INTRODUCING RAINWATER HARVESTING SYSTEMS FOR THE WATER UTILIZATION OF LANDSCAPING PROJECTS IN SRI LANKA, BASED ON A CASE-STUDY AT WAYAMBA UNIVERSITY

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Abstract

The scarcity of water is one of the main issues which the whole world is currently confronting. In such a situation, using potable water on behalf of landscaping projects can never be encouraged. In this study, rainwater harvesting method which can be seen under the category of sustainable development was proposed for the water demand of landscaping projects.

The selected case study is an actual project proposed for the Wayamba University, Sri Lanka which consists a landscaping project of 7.3 Acre where the monthly water demand is about 701m^3. On behalf of water demand of landscaping, a rooftop rainwater harvesting system covering about 718m^3 minimum monthly rainwater harvest using a roof area of 6000 m^2 was proposed. Since there is a balance of 17m^3 collectable water, the expected water demand can be effectively fulfilled. The rainwater storage tank suitable for the expected project was proposed to be imported from Australia (BlueScope steel water tank) or proposed to be built meeting same quality in Sri Lanka.

The proposed system which recovers the project cost in 7.2 years, serves a considerable amount of financial benefits and solutions for wastage of water as well as usage of potable water on behalf of landscaping requirements. Since the proposed system can be effectively used for the desired goal of landscaping, the same system can be proposed for the other universities in Sri Lanka as well as the foreign universities. This can be used not only for the landscaping projects but also for the day-to-day purposes such as gardening, washing and flushing purposes. As the next stage of the project, the same type of a model can be effectively used for the fulfilment of potable water demand adding specific water purification methods.

Introduction

The water demand of a landscaping project is usually fulfilled by normal city water supply which delivers the purified water in potable condition. Using potable water for gardening purposes is a real disaster. But in fulfilling of water demand of such activities, natural rainwater can be used through an effective rainwater harvesting system. This study reveals the feasibility of utilizing rainwater on behalf of the landscaping projects using an actual case study from Wayamba university, Sri Lanka.

Calculations

Rainfall calculation

Harvestable rainwater amount (m^3) is given by;
Roof top area (m^2) × Average monsoon rainfall (m) × Runoff coefficient
Roof top area = 6000 m^2
Runoff coefficient = 0.9
Average monsoon rainfall;
from the data of Meteorology Department = $\frac{0.3\times A}{5} + \frac{0.7\times B}{5}$
Where; A is 2007-2011 rainfall water harvested and B is 2012-2016 rainfall water harvested
Minimum average monthly rainfall harvest = 718 m^3

Water usage calculation

Total landscaping area = 7.3 Acre
Water demand per 1 perch = 10 litre x 2 [Per day (2 times)]
Total water usage per Month = 10 x 2 ×160 × 7.3 × 30 = 700,800 l = 700.8m^3

Project cost calculation

As the rainwater storage tank, XL 45-R7 tank was proposed to be imported from BlueScope steel water tanks, Australia. Project cost was calculated with respect to that storage tank (tank cost with shipping has been used, 1 USD = 150.00LKR). VAT of 15% and NBT of 2.04% has been added in total cost.

Cost of the tank = 9,000 USD
Transport and installation cost = 345,000.00 LKR
Total project cost = (9000x150) + 345,000 = 1,695,000.00 LKR
Total project cost with Taxes = (1,695,000×1.0204) ×1.15 = 1,989,014.70 LKR

Figure 1. Considered Landscaping program

Figure 2. Location of the storage tank near gymnasium

Benefit Cost Analysis

The objective of the benefit cost analysis was to find the project recovery period.
Average water consumption = 700.8 m^3
1 water unit = 2.83 m^3
Average water units per month = 700.8/2.83 = 247.63 units
According to NWS&DW policies, water consumption which greater than 90 units is charged 140 LKR per unit and 1600 LKR of monthly service charge ('National Water Supply and Drainage Board', 2018)
Average cost of water per year = {(247.6325x140) +1600} ×12 = 435,222.60 LKR
Cost of the proposed project = 1,989,014.70 LKR
Let the project cost recovery period to be "Y"

$$Y = \frac{\text{project cost} + (\text{project cost} \times \text{inflation} \times Y)}{\text{average annual water cost}}$$

$$Y = \frac{1{,}989{,}014.70 + (1{,}989{,}014.70 \times 0.08 \times Y)}{435{,}222.60}$$

Y = 7.2037, take as 7.2 years
Project cost recovery period is about 7.2 years

Discussion

Though the rainwater harvesting systems are not extremely used in Sri Lanka, they are commonly used in developed countries. In most of the cases roof top rainwater harvesting systems are used in the buildings for flushing purposes without having any water purification process. The proposed system can easily be developed to such uses doing some adjustments.

The proposed system includes a storage tank which is to be imported from an Australian company. In there, actual scenarios were considered which are done in an actual project, but if the tank can be locally produced with expected outcomes, huge amount of money saving can be done. On the other hand, importing a well-produced storage tank will save time (spend in production and design phase) and maintenance supervision will be given by the company itself. Anyhow, the cost is negligible comparatively the benefits of the project which is capable of recovering the cost within 7.2 years

Conclusions

The rainwater harvesting system which can be seen under sustainable development, is one of the best solutions to minimize the wastage of potable water in landscaping projects and results in considerable financial benefits. Though the proposed system is based on as actual proposed project for Wayamba University of Sri Lanka, this would be a fine encouragement model which can be easily adaptable for the rest of universities in Sri Lanka and the world.
Not only for the landscaping projects, but also for the same model is appropriate in day-to-day gardening, washing and flushing tasks where there is no need of water purification. When it comes to the nest stage, same model can be used for the fulfilment of the drinking water demand inserting some effective purification methods.

This model can directly be used to encourage Sri Lankan society to make use of the precious rain water. Minor type rainwater harvesting system similar to the described method can be used for domestic water demand of gardening, vehicle washing and sanitary facilities.

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