Integrated Water Resources Management in Kosovo

CEDE
Center for Education and Development of Environment

INTEGRATED WATER RESOURCES MANAGEMENT IN KOSOVO

(IWRM-K) – PHASE 2

MAY 2024 – APRIL 2029

# RAINWATER HARVESTING SYSTEM

## Practical report for schools, municipalities and public institutions

*Based on the pilot project at Primary and Lower Secondary School "Xheladin Gashi - Plaku", Komoran, Municipality of Drenas*


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Integrated Water Resources Management in Kosovo

CEDE Center for Education and Development of Environment

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## List of acronyms:

| | |
|---|---|
| **KEPA** | Agency for Environmental Protection of Kosovo |
| **WSRA** | Water Services Regulatory Authority |
| **CEDE** | Center for Education and Development of Environment |
| **EAA** | Environment Agency Austria |
| **IHMK** | Hydrometeorological Institute of Kosovo |
| **IWRM-K** | Integrated Water Resources Management in Kosovo |
| **MESP** | Ministry of Environment and Spatial Planning |
| **SDC** | Swiss Agency for Development and Cooperation |

## 1. Executive Summary

This report presents the implementation and replication model of a system for the collection and use of rainwater in schools and other public facilities. The model is based on the pilot project “Rain for Resilience – Strengthening Local Water Use Practices”, carried out by the Center for Education and Development of Environment (CEDE) at the Primary and Lower Secondary School "Xheladin Gashi - Plaku" in Komoran, Municipality of Drenas. The project was developed within the IWRM-K program and aims to show how a public facility can use rainwater as an alternative source for non-potable needs.

The project addresses a simple and very practical problem: in many schools and public institutions, water treated for drinking is also used for irrigation, external cleaning and maintenance. This increases the pressure on the water supply network, especially in dry periods, and loses the opportunity to treat rainwater as a local resource. The pilot project turns the roof of the school into a collection surface, the courtyard into a demonstration space and the technical system into an educational tool for students.

Through this project, a system consisting of a network of pipes for collecting water from the roof, inspection chamber and inlet filter, underground tank of reinforced concrete, pump, sprinkler and drip irrigation system, taps with sensors and digital irrigation control through the Rain Bird application has been installed in Komoran. A water level sensor is also included for monitoring. The system is designed for non-potable uses: lawn irrigation, exterior cleaning, maintenance and, as needed, as an alternative source for public services such as firefighters and cleaning operators.

The roof catchment area of the pilot facility is 1,838.7 $m^2$, while the data from IHMK of 700 mm of average annual rainfall in the Municipality of Drenas were used for the calculation. With a practical efficiency of about 80%, the system can provide approximately 1,000,000 liters of usable water per year, or about 1,000$m^3$. The tank has a capacity of about 40 $m^3$, with dimensions of 6 m x 4.2 m x 1.6 m. This means that, in operational use, the system can replace around 25 full tank fills per year with water that would otherwise be drawn from the drinking water network.

The integrated system package in the pilot model was valued at EUR 26,796. This amount does not only represent the construction of the tank, but includes a wider technical intervention: works, concrete tank, pipes, filtration, pump, irrigation system, level sensor, sensor taps and irrigation control elements. For this reason, this value should only be taken as an indicative reference for a similar integrated system, not as a standard price for each facility.

Using the volumetric tariff of the water supply for the non-domestic/commercial and institutional category of KRU "Prishtina" for the year 2026, of 0.8248 EUR/$m^3$, the replacement of about 1,000 $m^3$ of drinking water per year represents a tariff value of about 824.80 EUR/year. However, this indicator should be read as an illustration of the practical impact of the system, not as the main financial rationale for the investment. The main value of the model lies in the reduction of drinking water use for non-potable needs, the creation of an alternative local source, the potential support for firefighters and public services, the improvement of green spaces and the educational use of the system by schools.

| KEY INDICATOR | VALUE |
|---|---|
| Location: | Primary and Lower Secondary School “Xheladin Gashi - Plaku”, Komoran, Drenas |
| Roof surface: | 1,838.7 $m^2$ |
| Precipitation used in the calculation: | about 700 mm/year |
| Practical efficiency of the system: | about 80% |
| Estimated usable water: | about 1,000,000 L/year (1,000 $m^3$/year) |
| Tank capacity: | about 40 $m^3$ / 40,000 L |
| Reserve for firefighters: | 10 $m^3$ / 10,000 L reserved for emergency use by the Fire Department |
| Faucets with sensors: | 8 pcs |
| Irrigation area: | 1,640.47 $m^2$ |
| Contracted cost: | 26,796 EUR |
| Principal Beneficiaries | School, students/staff, municipalities, firefighters, public services |

*Table 1: Main data of pilot model in Komoran*

***Note:***
*The model is replicable when treated as a combination of infrastructure, maintenance, education and institutional responsibility. If it is built only as a technical investment, without ownership and a maintenance plan, it risks losing functionality after delivery.*

## 2. The context and problem the project addresses

Kosova has limited water resources and still limited capacities for their accumulation, storage and long-term management. The review of the State Strategy for Water 2023–2027 emphasizes that renewable water reserves in Kosovo are relatively few, that only a small part of water comes from outside the territory of the country, while internal water is mainly generated by rainfall. This makes rainfall management and more rational use of water an important issue for public institutions, especially at the local level.[1]

The annual report of the Environmental Protection Agency of Kosovo (KEPA) on the state of the environment 2024 treats water as one of the main environmental components. KEPA emphasizes that general water resources are used mainly for urban, industrial and agricultural purposes, while pollution, untreated discharges, uncontrolled use of resources and damage to river beds continue to be pressures on water bodies. In this context, any measure that reduces the use of potable water for non-potable purposes is a practical measure of sustainable management.[2]

National water strategies and the revised MESP documents call for more integrated, coordinated and actionable management of water resources. This means that municipalities should not only expect large central investments in dams, networks and plants. They [3] can undertake small and medium measures in public facilities: rainwater harvesting, use of non-potable water for irrigation, reduction of losses, education of students and better maintenance of public spaces.

Our pilot project addresses exactly this scope of action. It does not replace the public water supply system and does not treat rainwater as drinking water. On the contrary, it saves potable water by using rainwater where the potable water standard is not required: in irrigation, external cleaning and technical needs. This is especially important for schools, because they have large roofs, yards that require irrigation, daily users, and direct educational potential.

To identify the same problem in other locations, the focus should be on three issues: is potable water used for non-potable needs; does the facility have sufficient roof surface and infrastructure for water collection; and is there a real need for irrigation or maintenance that can be covered by rainwater. If these three conditions exist, then the facility is a serious option for replication.

[1] Ministry of Environment, Spatial Planning and Infrastructure (MESP). "Revision of the State Water Strategy 2023-2027 and Action Plan 2023-2025". Pristina, 2023, p. 12.

[2] Environmental Protection Agency of Kosovo (KEPA). Annual report on the state of the environment 2024, published 2025. https://www.KEPA-rks.net/assets/cms/uploads/files/Raporti%20vjetor%20i%20gjendjes%20se%20mjedisit%202024%20al.pdf

[3] MESP. Review of the State Water Strategy 2023-2027 and Action Plan 2023-2025. https://MESP.rks-gov.net/MESPFolder/OtherDocuments/RISHIKIMI_I_STRATEGJIS%C3%8B_SHTET%C3%8BRORE_P%C3%8BR_UJ%C3%8BRA_2023-2027_DHE_PLANI_I_VEPRIMIT_2023-2025_SHQIP.pdf

## 3. Purpose and objectives of the rainwater harvesting system

The system was created in order to demonstrate a functional model for the collection, storage and use of rainwater in a public school facility, with the aim of saving drinking water, increasing local adaptability to dry periods and promoting practical education for rational use of water.

Furthermore, the system is designed to achieve the following goals:

- The use of potable water for irrigation, external cleaning and maintenance of school premises is reduced;
- A safe and functional technical system is installed for the collection of water from the roof, initial filtration, storage in the tank and distribution for non-potable uses;
- Increase awareness of students, staff and the community about sustainable water management and adaptation to climate change;
- This creates a documented model that can be used by other municipalities for schools, kindergartens, youth centers, sports facilities or administrative buildings.

For municipalities, the value of this model lies in the fact that it can be adapted according to the size of the facility. A small school may use a modular or plastic tank, while a large public facility may require a concrete tank, structural design, and more advanced surveillance. However, the principle remains the same: calculate the water potential, determine the actual use, design the system as needed and ensure maintenance after completion.

The following table presents the main problems commonly encountered in public facilities and how the rainwater harvesting model can contribute to addressing them.

| LOCAL PROBLEM | HOW THE RAINWATER MODEL HELPS |
|---|---|
| Use of potable water for irrigation and cleaning | Replaces part of the consumption with water collected from the roofs. |
| Droughts and hot periods | Saves water during rainfall and makes it available in times of need. |
| School yards with poor greenery | Enables more regular irrigation with drip/sprinkler system. |
| Lack of practical education | Turns the school into an open laboratory for learning about water, climate and the environment. |
| Public services in need of alternative water points | Creates controlled exits for firefighters and cleaning operators. |

| | |
|---|---|
| Infrastructure projects without ownership after delivery | The model requires separation of responsibilities before construction and training after installation. |

*Table 2: Correlation between local problems and solutions provided by the model*

For schools, the value of this model is even greater. Students see the system, understand how water is collected, see how it is used in irrigation and can participate in awareness activities. Thus, the investment does not remain only a technical facility hidden in the ground, but becomes a visible example of sustainable resource management.

## 4. Pilot system location description

The location of the piloted system is Primary and Lower Secondary School "Xheladin Gashi - Plaku" in Komoran, Municipality of Drenas. The facility is suitable for this type of system due to the large roof area, the yard with green spaces, the presence of school staff and the large number of students who can benefit from the educational component.

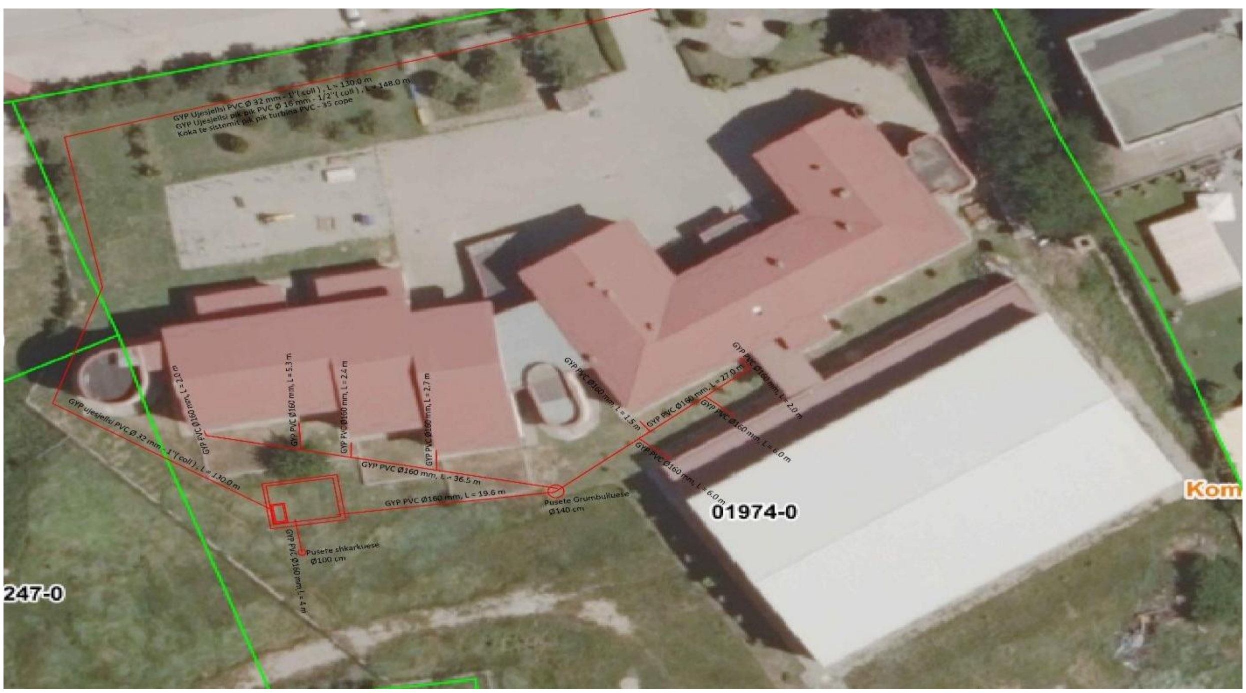



*Photo 1: Pilot location and tank positioning in school space*

The reservoir is located in the school yard, in a position that enables connection to the roof discharges and distribution to the irrigation system. Access for works and maintenance was an important element, because the tank is underground and requires excavation, concreting, waterproofing, covering and controlled access for servicing. For replication, the municipality must verify not only the physical space, but also the safety of students during the works and during subsequent use.

In the calculation of the rainwater potential, the minimum data are the roof area, the average annual precipitation from the IHMK and the runoff coefficient. The coefficient depends on the roof material, slope, gutter condition, filtration losses and tank limitations. For conservative planning, it is recommended to use a coefficient of 0.75-0.90, while in the pilot a practical efficiency of about 80% was used, which brings the operational potential to about 1 million liters per year.

**Basic formula:** Potential water for collection = Roof area x Annual precipitation x Runoff coefficient

Pilot example: 1,838.7 $m^2$ x 700 mm/year x 0.80 ≈ 1,029,672 L/year, so about 1,000 $m^3$ of usable water per year.

The number of direct users includes students and school staff, while indirect beneficiaries are the municipality, maintenance services, the Fire Department in Drenas and the surrounding community.

## 5. Technical description of the system

The system works on a simple logic: rainwater is collected from the roof, directed through gutters and pipes, passes through initial filtration, stored in an underground tank and pumped to points of use. In this pilot, the tank is made of reinforced concrete, with dimensions of 6 m x 4.2 m x 1.6 m and a capacity of about 40,000 liters. Concrete is the strong point of the system, because it provides longevity, mechanical stability and suitability for public buildings, provided that waterproofing and quality control are done well.

An important element of the design is the preservation of a minimum amount of water for emergency use. In the pilot model, about 10,000 liters of water remain reserved for the Fire Department. This has been achieved by not placing the water intake point for irrigation and common uses at the bottom of the tank. In this way, even when the water is used for irrigation, cleaning or maintenance, a minimum amount remains available for refilling in emergency cases. This technical detail is important for replication, because if the system is planned to serve the firefighters as well, the emergency reserve must be foreseen in the design.

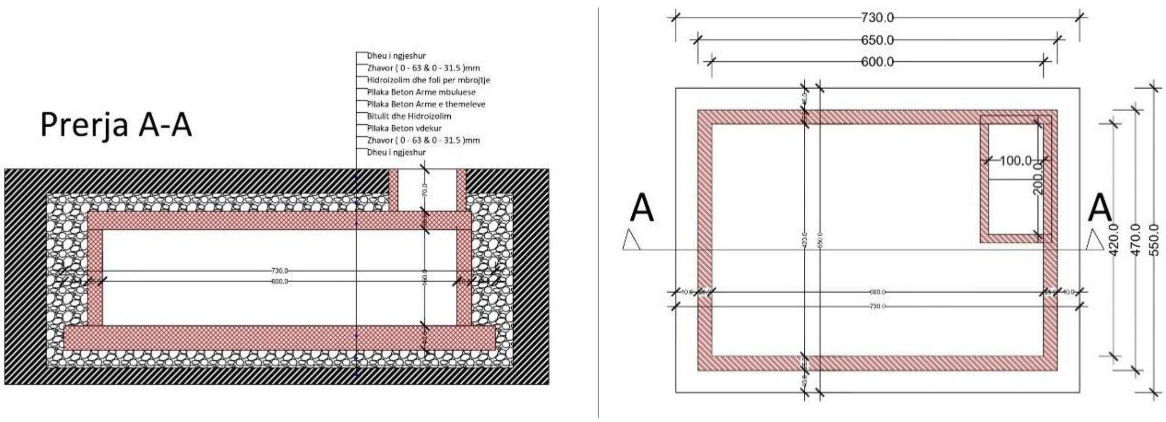



*Photo 2: The base and cut of the rainwater tank*

The main components are:

- Network of gutters and collecting pipes;
- Control functions;
- Incoming filter and waste separation;
- Reserved;
- Pump;
- Valves and distribution pipes;
- Sprinkler and drip irrigation system;
- Digital irrigation control;
- Water level sensor;
- Overflow/overflow; and
- External lock for controlled use by public utilities.

| COMPONENT | FUNCTION IN SYSTEM |
|---|---|
| Roof and gutters | Collect rainwater and direct it to the technical network. Their condition directly affects the quantity and quality of water that reaches the reservoir. |
| Initial filtering | Removes leaves, scales and residues. Clear first flow separation mechanism or equivalent filtering solution is recommended in replications. |

| | |
|---|---|
| Concrete tank | Conserves water underground, protected from physical damage and exposure. It requires quality waterproofing and access to cleaning. |
| Pump and valves | Enable the pressure and distribution of water to irrigation areas and points of use. |
| Irrigation system | Use non-potable water for greening; in the pilot it includes sprinklers and drip-irrigation lines on an area of about 1,640.47 $m^2$. |
| Level sensor and control Rain Bird | Helps in more rational monitoring and management of irrigation, especially when the system has several areas of use. |
| Overflow | Directs excess water in a controlled manner when the tank is full. This is necessary for safety and stable operation. |

*Table 3: Main system components and their function*

The collected water should not be treated as drinking water. For use in schools and public facilities, the safest uses are irrigation, outdoor cleaning and technical uses. Use for drinking, cooking or hygiene would require special treatment, regular laboratory analysis and approvals according to drinking water standards. For replication, this should be clearly stated in the project, on the information boards and in the user manual.

In this pilot no solar energy integration has been applied. However, for larger facilities or for municipalities aiming for a fully independent system, supplying the pump with energy from photovoltaic panels can be considered as an option. This should not be set automatically; pump power, watering schedule, installation cost and maintenance of the solar system should be considered.

## 6. Step-by-step implementation process

For replication, the process is as important as the equipment. The project does not start with the purchase of the tank, but with the assessment of the location, the need and the division of responsibilities. In the piloting of this system, CEDE coordinated the project and procurement, the technical company carried out the works, while the municipality and the school were involved as users and institutionally responsible.

This process represents the practical path from the initial idea to the full functioning of the rainwater harvesting system. It helps municipalities, schools and implementing organizations to plan the investment in a structured way, avoiding errors in dimensioning, procurement, implementation and maintenance.

The following figure presents the main steps to be followed for the planning, implementation, testing and delivery of a functional rainwater harvesting system.

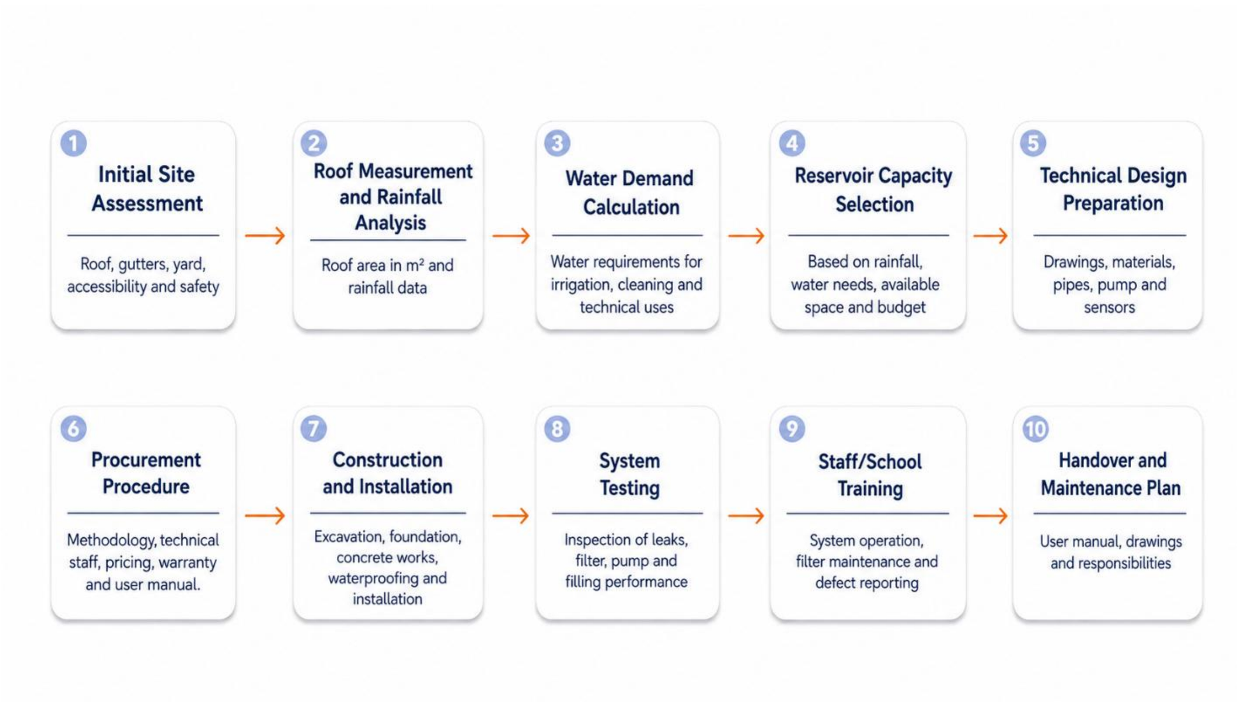



***Figure 1:*** *Step-by-step process of rainwater harvesting system implementation*

## 6.1. Initiation and institutional agreement

In the initial phase, before the design and before the opening of the procurement procedure, a clear institutional agreement must be ensured between the municipality, the beneficiary school/facility and the implementing organization. This agreement should define the reason for the investment, the location where the intervention will take place, the main uses of the system, the way of management and the responsibilities after delivery. Such clarification helps ensure that the system has institutional ownership, is used regularly, and is incorporated into the maintenance practices of the municipality or school.

In the case of the pilot in Komoran, CEDE has held the role of general coordination, while the municipality and the school have been key parties for institutional use and continuity. For replication, the municipality should formalize this role from the outset, even if the project is donor-funded or implemented by an NGO. A short internal decision, a consent, an agreement e-mail or a meeting minutes is enough to prove that the location has been accepted and that the maintenance will be taken over after the technical acceptance.

The product of this stage should be a short project initiation file. It should contain the name of the facility, the reason for the selection, the contact person at the school, the responsible municipal directorate, the expected uses of the water, the known limitations and the decision of who will manage the system after delivery. Without this document, the designer and economic operator can build the system technically, but the long-term use remains unclear.

| | |
|---|---|
| Who leads this stage: | Municipality or implementing organization, in coordination with the school. |
| Indicative duration: | 1 week, if parties are available. |
| Minimum documents: | Decision/agreement on the location, contact persons, brief description of the need. |
| Main risk: | The project is treated as an external investment, not as a municipal/school asset. |
| Solution: | Responsibilities for use and maintenance to be agreed before technical design |

*Table 4: Summary of the initial stage of institutional agreement*

### 6.2. Initial location rating

Site evaluation is the step that determines if the project makes sense. A building may have a great roof but damaged gutters; may have a green yard but no safe storage space; or it may have technical potential, but lack the person who will control the system. For this reason, the first field visit should be done with a practical eye, not only with the aim of confirming the idea.

During the visit, the condition of the roof, the direction of the water flow, the condition of the gutters, the points where the water is currently discharged, the space for placing the tank, the distance from the facility to the tank, the presence of cables or underground installations, access to machinery and the safety of students during the works must be verified. In schools, this phase should be done in conjunction with the principal and technical/maintenance staff, as they are usually best aware of yard problems, runoff during rainfall and practical access limitations.

In the pilot, the location of the tank was chosen in the school yard, with possible access for works and connection to the collecting surface of the roof. This choice is important for replication: the tank should not only be placed where there is space, but where the cost of connections, safety, service access and water use are balanced

***Note:** *The site visit should be completed with photographs, simple sketch, notation of water discharge points and list of obstacles. This short document presents the basis for the designer and for the financial decision of the municipality/organization.*

## 6.3. Climax measurement and precipitation analysis

The peak measurement must be done carefully, because the error at this point affects the whole project. For water collection purposes, it is the effective horizontal surface area that contributes to the flow to the gutters that is important, not just the visual impression of the size of the facility. For facilities with multiple wings, multiple roof levels, or split discharges, the designer must identify which parts of the roof will actually connect to the system.

In Komoran, the catchment area used in the calculation is 1,838.7 $m^2$, while the average annual rainfall is taken as 700 mm/year. The area was measured using the geoportal of Kosovo and the average annual rainfall from IHMK. Using a practical factor of about 80%, the usable potential is estimated at approximately 1,000,000 liters per year. For replication, this calculation should be done in two ways: once with maximum potential and once with conservative coefficient. The conservative calculation is more useful for decision-making because it takes into account filtration losses, overflow, periods when the reservoir is full and rainfall that falls outside the season of use.

At this stage a common mistake should be avoided: to use only the annual amount of precipitation without relating it to the seasonal distribution. In Kosovo, the need for irrigation is higher during dry and hot periods, while rainfall may be more frequent in periods when the demand for irrigation is lower. <u>The reservoir capacity should therefore be dimensioned based on the balance between rainfall, water demand and budget, not just based on the annual total.</u>

| | |
|---|---|
| Who makes it: | Designer/engineer, with school support for facility access and practical information. |
| Documents: | Surface measurement, peak sketch, theoretical and conservative potential calculation. |
| Risk: | Overestimation of the actual amount of water that can be used. |
| Solution: | Using coefficient 0.75-0.90 and verifying real collection points. |

*Table 5: Peak Measurement and Pooling Potential*

## 6.4. Calculation of water needs and priority uses

Once the water collection potential from the roof is assessed, it must be clearly defined what that water will be used for. This is an important stage, because the system should not be designed only to store water, but to use it sensibly and with a clear priority. In schools, the most common uses are lawn watering, outdoor cleaning, yard maintenance, and educational activities. However, in certain locations, the system can also be of significant value to public and emergency services.

In the pilot model at Komoran, one of the priority uses is the possibility of using the tank by the Fire Department. This is directly related to the position of the school and the fact that several surrounding villages gravitate to this area. In the event of a fire in this area, firefighters can refill at the tank located near the school, without having to go all the way back to the main filling point at Drenas. This can positively affect the reaction time, especially in cases where every minute is important.

This function does not replace the main fire department infrastructure, but creates an additional local point for technical water supply. For this reason, in similar projects it should be assessed if the public facility is located in a strategic location for emergency services. If so, the system should provide for convenient access, controlled external locking and a simple procedure for registration of use.

In the pilot model it is planned that about 10,000 liters of water will remain as a reserve for the Fire Department and will not be used for irrigation, cleaning or common uses. This has been solved technically by placing the water intake point for irrigation above the minimum reserve level, so that daily uses do not completely deplete the reservoir. This makes emergency prioritization part of the technical design of the system, not just its management. For replication, the municipality must decide at the design stage whether the system will have a minimum reserve for firefighters and how much this amount should be.

In addition to firefighters, collected water can also be used by municipal operators for cleaning, road maintenance, washing public spaces or watering public greenery. However, these uses must be controlled and not jeopardize the main function of the system.

For replication, uses should be ranked in order of priority: emergency use by firefighters, watering school lawns, exterior cleaning and maintenance, then utility use. This makes the system clearer to manage and more useful to the community.

### 6.5. Selecting tank capacity and type

The reserve is the most visible element financially, but it should not be the first point of decision. Capacity should come from calculation, not from the desire to build as much as possible. A tank that is too small will fill and overflow frequently; a very large tank increases the cost of excavation, concrete, waterproofing and safety, without guaranteeing higher water use.

In Komoran, an underground concrete tank with a capacity of about $40m^3$ has been built. This is a strong solution for longevity and suitable for public facilities with long-term use. For smaller facilities, plastic or modular tanks can be more practical, cheaper and quicker to install. For large schools, the concrete tank remains a serious solution, but requires structural design, quality waterproofing, a secure cover and access for cleaning.

At the reservoir selection stage, the terrain must also be evaluated. Groundwater level, soil stability, access to excavation, and proximity to the facility affect cost and safety. If these are not checked before contracting, the operator may request changes during the works, which increase the cost or create delays.

*Determining the capacity of the reservoir should be related to three questions: how much water can be collected, how much water will actually be used and how much the institution can maintain. The combined answer to these three questions gives the correct size .*

## 6.6. Preparation of the technical project and procurement file

The technical project must turn the idea into an implementation document. It should include not only the outline of the tank, but the entire path of the water: from the roof, through the gutters and pipes, to the filter, tank, pump, irrigation system, overflow and points of use. The clearer this path is in the project, the less room there is for interpretation during bidding and implementation.

The procurement file should ask for clear quantities and specifications. The dimensions, material, grade of concrete, reinforcement, waterproofing, cover and ventilation should be mentioned for the tank. For the installations, the diameters of the pipes, inspection chambers, filter, pumps, valves, irrigation system, level sensor and irrigation control should be mentioned. A user manual, staff training, construction plan and acceptance report are required for delivery.

In replication, procurement documents should be a means to protect quality. When specifications are generic, bidders can offer unmatched solutions. When the specifications are clear, the evaluation committee can compare not only the price, but also the methodology, materials, experience and warranty.

| | |
|---|---|
| Who prepares it: | The designer and the procurement team, with control from the implementing municipality/organization. |
| Documents: | Technical project, preliminary measure, ToR, evaluation criteria, financial form, draft contract |
| Risk: | General specifications allowing weak or unclear offers |
| Solution: | Specifications with quantities, materials, standards, testing, warranty and delivery documents |

*Table 6: Technical project and procurement documents*

## 6.7. Procurement and evaluation of offers

Procurement should be treated as a quality decision, not just a process for selecting the lowest price. In the pilot project, the evaluation of the offers was done by combining the financial aspect with the technical evaluation, in order to select the offer that offers the most suitable solution for the location, the clearest implementation methodology and the best capacity for quality realization.

This approach is particularly important for rainwater harvesting systems, because the quality of workmanship and materials directly affects the long-term functionality of the system. Elements such as excavation, foundation, reinforcement, concreting, waterproofing, underground pipes, filtration, pumps and irrigation system are not easily corrected after the completion of the works. For this reason, an offer should be evaluated not only according to the cost, but also according to the way the operator understands and proposes the realization of the system.

In the pilot project, the evaluation criteria combined price with technical quality. The weight of the financial offer was 50%, while the technical part included compliance with technical specifications, experience and references in similar work, technical capacity and proposed staff, as well as the deadline for implementation. Such a structure helps the procurement decision to be more balanced and more protected from the risk of choosing a technically weak solution.

For replication, it is recommended that the technical criteria be clear from the procurement file. They should require work methodology, school environment safety plan, responsible technical staff, similar references, realistic implementation plan, warranty for key equipment and delivery documents such as user manual, as-built sketch and acceptance record.

During the clarification phase, bidders should be allowed to ask technical questions and the answers should be clear to everyone. After the evaluation, the committee's report must document the professional reasoning why the selected offer is the most appropriate in relation to the price, methodology, technical capacity and quality of the proposed solution.

### 6.8. Works and installations

Works and installations for the rainwater harvesting system must be treated as an integrated phase, where safety, technical quality and final functionality depend on how the field work is organized. When the system is built in an active school, the mobilization of the workshop should include the clear definition of the work area, its enclosure, the path of movement of the machinery, the work schedules, the place of depositing the materials and the way of removing the soil. Students and staff must not have access to the excavation area, while any movement of machinery must be coordinated with the school administration. For this reason, the safety plan must be part of the contract and be implemented throughout the period of works.

Before starting the works, the initial condition of the yard must be documented with photographs. This helps in reporting, monitoring and verifying that the space is returned to an orderly state after completion. During the works, the technical control must be done before the elements are covered. The excavation must respect the dimensions of the project, while the foundation must be prepared and compacted according to the technical requirements, because the tank rests on it. The reinforcement must be checked before concreting, since after the concrete has been poured it can no longer be verified that it has been placed correctly. The same applies to waterproofing, which must be photographed and technically accepted before covering.

In the event that underground water, unstable ground, unforeseen installations or other obstacles are encountered during excavation, the work must be temporarily stopped and a technical solution agreed upon with the municipality, the designer or the supervisor must be sought. Improvised solutions at this stage can create problems later with stability, leaks or maintenance.

After the completion of the construction part, the functionality of the system is ensured through hydraulic installations and follow-up equipment. This includes connecting the pipes from the roof, installing the valves and inlet filter, connecting to the tank, installing the pump, valves, irrigation system, and water level sensor. The inlet filter must be easily accessible for cleaning because water from the roof can carry leaves, dust and particles that damage the pump or fill the tank with debris. The irrigation system is preferably divided into zones, in order to better control the pressure and use the water efficiently. In the pilot model, digital control through the Rain Bird application and a water level sensor were also used; these are not necessary in every case, but are useful for more accurate management, monitoring and reporting.

### 6.9. System testing and acceptance

Testing should be a structured process that verifies that the system functions as designed and is ready for safe use. The procedure should include checking the flow of water from the roof to the tank, the operation of the filter, the inlet to the tank, the absence of leaks, the operation of the pump, the pressure in the irrigation areas, the level sensor, the digital control and the overflow system. The testing must be done before the regular use of the system and before the final delivery to the responsible institution.

For replication, technical acceptance and handover should be treated as an essential part of the project. The technical acceptance report is an instrument that protects the municipality, the school, the economic operator and the implementing organization. It documents the state of the system at the time of delivery, tests performed, possible remarks, deadline for corrections, accepted documents, guarantees, user manual and maintenance responsibilities.

The minutes must be signed by the representative of the municipality, the representative of the school, the economic operator and, when applicable, the technical supervisor or implementing organization. If the system is also intended to be used by the Fire Department or by public service operators, it is recommended that a practical test be carried out with end users and this is evidenced in the handover documentation. This ensures that the system is functional, understandable and ready for institutional use.

*Photo 3: Testing the fire extinguisher and sprinkler system*

### 6.10. Staff training and operational handover

A good technical system can fail if users don't know how it works. The training should be practical and short: how to check the water level, how to activate the irrigation, how to clean the filter, when to notify the municipality or the serviceman, how to protect the system before winter and what not to do. It is not enough that the manual is submitted on paper; there must be a field demonstration.

The training should include the school director, the maintenance person, a representative of the municipality and, if there is a digital system, the person who will have access to the application. For level sensor and digital control systems, it must be determined who stores the data and who uses it for reporting. For sensorless systems, manual logging is sufficient, but must be used regularly.

Operational delivery should include manual, construction schematic, equipment list, servicer/operator contact, maintenance recommendations and monthly registration form. Without these documents, every change of staff in the school weakens the institutional memory of the system.

### 6.11. First delivery period and maintenance schedule

The first three months after delivery are the most important period to understand if the system is being used correctly. In this period, it should be assessed whether the irrigation pressure is sufficient, whether the filter is cleaned in time, whether the application is understood, whether there is a leak, whether the use of public services is clear, and whether the school knows who to contact in case of a problem.

The municipality must make at least one control visit after the first month and one after three months. These visits do not need to be long. Just check the water level, filter, pump, watering areas, covers, safety and maintenance log. If a small problem is identified, it should be solved immediately, because small defects at the beginning often become the reason why the system is neglected.

After a full irrigation season, the municipality can prepare a one-page summary: how much water was estimated to be used, what worked well, what maintenance was done, what costs were incurred and what needs to be changed. This summary is very valuable for replication in the next facility.

| PHASE | ORIENTATIVE TIME | MAIN PRODUCT | MAIN CARE |
|---|---|---|---|
| Initiation and agreement | 1 week | a greement on location and responsibilities | ownership after delivery |
| Location rating | 1 week | brief report with photos and sketch | roof, gutters, access, security |
| Measurements and calculations | 1-2 weeks | water potential and need for use | conservative coefficient and seasonal demand |
| Design and procurement | 3-5 weeks | project, advance measure, ToR and contract | clear specifications and warranty |
| Works/installations | 6-10 weeks | reservoir, pipes, filters, pump, irrigation | documentation before coverage |
| Testing and delivery | 1 week | records, manual, training, as-built | rejection without functional testing |
| Check after delivery | 1-3 months | brief operational report | quick resolution of minor defects |

*Table 7: Indicative plan of system implementation and delivery*

*For replication, the greatest value is not only in the dimensions of the tank, but in the way the process is documented: pre-investment assessment, control during works, delivery testing and responsibility after installation. These make the pattern repeatable.*

## 7. Budget and indicative costs

The budget for a rainwater harvesting system should be planned as an integrated investment, not just the purchase of a tank. The actual cost depends on the size of the facility, the roof area, the distance between the facility and the tank, the type of terrain, the required capacity, the way the water is used and the level of automation of the system. For this reason, any municipality or institution that intends to replicate the model must prepare a preliminary technical assessment before setting the final budget.

In the pilot model at Komoran, the contracted value for the integrated system supply, installation and commissioning package was EUR 26,796. This amount does not refer only to the tank, but to a wider intervention that includes works, concrete tank, pipes, filtration, pump, irrigation system, water level sensor, sensor taps, irrigation control and elements for use by public services, including the possibility of supply by the Fire Department. For this reason, this value should only be taken as an indicative reference for an integrated system and not as a standard price for each facility. In other projects, the cost may vary depending on the size of the roof, tank capacity, pipe spacing, tank type, level of automation, and additional functions required by the municipality.

For such systems, the price should be evaluated together with the technical quality. A cheaper offer may seem more favorable at first, but if there are weaknesses in methodology, materials, waterproofing, filtration, pumping or supervision, it can create higher costs after delivery. Therefore, during procurement, a balance must be sought between price, operator experience, quality of materials, work plan, guarantees and technical capacity to complete the system functionally.

For replication, the budget should be divided into several main categories: technical design, earthworks, construction or placement of the tank, waterproofing, piping, inspection chambers, filtration, pumps, irrigation system, sensors, installation, testing, training and maintenance. When the system is also intended to be used by firefighters, the cost for controlled external access and suitable access for vehicles should also be calculated.

| Reservoir alternative | Eligibility | Advantages | Limitations |
|---|---|---|---|
| Reserved plastic above ground | Small facilities, educational use, limited irrigation | Lowest cost, fast installation, easy maintenance | Limited capacity, damage exposure, visual impact |
| Reserved underground plastic | Facilities with limited space above ground | More protected, less visible | Requires excavation and good foundation |
| Modular system | Facilities where flexibility is required | Can be expanded as needed | Requires quality assembly and careful design |

| | | | |
|---|---|---|---|
| Reserved reinforced concrete | Schools and long-term public facilities | Longevity, greater capacity, structural stability | Higher initial cost, requires professional design and supervision |

*Table 8: Comparison of reservoir alternatives according to suitability, advantages and limitations*

In financial terms, the savings potential can be presented as a supporting indicator. In the pilot, the system is expected to replace around 1,000 $m^3$ of potable water per year for non-potable uses. With the institutional fee of 0.8248 EUR/$m^3$, this represents about 824.80 EUR/year value of water replaced by the network. However, the main value of the system is not only saving on the bill, but creating an alternative source of water, reducing dependence on drinking water, improving the maintenance of public spaces and increasing local capacity for emergency response.

For this reason, the main principle of budgeting should not be the cheapest system, but the most suitable system for the location, use and long-term maintenance.

## 8. Roles and responsibilities

The rainwater system requires institutional ownership. Responsibilities should be allocated before installation, not after the first defect appears. This is one of the main conditions for successful replication.

The municipality should take the main role in securing permits, institutional coordination, involvement of the directorates for education, public services and environment, as well as in long-term maintenance. The school should take care of daily use, basic control and problem reporting. The implementing organization coordinates the process, documentation, and education, while the technical company designs, builds, tests, and trains users. The donor supports funding and monitoring, but should not remain the actor that keeps the system alive after the project ends.

| ACTORS | PRIMARY RESPONSIBILITY |
|---|---|
| Municipality | Ensures coordination, maintenance budget, inclusion of public services and servicing when required. |
| School | Uses irrigation/cleaning system, checks basic elements and reports problems. |
| Executive organization | Coordinates the project, documents the model, supports education and prepares material for replication. |
| Technical company | Performs design/works, testing, delivery, manual and technical training. |

| | |
|---|---|
| Donor | Finances and monitors the achievement of results, requiring documentation and sustainability. |
| Students and staff | Participate in education, use the system as a practical example and help in the culture of water saving. |

*Table 9. Division of roles and responsibilities for system operation*

In the pilot, maintenance will be done by the municipality. This is a reasonable solution, because the system is a public asset and is connected to a school facility. However, the municipal responsibility must be translated into a concrete procedure: who controls the system, who keeps the register, who notifies the repairer, who approves the expenditure and who verifies the repair.

## 9. Operation and maintenance

Maintenance is where the real lifespan of the system is decided. A concrete tank can have a long life, but the pumps, filters, inspection chambers, valves and irrigation system require periodic inspection. If these elements are neglected, the system may remain physically built but not used.

In regular use, the school should check the water level, the condition of the filter and the operation of the irrigation system. After heavy rains, ditches and overflow should be checked. During the irrigation season, the pressure and operation of the zones should be checked. Before winter, the risk of frost must be verified, especially in the exposed parts of pipes and valves. In the event of a malfunction, the system must be stopped and the municipality or service technician notified.

| FREQUENCY | WHAT IS CHECKED | RESPONSIBILITY |
|---|---|---|
| Every week during the irrigation season | Water level, visible damage, faucets, basic irrigation operation | School |
| After heavy rains | Filter, inspection chambers, overflow, debris at entry points | School + municipality |
| Every month in season | Pumps, valves, pressure, sensors, irrigation zones | Municipality/serviceman |
| Every 2-3 months | Gutters, inlets, covers and signage | Municipality + school |
| In early spring | System restart, irrigation test, initial cleaning | Service + school |
| In late autumn | Winter preparation, frost protection, final cleaning | Municipality/serviceman |

| | | |
|---|---|---|
| Once a year | General tank, pump, safety and documentation inspection | Municipality |

*Table 10: Indicative system operation and maintenance plan*

The maintenance log should be simple. Just include the date, water level, filter check, pump condition, problem noted and action taken. This register is useful for the school, the municipality, the servicer and the donor, because it shows whether the system is being used or just installed.

## 10. Monitoring and success indicators

The success of the system should be measured by the amount of water collected or used. If the level sensor works regularly, data can be obtained from the system. If not, the municipality can use monthly estimates based on rainfall, reservoir level and irrigation schedule.

The other indicator is the reduction in the use of potable water for irrigation. This can be compared with previous school bills, if there is separate data or if watering periods are comparable. In practice, the total water bill can be affected by many factors, so reporting should be careful and not claim exact financial savings without regular measurement.

| Indicator | How is it measured | Why is it important? |
|---|---|---|
| Amount of water collected/used | Level sensor, manual register or calculation by precipitation | Indicates real system usage |
| Drinking water replaced | Estimation of $m^3$ used for irrigation/cleaning | Indicates the effect on the water supply network |
| Tariff value of replaced water | $M^3$ x 0.8248 EUR/$m^3$ for the institutional category | Translates the impact into financial language |
| Functionality after 6/12 months | Technical inspection and maintenance log | Indicates stability after delivery |
| Educational Beneficiaries | List of school attendance and activities | Indicates the educational value of the investment |
| New candidate facilities | Municipal list of assessed schools/facilities | Indicates the potential for replication |

*Table 11: Key indicators for monitoring system operation and impact*

## 11. Results and impact

The first result of the project is the operationalization of a concrete system for the use of rainwater in a public school. This shifts the discussion from the general idea of saving water to a visible and measurable solution on the ground. The system shows that a school can use its roof as an alternative water source and link it to green irrigation and environmental education.

The second result is the potential saving of about 1,000 $m^3$ of drinking water per year. This does not itself solve the problem of water supply at the municipal level, but it is a direct measure that reduces the use of treated water for functions that do not require drinking water quality. In some replication facilities, the cumulative effect becomes more apparent.

The third result is the educational impact. Students do not only learn in theory about the water cycle, climate change and saving resources; they see the system at school. This makes education more concrete and connects everyday behavior with public infrastructure.

The fourth result is institutional value. The project creates a model of cooperation between the implementing organization, municipality, school, technical operator and public services. This model is as important as the reservoir because it shows municipalities how they can plan, procure, test and maintain a similar investment.

In terms of replication, the model is especially suitable for schools with large roofs and courtyards that require irrigation. The system can also be adapted for nurseries, sports facilities, family medicine centers and administrative buildings, if there is a real need for non-potable water and tank space.

## 12. Challenges, risks and lessons learned

The application of the rainwater harvesting system in Komoran showed that this model is feasible, practical and useful for non-potable uses. However, to successfully replicate it in other facilities, it is not enough to simply copy the technical solution. Each location has different conditions: roof area, condition of gutters, space for storage, access for works, need for irrigation, possibility for use by public services and capacity for maintenance. For this reason, the model must be adapted to the local context and planned as a long-term investment.

### Challenges during implementation

One of the main challenges is related to the development of works in the school space. Digging, moving machinery, opening channels and laying pipes require careful organization, especially when the school is operational. The perimeter of the workshop, the work schedule, the safe access of the machinery and coordination with the school directorate must be determined before the start of the work.

The next challenge is adapting the technical project to the real conditions on the ground. Unforeseen obstacles may arise during the implementation, such as more difficult terrain, groundwater, existing installations or the need to change the diameter of the pipes. These cases should be handled with documented technical decisions, because improvised solutions may create problems later in operation or maintenance.

In this type of system, the quality of the works is crucial. The foundation, reinforcement, concreting and waterproofing should be checked before covering, as they become difficult to check later. The same applies to the filter, pump, inspection chambers and hydraulic connections, which must be accessible for inspection and service.

**Replication risks**

The biggest risk is choosing an inappropriate location. A public facility is not automatically a good option just because it has a roof. Before the investment decision, the catchment area, the condition of the gutters, the space for the tank, the real need for water and the responsibility for maintenance after delivery should be evaluated.

Another risk is the incorrect dimensioning of the tank. If the capacity is based only on the theoretical potential of rainfall, without analyzing the real use, the system may turn out to be inefficient. Too small a reservoir may not provide water in dry periods, while too large a reservoir may increase cost without creating commensurate benefit.

Maintenance is a particular risk. Filters, pumps, inspection chambers, valves and the irrigation system require periodic inspection. If no responsible person is appointed and no minimum budget is foreseen for servicing, the system may work well at first, but gradually lose its effect.

In cases where the system is planned to be used by the Fire Department or public services, this function must be designed from the beginning. Without appropriate access, controlled external locking and usage procedure, this value can only remain theoretical.

**Lessons Learned**

The main lesson is that the system should be treated as an integrated solution: technique, maintenance, education and institutional coordination. The tank is only part of the investment. Real value is created when water is collected, used regularly, maintained and served for concrete school and community needs.

For replication, the first step should always be to evaluate the location. Before designing, roof surfaces must be measured, gutters checked, priority uses determined, and who will maintain the system confirmed. In procurement, price must be balanced with methodology, experience, quality of materials and testing plan.

An important lesson from the pilot model is that use by the Fire Department can significantly increase the public value of the system, especially in areas where the main filling point is further away. For this reason, in similar projects, the role of the facility as an auxiliary point for technical water supply in emergency cases should also be analyzed.

Finally, the system must be delivered with clear documentation: sketch of how it was built, user manual, acceptance record, maintenance plan and division of responsibilities. These elements make the difference between a physically completed project and a system that continues to function as a public asset.

## 13. Minimum requirements for replication

A facility is a good option for replication when it has sufficient roof, functional or repairable gutters, tank space, real need for irrigation/cleaning, access to works and clear responsibility for maintenance. If one of these elements is missing, the project should not be rejected immediately; but should be classified as "partially suitable" and additional interventions planned.

| Criteria | I suitable | Partially suitable / requires intervention |
|---|---|---|
| Roof | Enough surface, good condition, clear leaks | The roof is damaged or requires repair before connecting to the system |
| Gutters | Functional and connected to pipes | Damaged, dirty or with scattered leaks |
| Space for tank | Safe, accessible and does not impede movement | Has space but requires security measures or other technical solution |
| Need for non-potable water | Greening/cleaning with regular use | Need is seasonal or limited |
| Maintenance | Responsible person and municipal support | No clear responsibility or defined budget |
| Educational value | The school uses the system in learning and activities | The system remains technical, without an educational plan |

*Table 12: Basic criteria for system replication*

The same principles can be used for agricultural facilities or large farms, but the assessment should focus more on the seasonal demand for water, the catchment areas, the quality of the water needed and the capacity for technical maintenance.

Facilities that do not have a real need for non-potable water, do not have access for maintenance or have a high technical risk from the ground, should be treated with care. In such cases it may be better to start with simpler measures: gutter repair, water conservation education, sensor taps or small demonstration tanks.

## 14. Replication recommendations

Replication should begin with public facilities where the benefit is clear: schools with large roofs, green yards, water consumption for irrigation and staff that can be involved in maintenance. It is not recommended to start with many facilities at once without well documenting the first 1-2 additional cases.

- Municipalities must always do a technical assessment before design. The capacity of the tank should not be chosen with the logic of "the bigger, the better". The reservoir should be related to rainfall, roof area, real water demand, budget and maintenance potential. For smaller facilities, modular solutions can be more economical and faster; for large schools, the concrete tank may be more durable.
- In the procurement, the municipality must ask for unit prices, work methodology, technical staff, similar references, safety plan for school works, user manual, work scheme, guarantee and training. Choosing only on the lowest price is a risk in systems where the quality of waterproofing, filtration and pumping determines long-term success.
- Maintenance should be foreseen from the beginning. Even if a separate budget line is not created, the municipality must integrate it into the annual budget for the maintenance of school facilities or public services. A small amount for servicing can avoid system failure due to minor defects.
- The educational component should be part of the model, not a side activity. In each school where the system is replicated, a hands-on lesson for students, an information board in the yard, a measurement/monitoring activity and a short seasonal report from the school are recommended.
- The system can be considered as the possibility of adapting this model for agricultural uses, especially in farms with large roof surfaces, greenhouses, livestock facilities or warehouses. In these cases, the system must be designed on the basis of the seasonal need for water, the capacity of the tank, the required water quality and the cost of maintenance, in order to serve for irrigation, technical cleaning and maintenance of the farm spaces.

# 15. APPENDICES

## APPENDIX 1: Forms and checklist for replication

### 1.1 Form for initial site assessment

This form is used during the first visit to the school, public institution or other facility where the installation of the rainwater harvesting system is planned. The aim is to assess whether the site has the technical, operational and institutional conditions for replication.

| Basic data | Description |
|---|---|
| Name of the facility | |
| Municipality / location | |
| Facility type | School / nursery school / public facility / other facility |
| Contact person | |
| Date of visit | |
| The team that did the assessment | |

| Criteria | Guide question | Rating / notes |
|---|---|---|
| Roof | Does the facility have sufficient roof surface for water collection? | |
| Roof condition | Is the roof in good condition and suitable for collecting water? | |
| Gutters | Are the gutters functional and can they be connected to the system? | |
| Download points | Where is rainwater currently discharged? | |
| Space for tank | Is there safe storage space above ground or underground? | |
| Access for works | Can machinery and materials enter without endangering the facility/users? | |

| | | |
|---|---|---|
| Need for water | Has a real need for irrigation, cleaning, maintenance or technical use? | |
| Use by firefighters Does | Have strategic value as an emergency replenishment location? | |
| Maintenance | Is there a person/institution that can take responsibility after delivery? | |
| Security | Can the workshop be surrounded and security managed during the works? | |
| Educational value | Can the system be used for environmental/educational activities? | |

**Final location rating:**

☐ Suitable for replication

☐ Partially suitable; requires preliminary interventions

☐ Not suitable without additional investment

**Key notes:**

___________________________________________________________________________

___________________________________________________________________________

_______________.

**1.2 Checklist before investment decision**

Before the municipality or institution makes a decision on investment, the following points must be checked:

☐ The roof area has been measured.

☐ The roof, gutters, and discharge points have been inspected.

☐ A potential location for the storage tank has been identified.

☐ Access for construction works and maintenance has been assessed.

☐ The annual rainwater harvesting potential has been calculated.

☐ Priority uses of the collected water have been identified.

☐ The need for a water reserve for the Fire and Rescue Unit has been assessed.

☐ The institution or person responsible for maintenance has been designated.

☐ A minimum maintenance budget has been prepared.

☐ A technical design has been prepared or is planned.

☐ The technical testing and acceptance process has been prepared.

☐ Training for the facility staff has been planned.

☐ The final documentation has been prepared, including the user manual, as-built drawings, and maintenance log.

## APPENDIX 2: Calculation of water potential

Calculation of rainwater potential helps the municipality or institution to understand how much water can be collected from a facility and if the investment has a practical rationale. The calculation should be used as a guiding basis for design, while the final dimensioning should be done by the designer/engineer.

### 2.1 Basic formula

| Potential Water for Collection = Roof Area × Annual Rainfall × Runoff Coefficient |
|---|

Where:

- **The surface of the roof** is expressed in $m^2$;
- **Annual precipitation** is expressed in mm/year;
- **The flow coefficient** is usually taken to be 0.75–0.90, depending on the roof material, condition of gutters, filtration, losses and reservoir limitations.

In practice, 1 mm of precipitation over 1 $m^2$ of surface is approximately equal to 1 liter of water.

### 2.2 Model for calculation

| Parameter | Value |
|---|---|
| Ceiling surface | ___ $m^2$ |
| Average annual precipitation | ___ mm/year |
| Flow coefficient | ___ |
| Annual water potential | ___ L/year |
| Potential in $m^3$ | ___ $m^3$/year |
| Tank capacity | ___ $m^3$ |
| Minimum contingency reserve, if applicable | ___ $m^3$ |
| Operating quantity for common uses | ___ $m^3$ |

### 2.3 Pilot model example in Komoran

| Parameter | Value |
|---|---|
| Ceiling surface | 1,838.7 $m^2$ |
| Average annual precipitation | 700 mm/year |
| Flow coefficient | 0.80 |
| Annual water potential | 1,029,672 L/year |
| Potential in $m^3$ | about 1,000,000 L/year |
| Tank capacity | about 1,000 $m^3$/year |
| Minimum contingency reserve, if applicable | about 40 $m^3$ |
| Operating quantity for common uses | about 10 $m^3$ |

**Note:** The reserve for the Fire Department does not mean that the annual potential is reduced by 10 $m^3$, but that a minimum part of the water in the tank is not used for irrigation or ordinary cleaning. This should be foreseen in the design, through the position of the water intake point for routine uses.

### 2.4 Interpretation of the result

The calculation shows the indicative potential, but does not guarantee that the entire amount will actually be used. Utilization depends on seasonal rainfall distribution, reservoir capacity, irrigation needs, losses, overflow and maintenance. For this reason, municipalities should use conservative calculations and design the system according to the real need, not only according to the maximum annual potential.

**APPENDIX 3:** Technical schemes and indicative measures

**CONSTRUCTION AND PRECAUTIONS OF CONSTRUCTION WORK**
**TRAINWATER COLLECTION TANKS IN "XHELADIN GASHI - PLAKU" Primary and Lower Secondary School, KOMORAN**
**VOLUME CAPACITY: $V = 6 \times 4.2 \times 1.6 = 40.32\ m^3$**

| | | | | | |
|---|---|---|---|---|---|
| | **MAIN PROJECT WORKS FOR REALIZATION** | | | | |
| | **Description of works** | **Unit** | **Qty** | **Pri ce** | **To tal** |
| | The main project for the design of the tank by the design staff, prepared for realization with all phases. | Com plete | 1 | | |
| | **All main project jobs** | | | | |
| | **EARTH WORKS** | | | | |
| | Excavation by machine of the soil (humus t = 40 cm), opening of the foundation, the wall plate of the water tank and transportation to the warehouses provided for collection. | $m^3$ | 13 6 | | |
| | Excavation by machine, opening of the channel from the existing facility to the water tank and transportation to the storage facilities provided for collection. L = 150 m, B = 30 cm, H = 100 cm. | $m^3$ | 60 | | |
| | Supply, laying and compaction of gravel (crushed stone buffer with granulometry 0–63 mm), suitable for compaction, thickness t = 25 cm, under the foundation of the tank slab. | $m^3$ | 13 .81 | | |

| | | | | | |
|---|---|---|---|---|---|
| | Supply, laying and compaction of gravel (crushed stone buffer with granulometry 0–31.5 mm), suitable for compaction, thickness t = 10 cm, under the foundation of the tank slab as well as on the side of the tank. | $m^3$ | 65 | | |
| | Supply, spreading and compaction of the soil on the concrete slab of the tank for planting grass, suitable for compaction, with a thickness of t = 70 cm, as well as the soil around the walls of the tank slab, as well as the covering of the pipe channel. | $m^3$ | 70 | | |
| | Supply and transport of precast concrete hoops Ø 60 cm, with all accompanying elements, as well as covering with a cover. | cope | 6 | | |
| | Supply and transport of the inspection chamber from the precast concrete circle Ø 140 cm, with a depth of 1.5–2 m, at the outlet of the last discharge pipe from the gutters, so that the waste, shingles, etc. fall down and only clean water enters the tank without debris. At the entrance of the pipe that conveys the water to the tank, a special filter should be placed to stop the smallest debris, with all the conveying elements, as well as the cover with a lid. | cope | 1 | | |

| | |
|---|---|
| **All ground works** | |

| | |
|---|---|
| | **CONCRETE WORKS** |

| | | | | | |
|---|---|---|---|---|---|
| | Supply, preparation and concreting of the leveling layer with poor concrete under the foundation plate of the tank, with thickness t = 2 × 5 cm, with concrete class C-12/16 MPa. | $m^3$ | 8.<br>25 | | |
| | Supply, molding, reinforcement and concreting of the foundation plate of the tank, with thickness t = 40 cm and dimensions according to the executive project. Concrete class C-25/30 MPa, with water impermeability additive. | $m^3$ | 14 | | |
| | Supply, molding, reinforcement and concreting of the walls of the tank, with a thickness of t = 25 cm and with dimensions according to the executive project. Concrete class C-25/30 MPa, with water impermeability additive. | $m^3$ | 8.<br>16 | | |

| | | | | | |
|---|---|---|---|---|---|
| | Supply, molding, reinforcement and concreting of the upper plate of the tank, with thickness t = 25 cm and dimensions according to the executive project. Concrete class C-25/30 MPa, with water impermeability additive. | $m^3$ | 6 | | |
| | Supply, moulding, reinforcement and concreting of the exit wall, flush with the ground, with a thickness of t = 20 cm and dimensions according to the executive project. Concrete class C-25/30 MPa, with water impermeability additive. | $m^3$ | 2 | | |
| | Supply, molding, reinforcement and concreting of the enclosure wall for the safety of the tank so that heavy circular weights do not circulate, with thickness t = 30 cm, width and h = 80 cm height, with dimensions as in the executive project. Concrete class, C-25/30 MPa. | $m^3$ | 8.<br>64 | | |
| | **All concrete works** | | | | |
| | **ARMATURE WORKS** | | | | |
| | | | | | |
| | Supply, transportation, cutting, bending and placement of S-500B MPa rebar, including all positions of reinforced concrete as per project. | kg | 4,<br>950 | | |
| | Supply, transport and work of the steel fence, with posts every 2.5 m, with dimensions 50 × 50 mm and height H = 100 cm, with two horizontal elements 60 × 40 mm and vertical elements 20 × 20 mm every 15 cm, for the safety of the tank so that heavy weights do not circulate. The enclosures should have a door for the entry-exit of the responsible staff. The height of the fence is H = 100 cm, with dimensions according to the executive project. | m' | 36 | | |
| | **All armor works** | | | | |
| | **WATERPROOFING WORKS** | | | | |

| | | | | | |
|---|---|---|---|---|---|
| | Supply, transport and installation of flame waterproofing in two layers, with waterproofing thickness t = 4 mm + second layer with tile t = 4 mm. Before placing the waterproofing, paint the preliminary layer of concrete with liquid bitumen, so that the adhesion becomes adequate.<br>Protective foil for insulation on the walls and on the top plate. | $m^2$ | 10<br>0 | | |
| | Supply, transport and installation of 2 col pump for extracting water from the tank, together with pipe and hydrant follower parts. | cope | 1 | | |
| | Supply, transport and assembly of the ribbed pipe from the facility to the tank, as well as from the tank to the outlet to the atmospheric sewer for excess water, HDPE SN4 dimension type – Ø 200 mm. | m' | 15<br>0 | | |
| | Supply, transport and assembly of Ø100 mm steel pipe for tank ventilation, turned 180° at the top to prevent debris from entering the pipe. | m' | 1 | | |
| | Supply, transport and installation of the steel cover for closing the outlet on the tank, with dimensions of 80 × 80 cm. | cope | 1 | | |

| | |
|---|---|
| **All Masonry works** | |

| | | | | | |
|---|---|---|---|---|---|
| | **ROUGH BUILDING WORKS (manual work)** | | | | |
| | Rough construction of the foundation, slab and surrounding wall according to the executive project. | $m^2$ | 35 | | |
| | Rough construction of the top plate of the tank according to the executive project. | $m^2$ | 30 | | |

| | | | | | |
|---|---|---|---|---|---|
| | **INSTALLATION OF IRRIGATION SYSTEM AND FAUCETS WITH SENSORS** | | | | |
| | Supply and installation of drip irrigation system in the school yard | $m^2$ | 12<br>00 | | |
| | Supply and installation of faucets with sensors | cope | 8 | | |

| | |
|---|---|
| All rough Construction work (handiwork) | |

| | | |
|---|---|---|
| | MAIN PROJECT WORKS FOR REALIZATION | |
| | EARTH WORKS | |
| | CONCRETE WORKS | |
| | ARMATURE WORKS | |
| | WATERPROOFING WORKS | |
| | ROUGH BUILDING WORKS (manual work) | |
| | INSTALLATION OF IRRIGATION SYSTEM AND FAUCETS WITH SENSORS | |

| | |
|---|---|
| TOTAL OF CONSTRUCTION WORKS | |

## **APPENDIX 4:** Models for technical acceptance and maintenance

### 4.1 Model of the minutes of technical acceptance

Proceeds of technical acceptance and handover of the rainwater harvesting system

| **Basic data** | **Description** |
| --- | --- |
| Name of the facility | |
| Location / Municipality | |
| Date of acceptance | |
| Economic operator | |
| The representative of the municipality | |
| School/facility representative | |
| Implementing organization / technical supervisor | |

This record confirms that the system for collecting, storing and using rainwater has been checked, tested and delivered for use according to the project and the agreed requirements.

| **Checkpoint** | **Yes** | **No** | **Remarks** |
| --- | --- | --- | --- |
| The reservoir is built/placed according to the project | ☐ | ☐ | |
| Waterproofing has been applied and checked | ☐ | ☐ | |
| The pipes from the roof to the tank are functional | ☐ | ☐ | |
| The inlet filter is functional and accessible for cleaning | ☐ | ☐ | |
| The fields are closed, secure and accessible | ☐ | ☐ | |
| The pump has been tested and is working | ☐ | ☐ | |
| The irrigation system has been tested by area | ☐ | ☐ | |

| | | | |
|---|---|---|---|
| Water level sensor works | ☐ | ☐ | |
| Digital control, if applicable, is configured | ☐ | ☐ | |
| Overflow works | ☐ | ☐ | |
| Fire/Utility External Lock Tested | ☐ | ☐ | |
| Minimum reserve for firefighters is taken into account in operation | ☐ | ☐ | |
| Covers, enclosure and safety elements are in order | ☐ | ☐ | |
| User manual submitted | ☐ | ☐ | |
| Scheme of the realized state of the system has been submitted | ☐ | ☐ | |
| The responsible staff has been trained | ☐ | ☐ | |

**Submitted documents:**

☐ User Manual
☐ System Status Chart
☐ Major Equipment Warranties, if applicable
☐ Service Contact List
☐ Maintenance Log
☐ Photographic Documentation

Remarks and necessary corrections:

______________________________________________________________________________

______________________________________________________________________________

________________.

Deadline for corrections, if any: ______________________

**Signatures:**

Representative of the municipality: ______________________

School/facility representative: ______________________

Economic operator: ______________________

Implementing organization / technical supervisor: ______________________

Date: ______________________

### 4.2 Maintenance log template

This register must be kept by the school, municipality or person responsible for the system. It helps to highlight the controls, problems and interventions performed.

| Date | Element checked | Condition | Action taken | Responsible person |
|---|---|---|---|---|
| | Water level | OK / Not OK | | |
| | Input filter | OK / Not OK | | |
| | Shaktat | OK / Not OK | | |
| | Pump | OK / Not OK | | |

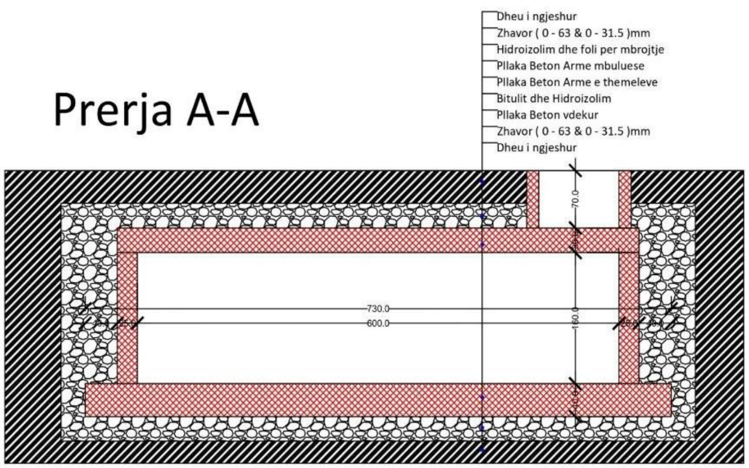
| | | | | |
|---|---|---|---|---|
| | Valves | OK / Not OK | | |
| | Irrigation system | OK / Not OK | | |
| | Level sensor | OK / Not OK | | |
| | Overflow | OK / Not OK | | |
| | Fire/utility lock | OK / Not OK | | |
| | Caps and safety | OK / Not OK | | |

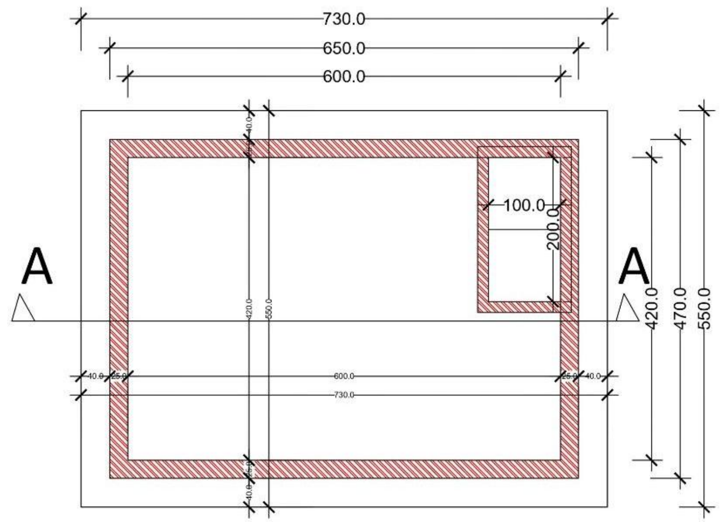
### 4.3 Minimum maintenance frequency

| Frequency | What is checked | Responsibility |
|---|---|---|
| Every week during the irrigation season | Water level, irrigation system, visible damage | School / responsible person |
| After heavy rains | Filter, inspection chambers, overflow, debris | School / municipality |
| Every month | Pump, valves, pressure, level sensor | Municipality / repairer |
| In early spring | Preparation of the system for the irrigation season | Municipality / school / repair shop |
| In late autumn | Cleaning, frost protection, final check | Municipality / repairer |
| Once a year | General tank and system inspection | Municipality / technical supervisor |

Note: If the system is used by the Fire Department or utility operators, each use must be recorded with date, purpose, approximate quantity and person/institution user.

**APPENDIX 5:** Photograph from pilot implementation


T
T
MD
8.95 m
7.00 m
9.00 m
9.05 m
6.95 m
T
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MD
T
5.10 m
MD
8.05 m
9.05 m
9.00 m
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T
MD
MD
6.00 m
6.00 m
MD
MD
6.00 m
6.05 m
9.00 m
MD
MD
MD
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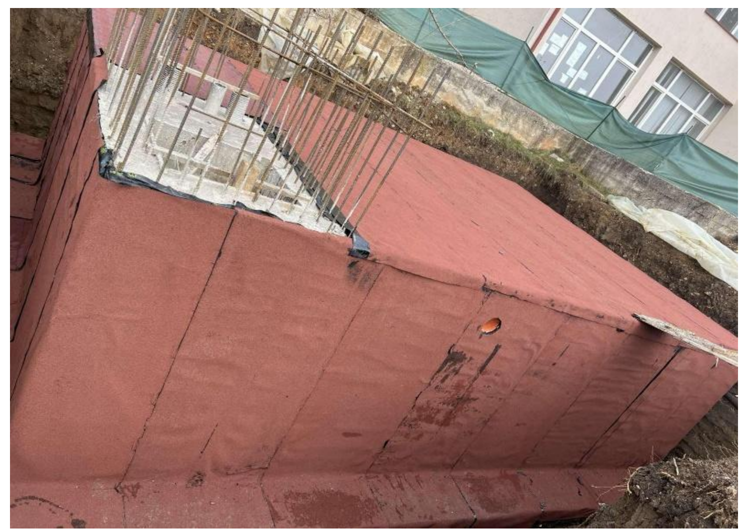
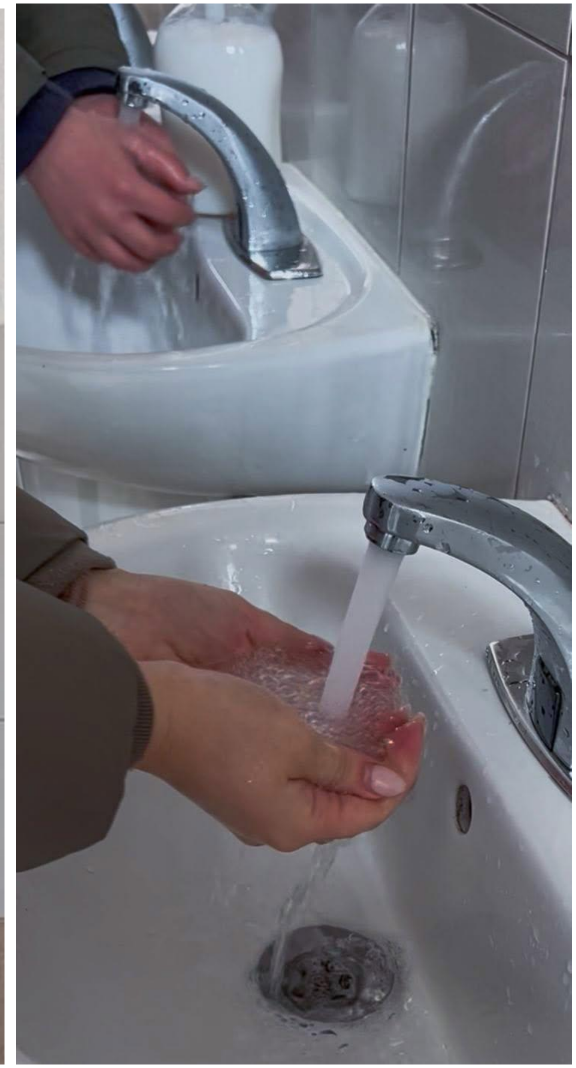
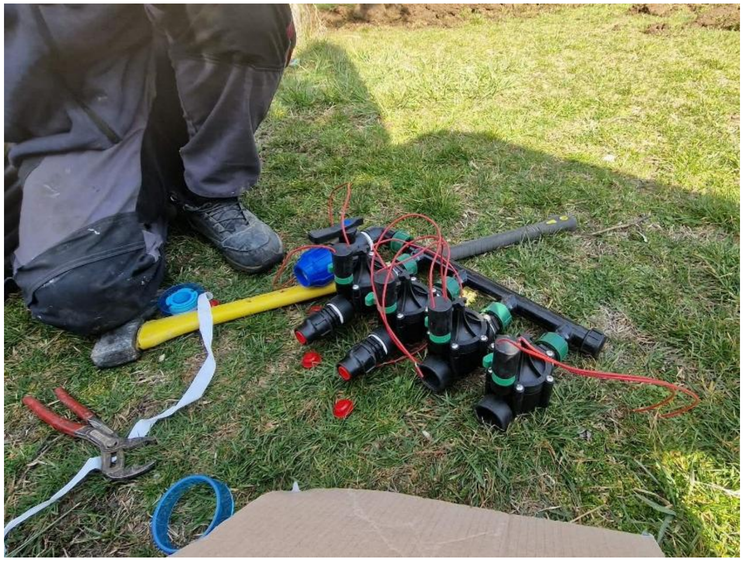
ankara
membran

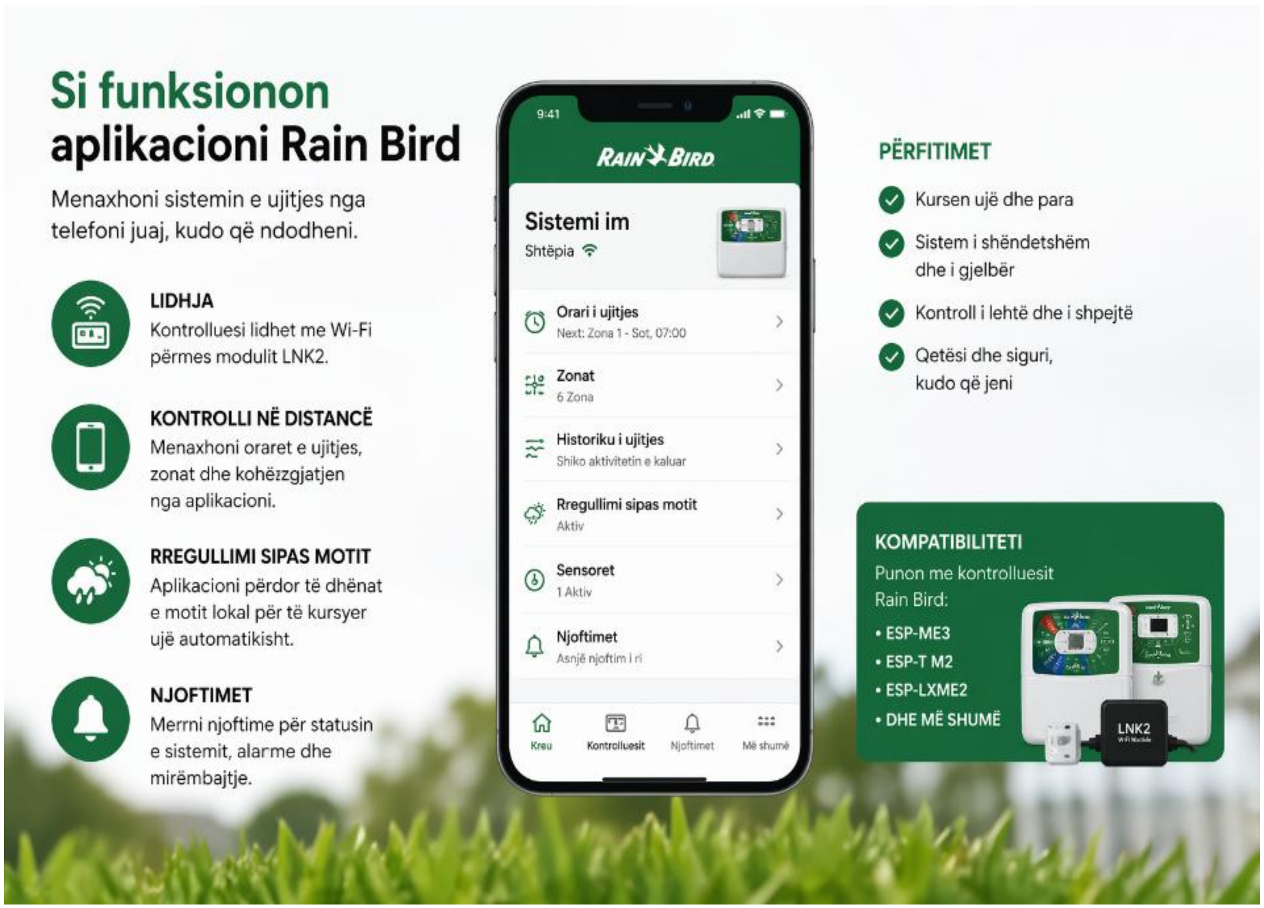



Çdo pikë
ka rëndësi
KONTROLLO
PRESIONIN
E UJIT
MOS E LE UJIN
TË RRJEDHË KOT

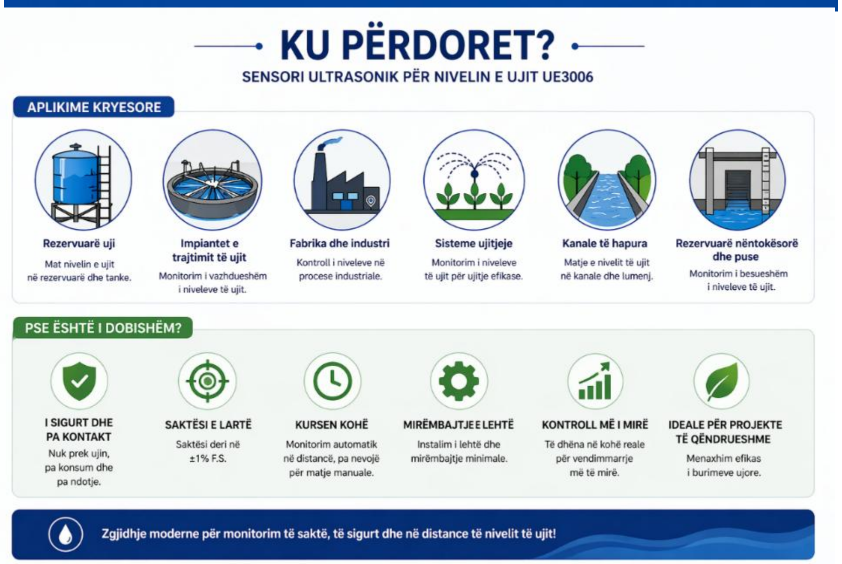





Si funksionon aplikacioni Rain Bird
Menaxhoni sistemin e ujitjes nga telefoni juaj, kudo që ndodheni.
LIDHJA
Kontrolluesi lidhet me Wi-Fi përmes modulit LNK2.
KONTROLLI NË DISTANCË
Menaxhoni oraret e ujitjes, zonat dhe kohëzgjatjen nga aplikacioni.
RREGULLIMI SIPAS MOTIT
Aplikacioni përdor të dhënat e motit lokal për të kursyer ujë automatikisht.
NJOFTIMET
Merrni njoftime për statusin e sistemit, alarme dhe mirëmbajtje.
9:41
RAIN BIRD
Sistemi im
Shtëpia
Orari i ujitjes
Next: Zona 1 - Sot, 07:00
Zonat
6 Zona
Historiku i ujitjes
Shiko aktivitetin e kaluar
Rregullimi sipas motit
Aktiv
Sensoret
1 Aktiv
Njoftimet
Asnjë njoftim i ri
Kreu
Kontrolluesit
Njoftimet
Më shumë
PËRFITIMET
Kursen ujë dhe para
Sistem i shëndetshëm dhe i gjelbër
Kontroll i lehtë dhe i shpejtë
Qetësi dhe siguri, kudo që jeni
KOMPATIBILITETI
Punon me kontrolluesit Rain Bird:
• ESP-ME3
• ESP-T M2
• ESP-LXME2
• DHE MË SHUMË
LNK2


SENSORI ULTRASONIK PËR NIVELIN E UJIT
UE3006
Mat nivelin e ujit pa kontakt, i saktë dhe i besueshëm.
Mat nivelin e lëngjeve pa kontakt
në rezervuarë, tanke, kanale etj.
I saktë dhe stabil
Saktësi ±1% F.S.
I lehtë për instalim dhe mirëmbajtje
Monitorim në distancë
përmes 4G (me pajisjen DTU)
Gama matëse
0 – 1.6 metra
Mediumi
Ujë
Dalia e sinjalit
RS485
Furnizimi (sensori)
24 VDC


SI FUNKSIONON DHE LIDHJET
SI FUNKSIONON?
1 Sensori vendoset mbi rezervuar
2 Dërgon valë ultrasonike drejt ujit
3 Valët kthehen mbrapa
4 Pajisja llogarit nivelin e ujit
Distanca
LIDHJA DHE MONITORIMI
UE3006
Sensori
RS485
HK301 DTU
4G
Cloud
(Platforma)
Furnizimi
12 – 28 VDC
Shikoni të dhënat në telefon ose kompjuter
Lidhje e qëndrueshme përmes RS485
Monitorim në distancë përmes 4G (internet)
Të dhënat ruhen në cloud dhe aksesohen lehtë
Qasje në të dhëna në kohë reale


KU PËRDORET?
SENSORI ULTRASONIK PËR NIVELIN E UJIT UE3006
APLIKIME KRYESORE
Rezervuarë uji
Mat nivelin e ujit në rezervuarë dhe tanke.
Impiantet e trajtimit të ujit
Monitorim i vazhdueshëm i niveleve të ujit.
Fabrika dhe industri
Kontroll i niveleve në procese industriale.
Sisteme ujitjeje
Monitorim i niveleve të ujit për ujitje efikase.
Kanale të hapura
Matje e nivelit të ujit në kanale dhe lumenj.
Rezervuarë nëntokësorë dhe puse
Monitorim i besueshëm i niveleve të ujit.
PSE ËSHTË I DOBISHËM?
I SIGURT DHE PA KONTAKT
Nuk prek ujin, pa konsum dhe pa ndotje.
SAKTËSI E LARTË
Saktësi deri në ±1% F.S.
KURSEN KOHË
Monitorim automatik në distancë, pa nevojë për matje manuale.
MIRËMBAJTJE E LEHTË
Instalim i lehtë dhe mirëmbajtje minimale.
KONTROLL MË I MIRË
Të dhëna në kohë reale për vendimmarrje më të mirë.
IDEALE PËR PROJEKTE TË QËNDRUESHME
Menaxhim efikas i burimeve ujore.
Zgjidhje moderne për monitorim të saktë, të sigurt dhe në distance të nivelit të ujit!


SPECIFIKIMET E DTU DHE INFORMACION I PËRGJITHSHËM
SPECIFIKIMET E DTU (HK301)
Input
3-way RS485 Modbus
Furnizimi
12 – 28 VDC
Lloji i sinjalit
4G
Monitorimi
Mbështet Cloud Platform dhe aplikacion mobil
HK301
INFORMACION TJETËR
I besueshëm
Performancë e qëndrueshme dhe afatgjatë.
I saktë
Matje të sakta me saktësi ±1% F.S.
I lehtë për t'u përdorur
Instalim i thjeshtë dhe konfigurim i shpejtë.
Punon gjatë gjithë kohës
Monitorim në kohë reale, 24/7.
MONITORIM NË CLOUD
Të dhënat dërgohen në cloud në kohë reale dhe mund të shihen nga kudo, në telefon ose kompjuter.
PAGESA
100% T/T në avancë
PËRMBLEDHJE
Zgjidhje moderne, e besueshme dhe efikase për matjen e nivelit të ujit dhe monitorim në distancë.
I BESUESHËM | I SAKTË | I LEHTË PËR T'U PËRDORUR
Zgjidhje inteligjente për menaxhimin efektiv të ujit!

| | |
|---|---|
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***Note:***
*This document can be used as a guiding basis for replication, but each new project must be adapted to the technical, climatic, institutional and financial conditions of the respective location. Measurements, design and pre-measurement should be prepared by field professionals before implementation.*

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