Fulfillment Of Water Needs With Rainwater Harvesting Concept at Campus Universitas Padjadjaran, Jatinangor, West Java

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Abstract

University of Padjadjaran (Unpad) as a means of education and research has need of water large quantity. Until now meeting the needs of water was carried out as a conventional namely the usage of groundwater. Through the passing of time, the constant use of groundwater and land use change in the catchment area may pose a risk of ground water crisis. Rainwater in the university environment has large potential with an average annual rainfall is 961.92 mm. The concept of rainwater harvesting by using potential water which be runoff will become the source of water to the fulfillment of a need. Unfortunately, rainwater that become runoff can contain bacteria and chemical contents that may be harmful to health. It is necessary for the screening process using filtration and membrane technology that can clean water and produce safe water to drink.

Keywords : *groundwater crisis, rainwater harvesting, runoff water, membrane filtration.*

INTRODUCTION

University of Padjadjaran (Unpad) located distally from southeastern Manglayang Mountain. Potential groundwater in Unpad Jatinangor Campus area shows the decrease of main ground water level in the free aquifers [1]. This is allegedly due to an imbalance between the amount of groundwater taking and the amount of water absorbed into the soil. The increasing demand for groundwater has resulted in increased groundwater catchment so that shallow groundwater conditions have always declined, especially near production wells [2].

To meet the needs of water required methods other than continuous groundwater extraction. Another source for water compliance is to use surface water. Surface water can be taken from runoff stream or river water. The success or failure of rainwater harvesting depends greatly on the amount of water that can be harvested from an area under certain climatic conditions [3]

Utilization of rainwater can also be expected to be a solution to overcome flooding in urban areas [4]. The rainwater needed to meet the needs in the campus area is quite a lot. In addition, the advantages of water needs can also be infiltrated through artificial recharge to maintain the availability of groundwater in the future.

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Hydrological condition at research area shows in figure 1.

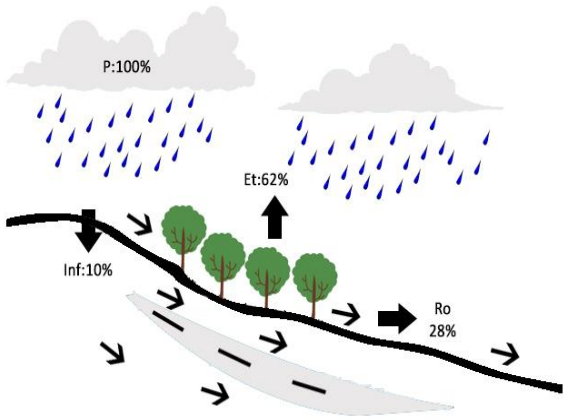

Figure 1 Water balance of jatinangor area: rain water (P) 100%, evapotrasnpiration (Et) 62%, Runoff (Ro) 28%, and infiltration (inf) 10%.

This paper intends to make the right concepts in meeting the water needs for campus needs and also support Unpad to become a green campus university.

THE CONCEPT OF RAINWATER HARVESTING METHOD

The concept of rainwater harvesting has been widely used throughout the world. The technology used can be rainwater collection from roofs of buildings, soil surface, and small catchment area by making artificial pond and reservoir. [5]

Rainwater harvesting is the collection, processing, purification and storage of rainwater that can then be used. There are a variety of methods for collecting and using rainwater depending on the environmental conditions and the way in which it is treated. There are 3 main ways of collecting rainwater [5] namely:

- Domestic collection by collecting rainwater that falls on the roof of buildings, roads or yard.
- In-situ collection by collecting water in the rain fall and collected in its place directly.
- External collection by utilizing rainwater into runoff and collected in an artificial reservoir or pond..

Domestic rainwater harvesting generally collects rainwater that falls onto the roof of the building. Quantity of water is affected by rainfall, roof area, and storage capacity [6]. Water collected through this method generally has a better quality because it can be controlled with good operation and relatively little clarity if necessary.

In-situ rainwater collection is simply to collect runoff water from a cropped area by inhibiting its infiltration rate [6]. The rain falling in this area is stored in the soil profile. This method is usually used for replenish soil moisture and soil conservation.

External rainwater collection is obtained from a catchment area of over 1 ha [6]. Catchment area can be plantation land, valley, or road. Runoff water collection is generally stored in reservoirs, ponds, tanks or ground water aquifers. A flow path is required to remove excess water.

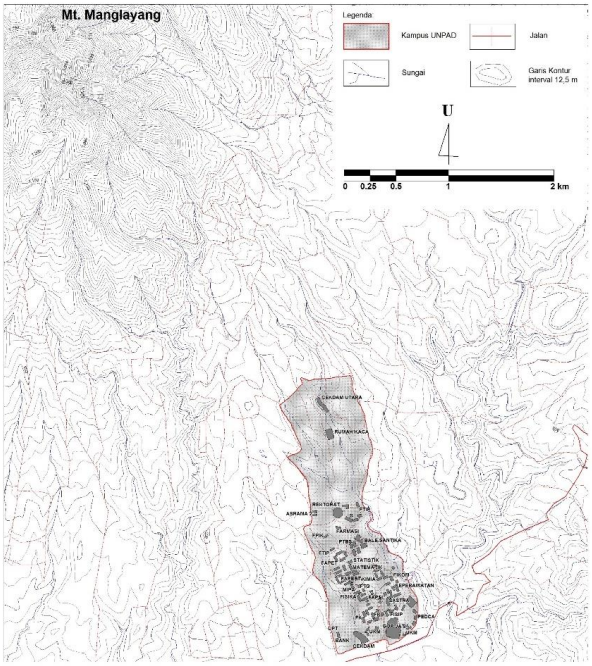

Figure 2 Unpad campus location to Manglayang Mountain as water catchment area

RESEARCH AREA

Unpad in Figure 2 is located in Sumedang Regency, West Java Province, Indonesia. The area is at an altitude of 700 to 900 masl has morphological conditions of hills and valleys composed by volcanic materials from Manglayang Mountain.

The topographic condition of unpad campus location has significant elevation difference so that it has slope to become catchment area [7]. Campus landscape conditions in the form of ridge and valley so it can be a catchment rain water that falls to the surface.

The most suitable method for Unpad campus environmental conditions is by using external rainwater collection method that collects rainwater into runoff into the artificial reservoir in the form of Check DAM by stemming the flow in the western part of the rectorate building.

The area surrounding the rectorate building is the highest of the other buildings. By using the gravity system, the flow of water will be more easily channeled to the entire campus area so it is suitable for the collection and processing of water as in figure 3.

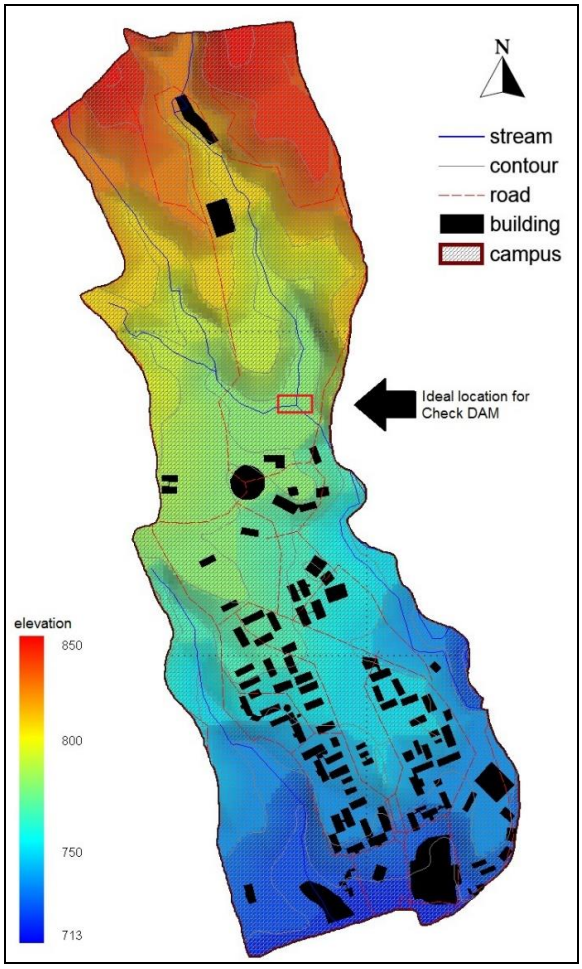

Figure 3. Topographic overlay and location of building and location suitable for water collection.

Rainfall Data

Unpad campus includes tropical area. From the observation of rainfall that falls in the campus area from 2010 to 2014 through rainfall stations in the Faculty of Agriculture are considered to represent displayed in the following graph in the figure 4.

The average annual rainfall is 961.92 mm. With a water catchment area of 1.475.000 m2 and a runoff of 28%, the available potential of this rainwater is 397,272 m3 per year. The amount is large enough to be used as raw water to meet the needs of campus activities.

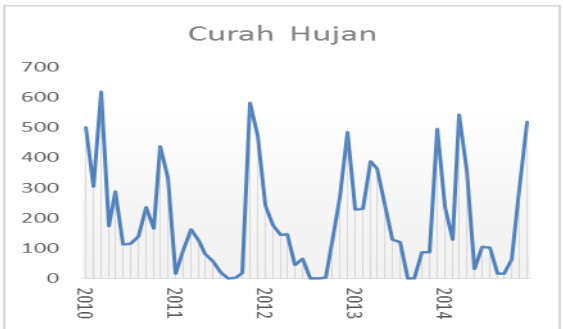

Figure 4 Graph of rainfall from 2010 to 2014 Unpad campus area

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Rainwater Quality

Rainwater generally has a low pollutant content depending on the quality of the atmosphere [5]. Urban atmospheric pollutants from high traffic and industry impacts include microorganism particles, heavy metals and organic substances swept away by water in the rain.

In addition, the surface of the catchment area can also be a source of pollutants in the form of heavy metals, organic substances and others. To utilize water into drinking water, it is necessary to clean up the dangerous contents.

Conceptually the water fulfillment system must adapt to water quality to the end user. If water is intended for drinking water then water quality should be adjusted to drinking water standards. If water is used only as raw water such as toilets, irrigation or laundry then the filtration can be adjusted so as not to waste too much energy.

Rainwater Treatment

The main requirement in the fulfillment of water requirements is a practical method to control water quality at a low cost [5]. If rainwater is obtained by domestic methods then the necessary disinfection is quite simple to do with chlorination. But for the external method it requires a more complete filtration.

As a water source then the harvesting water processing by external method can be done with artificial aquifer technology and rainwater storage (ABSAH) [5]. This technology is a filtration with a natural material composed of unconsolidated rocks and functions to resemble a natural aquifer. This artificial aquifer is composed of locally accessible materials in the environment such as gravel, coarse sand, medium sand, fine sand, red brick debris, limestone piles, charcoal or wooden shells and fibers.

The complete ABSAH building consists of a water intake basin, an artificial aquifer tub, a reservoir basin and a water utility tub, where the interconnecting chamber is connected by a rooster and fibers. Thus, all water entry processes, water movement in artificial aquifers, water storage and water retrieval are in controlled buildings.

This artificial aquifer functions as a filter, also acts as a mineral enhancer through the grain contact of rock material with water, and mimics the physical, chemical and biological processes as occurs in natural aquifers. The process of water movement in it is endeavored to run slowly (laminary flow) and with long trajectory. To keep water temperatures constant, preventing sunlight and outside pollution from entering, and preventing the growth of algae in the water, almost the entire building is tightly closed and partially planted into the soil.

The ABSAH building can be placed on the edge of the reservoir or pond with a slightly lower position to utilize the force of gravity as the flow rate. However, this building should be distinguished from outlet channels for excess water so that the incoming water can be controlled properly in order to maintain the quality of the filtering results.

Water filtering results through this technology is a raw water that can directly be used for toilet purposes, washing and others.

For the purposes of drinking water, the raw water should be reprocessed through membrane technology. The filter system of membranes for good drinking water is a low pressure membrane with a pore size of 0.1 μm [9]. Microorganisms contained in raw water can be filtered effectively.

To meet the needs of large drinking water can be made a large membrane network and equipped with

reservoir tanks before then distributed to the entire network of drinking water pipes.

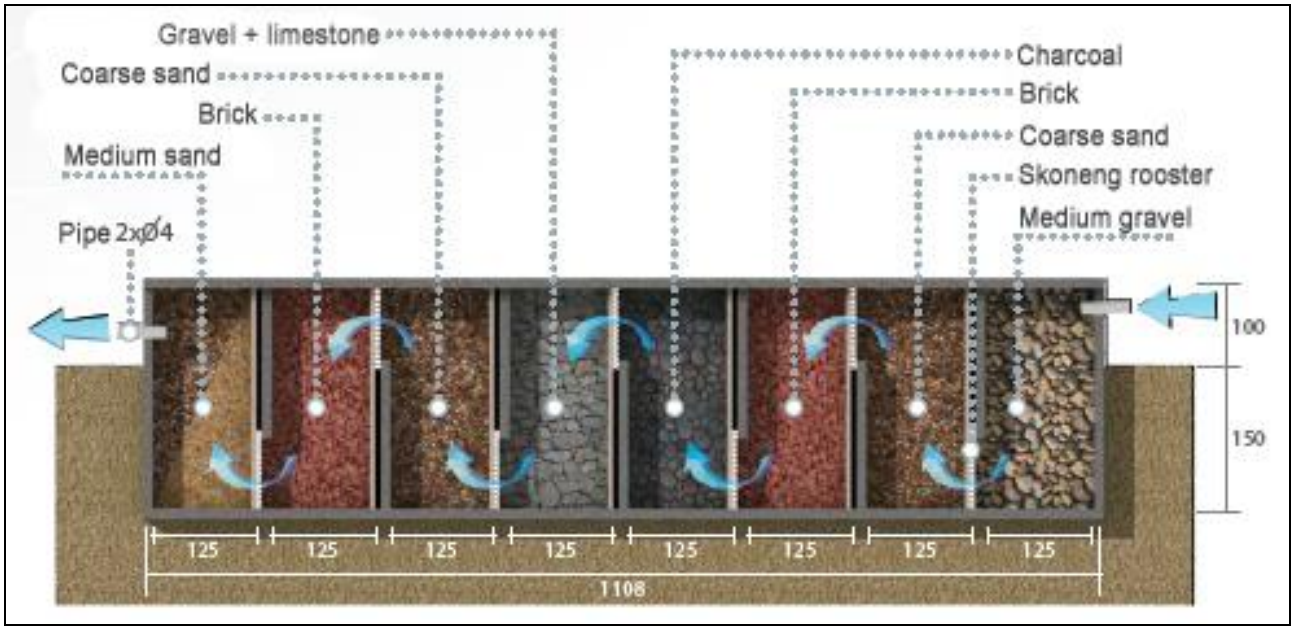

Figure 5 Arrangement of material ABSAH

CONLUSION

Rainwater harvesting is a suitable and profitable method to reduce the risk of groundwater crisis in Unpad campus environment. Rainfall conditions have the potential to provide water supply and topographic conditions support in the application of external rainwater harvesting methods.

Harvesting water quality may not be as good as groundwater quality. However, with the application of various technologies that are cheap enough to produce useful raw water. Drinking water requirements may still be insufficient by using legitimate filtration to be equipped with membrane technology.

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