth, and replenish drinking water sources. Rainwater contributes to the enrichment of water resources such as rivers, lakes, and underground aquifers.

Furthermore, rain has a crucial role in regulating climate. Whether a region is dry or humid largely depends on the amount of rainfall it receives. In agriculture, productivity is directly linked to precipitation levels, and insufficient rain can negatively affect crops.

According to experts, at least 40–60% of rainwater collected in urban and rural areas can be reused for secondary purposes [1].

Efficient rainwater management in Uzbekistan is essential for conserving water resources, developing agriculture, and preventing natural disasters. Data on rainfall levels over the past five years show an upward trend, indicating growing opportunities for utilizing this resource.

Rainwater is mainly collected and stored through reservoirs, canals, and collector-drainage systems. In urban areas, however, drainage and sewage systems are not fully developed, leading to flooding on roads during heavy rains due to incomplete infrastructure.

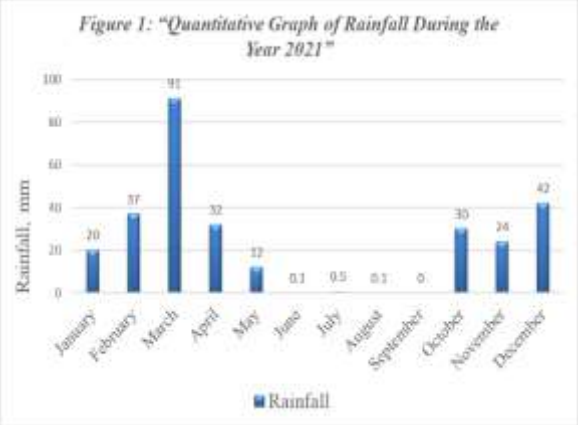

*Figure 1: "Quantitative Graph of Rainfall During the Year 2021"*

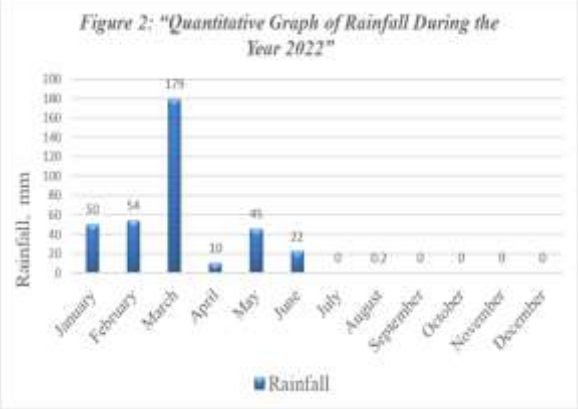

*Figure 2: "Quantitative Graph of Rainfall During the Year 2022"*

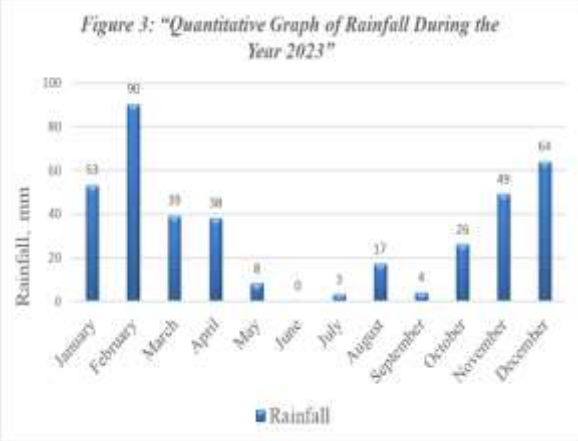

*Figure 3: "Quantitative Graph of Rainfall During the Year 2023"*

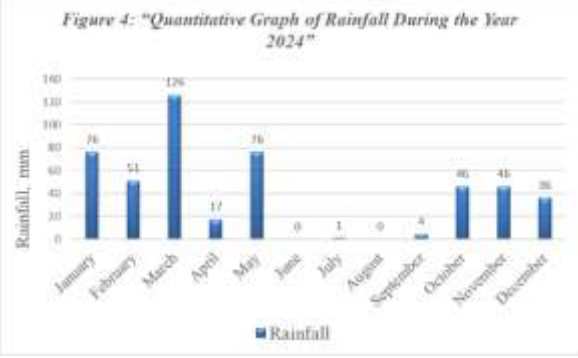

*Figure 4: "Quantitative Graph of Rainfall During the Year 2024"*

Under current conditions of climate change, drought, and water scarcity in Uzbekistan, the introduction of new technologies and projects for rainwater harvesting and efficient usage can greatly contribute to sustainable water resource management [2].

**Fig. 1. Streets of Tashkent after rainfall**

Special equipment or complex structures are not required to collect rainwater. Often, such systems simply consist of collecting water flowing from rooftops into containers through pipes. Using tanks, reservoirs, or special collection tanks, rainwater can be stored for future use. These containers must be clean, covered, and placed in shaded areas to maintain water quality and protect it from contamination.

### Rainwater Harvesting Technologies

The main current methods of rainwater harvesting include:

Rooftop collection systems – Rainwater flowing from roofs covered with slate, metal, or tiles is directed through pipes into storage tanks.

Open surface collection method – Rainwater from roads, fields, or yards is collected through drainage systems.

Integrated systems in supermarkets, industrial sites, and public buildings: Water from large surface areas is automatically gathered into specialized reservoirs [3].

Rainwater can be used not only for garden irrigation, but also for various technical and domestic purposes, such as:

watering gardens and yards;
washing cars and outdoor areas;
cleaning tools and equipment;
toilet flushing;
mixing cement in construction;
industrial technical use.

These applications not only help conserve water but also reduce expenses and support environmental sustainability.

## 3. Experiment methodology

Water Purification Technologies and Their Limitations – Although rainwater is conditionally clean, it is not always safe for direct use. It may contain debris, gravel, heavy metals, small particles, and microorganisms. Therefore, the following purification steps are necessary:

Mechanical filtration – Mesh screens and filters are used to capture large debris.

Sand filters – Effective for removing fine particles through mechanical cleaning.

Carbon filters – Help remove organic substances and gases.

Ultraviolet (UV) or ozone treatment – Used for disinfection and eliminating microorganisms.

Unfortunately, many of these systems are either expensive or energy-inefficient. A more economical solution

is the multi-stage natural filter system (multi-stage bio-sand filter) [4].

Main stages of the system:

[1] Mechanical filtration – Using mesh screens or grates to remove leaves, dust, stones, and coarse debris from rooftop or surface water.

[2] Sand filter – Multi-layered sand and gravel capture smaller particles. Water slowly passes through the sand, allowing both mechanical and partial biological purification.

[3] Activated carbon or coconut fiber layer – Used to reduce odor, color, some bacteria, and heavy metal residues. Roasted coconut shells can be used as a low-cost alternative.

(Optional) UV or solar disinfection – Placing water in the sun for 6–8 hours can make it relatively safe by eliminating bacteria and viruses [6].

Advantages of this system:

Built from local materials: sand, gravel, coconut shell, and metal mesh are widely available.

Minimal maintenance: requires only periodic replacement of sand and carbon.

No electricity required: operates through natural gravity flow.

Low installation cost: small systems can be built for approximately 3–5 million UZS.

Long service life: with proper maintenance, the system can operate effectively for 3–5 years.

For technical uses such as floor cleaning, garden watering, or toilet flushing, the first two or three purification stages are usually sufficient.

The multi-stage natural filter is a cost-effective, efficient, and technically simple purification method. It offers not only economic but also ecological sustainability. This system can be widely implemented in small households, schools, kindergartens, and community housing [5].

## 4. Conclusion

Collecting and purifying rainwater for secondary use is one of the key directions for conserving water resources and ensuring environmental sustainability. Although rainwater harvesting is not yet widely implemented in Uzbekistan, it is important to adopt practical and innovative approaches to utilize the available potential. If the proposals in this article are implemented, they can improve water supply and raise public ecological awareness.

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## Information about the authors

**Abdukadirova M.N.** Associate Professor, “Tashkent Istitute of Irrigation and Agricultural Mecanization Engineers” National Research University.
E-mail: mabduqodirova78@mail.ru
Tel.:+998 90 123 06 60
https://orcid.org/0000-0003-1188-2662

**Qosimova H.A.** Doctoral Student, Research Institute of Environmental Protection and Nature Conservation Technologies.
E-mail: khilolakakhkharova@mail.ru
Tel.:+998900649911
https://orcid.org/0009-0008-0624-5339

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