Measures of Sustainable Collection of Rainwater and Groundwater on the IAPM Campus 2021-2024

1. Introduction

The aim of this document is to introduce the available data and the proposed strategy supporting the current water management of the IAPM and to summarize the results of the measurements of the IAPM campus for the collection of rainwater and for the speed and volume of the groundwater immediately below the surface of the campus.

The area of ground surface within the limits of a certain zone in the catchment of a certain watercourse, at which actual defiltation and surface runoff are generated and apply to the watercourse, is termed a catchment's watershed of complementary shorter catchments. As a result of global socioeconomic changes, along with trends in legislative standardization processes, the number and extent of environmental conservation and drawdown zones in water countries often significantly grow, along with the associated perturbations of traditional water management. Water scarcity, due to the impact of climate change amplified by human activities and the enlargement of affected areas, can be expected. For this reason, and with the aim of efficient, balanced, and sustainable water management of such urban areas, including preventive measures, we can and must apply some water conservation services and measures even in a retroactive or superimposed manner. Regular rainwater and groundwater management are considered to be values that can be significantly affected by urbanization.

1.1. Background of Rainwater and Groundwater Collection

As cities expanded and urbanized, the direction of human endeavor moved towards tapping deeper and larger bodies of subterranean water. Today, many of the earlier recharge methods are being promoted with a new fervor as sustainable Rainwater Harvesting practices.

The knowledge of modern hydrogeologists permits improvements to traditional Rainwater Harvesting. Earthworks are done with greater precision and succeed in sheeting rather than concentrating rainwater in larger, deeper bodies. Well-sinking technology allows rapid and affordable encapsulation of rainwater locally, which in many cases would be lost as surface runoff. Siphons, rather than gravity-based channels, allow lifting of water essentially for free while conserving land clearances. Automatic valves contain water in situ and permit incremental collection in storage tanks, helping in reducing algal growth, seepage losses, and needs for filtering and restoration at each collection. Earlier mostly inefficient purposes have been improved in collection, pumping, and storage technology. To maximize the utility of the collected water, it is necessary to monitor weather, supply, and demand, canal commands, and water levels in tanks, and distribute the water to specific demand sites as the muscles of the traditional irrigation system may no longer be present. It is necessary to guard against contamination and unscheduled wastage.

2. Importance of Sustainable Water Collection

Water scarcity has become an enormous concern for communities around the world. In order to ensure sustainable availability of potable water resources in the future, many countries need to regulate their existing water resources. For this aim, the principles of sustainable water resource management must be adopted. Lately, treatments that conduct sustainable collection of rainwater and wastewater for reducing pressures on water supply have been increasingly reported. Progression of more sustainable forms of water supply systems may thus assist in the reduction of impacts and help improve ecological health. Furthermore, proactive measures of creating water-efficient systems on campuses and surrounding areas can reduce public expectations of adverse exteriorities due to conventional treatment works to landowners. Applying the detailed methodology can determine whether the ecosystem in the campus will be affected by these proposed treatments, and so they provide insights into the treatment method selection process.

2.1. Environmental Benefits

Environmental Benefits Sustainable collection of rainwater and groundwater has a number of associated environmental advantages. Reduction of stormwater runoff and urban flooding. Under natural conditions, a considerable portion of the rainwater that falls in a city is taken up by vegetation and ultimately returned to the atmosphere by evapotranspiration. Only a small portion will flow over the ground into water bodies. Impermeable surfaces in urban areas lower the percentage of water taken up by vegetation and increase the relative volume of stormwater runoff. This is an important driver of increased flooding downslope or at the nearest surface water drain. Local site aspects. The sustainable collection of rainwater and slowing down bulk movement into the local surface water drain is helpful to the receiving water body and its ecosystem. It can reduce the speed at which a flood wave reaches a watercourse and is crucial to the life expectancy and stability of hydraulically designed urban water infrastructure. Storing the first water falling in a rain event has direct benefits for local biodiversity and the health and robustness of urban ecosystems. Reducing the demand for municipal water resources. After treatment, water can be used as non-potable water for flushing toilets and other water needs, accounting for 80% of all water used in buildings. This form of separation of water uses is an increasingly common response to the need to reduce the consumption of municipal water resources. The collected stormwater can also be directly infiltrated at the point of use into the subsoil before it reaches the sewer system. This reduces the need for very costly and almost unaffordable sewers in the urban water management system.

3. Methods of Rainwater Collection

There are a number of methods for the collection of rainwater. There are systems that divert water immediately upon impact with the roof, while others store the rainwater for later use. Some systems can be easily integrated into existing structures such as pipes, while others must be implemented into buildings during the design stage. Each system operates on different scales, with some being able to collect as little as 50 liters of water and others capable of up to 3,000 liters. Rainwater can be collected from various surfaces such as the roof and the ground. It can also be used in different locations and for different purposes such as roof gardens and sewage systems. The ease of installation and the cost and time of maintenance are also important to consider. The most suitable system to implement will be largely dependent on the rainfall levels, materials, costs, and local climate.

Collection methods are most effectively implemented in urban areas, especially in areas where surface water becomes contaminated with sewage. Similarly, peak losses can be reduced in cities by preventing rainwater from entering sewage systems.

Point of impact systems became more popular as a method of stopping sewage overflows. This was due to the heavy rainfall spreading contaminated water widely. Water is most efficiently drained if it is diverted straight away; otherwise, large tanks are required to store it, which is not practical for most buildings. Diverting rainwater from the impact point is practical in summer elsewhere, but a larger percentage of rainwater occurs in winter when the soiled water is often released. Other advantages highlighted are the simplicity of the system: all materials and components are widely available normally too. There is no need for a filter if the surface is clean and dry, and debris can also be eliminated from the system. The system can start getting water relatively quickly as the harvesting container fills up as soon as water is collected in the pin. The volume of water collected through the system increases because when entering the pin, the water has not yet reached terminal velocity. Many aspects of the building, including materials used, are important. Also, the life of each system and how long it takes to load or install are considered. Some systems also require more or less maintenance.

3.1. Rain Barrels

Rain barrels are the most recognized method of rainwater collection. Typically, rain barrels capture runoff from rooftops. Economic or commercially available rain barrels can have an array of structural and functional designs, but they all hold precipitation in some portion of the container until it can be used. Add-ons like simple spigots, linking hoses, and substantially larger storage tanks or cisterns can be obtained to help manage and use stored precipitation more effectively.

In general, one of a few locations for each rain barrel will be occupied regardless of the style. A leaf guard and particulate intercept at the top of the unit help maintain the quality of the stored precipitation. The units are typically drained from the top, and this opening may be equipped with a submersible catch basket to maintain the quality of the stored material and provide a continuous water source. A spigot near the base of the side or front allows use of the stored precipitation.

In summary, rain barrels should increase the percentage of precipitation that is used within the ecosystem and decrease the amount that becomes runoff.

Economies of Rain Barrels

As illustrated in this section, rain barrels are relatively easy to use, install, and maintain. The rain barrels are usually stored during the non-precipitation season.

4. Methods of Groundwater Collection

4.1. New Wells Increased rates of groundwater use often necessitate new wells, which require a source of water and hydrological studies to assess the sustainable capacity of new well sites.

5. IAPM Campus

The Campus is developing and implementing initiatives to conserve water and harvest scarce rainfall to reuse across the campus. Innovations include a groundwater-based system to harvest and tap into the water table and a system for capturing rainwater for all water demands throughout the year. Each system alleviates the strain of water sourcing off the overutilized city water. While we do not have measurements at this time, the project has brought sustainable water systems to a place where young people can be involved in innovation; the students have learned about water use, and they have the next wave of students with which to improve it. This project demonstrates groundwater-use-conscious sustainable development, and already, many programs have taken on educational research into these water collection systems as part of their engagement with the local community. The campus overhead water tanks can store a combined 17,000 m3, but after a week without rainfall, the tank's petrol supply is nearly empty. Our sustainable collection of rainwater that can meet our needs for a 250 mm dry period requires a 10,000 m2 catchment or a 1-ha farm. We can sustainably collect an additional 50 m3/day of groundwater each month from the borehole of 40 m depth that we are already using to sustainably provide an additional 1 m3/week of greywater collected during rainfall or an additional 239 m3/week of sustainably collected water or an additional 68,000 m3 of harvested rainwater stored in the aquifer. The sustainability of this approach must be regularly reviewed, monitored, and improved. We can extend the visibility and potential use of the system to the city population by simplifying our water catchment, doubling the conservation area, and allowing the university population to partake in direct use by treating and using the double catchment basin greywater for non-food kitchen gardens.