

Design and Commercialization Study of Rainwater Harvesting System for Residential
House in Malaysia

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DECLARATION

I hereby declare that this project report entitled

DESIGN AND COMMERCIALIZATION STUDY OF RAINWATER HARVESTING SYSTEM FOR RESIDENTIAL HOUSE IN MALAYSIA

Is written by me and is my own effort and that no part has been plagiarized without citations.

Signature :.....

Writer Name :.....

Date :.....

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ABSTRACT

With the global change in weather patterns affecting rainfall distribution temporally and spatially, rainwater harvesting and utilization, Malaysia has certainly be given an added dimension and approach towards an integrated environment friendly and sustainable urban water resources development initiative. This study is aimed at discussing on how rainwater systems can save the water usage from public water supply, system design, installation cost various benefits of rainwater, and the most important thing is return of investment of this system. The amount of rainwater use and its consistency from past studies are explained. With the advantage of the country's blessed generous rainwater resources, capturing it for present and future use on-site would certainly help to count city public water supply and possibly replacing the non-potable of water supply, common whilst also reducing the potential of urban flash floods especially at the Klang Valley by via reduction of peak storm runoff. The system design was explained with drawing which can see more clearly about the water tank was placed and how it can influence the cost, tidiness, space and etc. for the first step, it is require to build a simple prototype to measure and analysis the volume of rainwater. In this study, all of analyze techniques are evaluate and briefly discussed. The results of analyze techniques was explained briefly by taking the rainfall data to determine the ideal water tank size. Then the total cost of project is determined to get the return of investment.

ABSTRAK

Dengan perubahan global, corak-corak cuaca juga mempengaruhi kadar penurunan hujan, dan penuaian air hujan. Malaysia mempunyai kelebihan bagi suatu dimensi dan pendekatan ke arah persekitaran bersepadu untuk bandar yang mesra alam sekitar dan perkembangan inisiatif bagi sumber air. Kertas kerja ini adalah bertujuan untuk berbincang tentang bagaimana sistem air hujan ini berupaya menjimatkan penggunaan air bersih, reka bentuk sistem, kos pemasangan dan pelbagai dan paling penting adalah jumlah balik modal bagi setiap reka bentuk sistem. Jumlah penggunaan air hujan dan taburannya daripada kajian-kajiannya sebelumnya juga diterangkan. Dengan kelebihan negara ini mempunyai sumber-sumber air hujan yang banyak dan bersih, penggunaan sistem ini untuk masa kini dan masa hadapan sudah tentu banyak membantu penjimatan air di kawasan bandar raya dan rumah-rumah teres juga berpotensi mengatasi masalah banjir kilat yang sering melanda terutama di Bandar-bandar besar sekitar lembah Klang. Reka bentuk sistem telah diterangkan dengan terperinci melalui lukisan. Kedudukan tangki air juga boleh mempengaruhi kos, kekemasan, dan lain-lain lagi. Sebagai langkah pertama, satu prototaip ringkas perlu dibina, sebelum membinanya ia perlu mengira kekuatan struktur tapak bagi mengelakkan struktur rosak atau runtuh sebelum ia menampung beban tangki air dengan jumlah maksimum isipadu air hujan. Dalam kajian ini, semua analisis teknik-teknik menilai secara ringkas diperbincangkan. Untuk menentukan saiz yang sesuai bagi tangki, data taburan hujan diperlukan. Jumlah kos projek juga perlu diketahui supaya dapat menentukan pulangan balik modal.

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LIST OF SYMBOL

%	=	percent
≡	=	equivalent rate
>	=	more than

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CHAPTER 1

INTRODUCTION

1.1 Background

The rainwater catchments system is based on collection of rainwater and gravity flow pressure principles. Rainwater runs off the roof of the house into rain gutters. Rainwater harvesting and utilization has been practiced in Malaysia especially in the villages since long ago. Subsequent to the 1998 April drought, the Minister of Housing and Local Government on 7 May 1998 has expressed the Government's interest for houses to be designed to include facilities for collecting rainwater. In 1999, the Ministry of Housing and Local Government has produced a Guideline on Installing a Rainwater Collection and Utilization System (Rainwater Guideline, 1999). This guideline is intended as an 'ideas manual' for reference for those who want to install a rainwater harvesting and utilization system. It aims to encourage the owners to think and adapt wherever possible appropriate innovative alternatives which offer real advantages and adaptable to their needs.

Many companies have been pursuing R&D on rainwater harvesting with focus on system design and installation cost, system performance and system operating and maintenance cost, unit cost, effectiveness in reducing the urban flash flood problems, and policies, by-laws and proposing incentives for system implementation.

This chapter introduces the problem statement, objectives and scope of this research. The study of rainwater system and what the benefit of it and the methodology of the study will be discussed in the next chapter

1.2 Overview of the Study

In this thesis, the work study is focused on to save the usage of water in house and reduces the risk of flood by using rainwater harvesting system. Besides, the original philosophy is to encourage home resident in Malaysia to use this method either from conservation measure water consumption, as rainfall distribution in Malaysia have high and often happened especially flash flood in big cities. So that the first thing to do is build the rainwater catchments system.

Most of the house in Malaysia faced problem if water supply interruption, so that, this system can be rainwater as a permanent usage.

1.3 Research Methodology

Work study is utilized in this project and the methods and techniques used are proved useful in how to save clean water by replacing rainwater and design the rainwater system. Process mapping will be conducted in order to analyze and understand the process involved from PSM 1 until PSM 2. The current performance of the job will be observed and the data will be recorded and documented. The volume of rainwater is required to record for every week, and recorded by using meter pipe. The data recorded will be analyzed by using Microsoft Excel. Here is the flow of the research methodology:

1.4 Problem Statement

The usage of public water supply have been process was increased base on increasing the resident house in Malaysia. Beside that the supplying of water was decreasing day by day and the cost of process was increasing year by year. Base on this system, it will decrease the usage public water supply and saving the cost of water usage.

1.5 Objectives

The objectives of this project are shown below:

- 1) Report results of a neighborhood-level rainwater catchments analysis for house at Malaysia.
- 2) Redesign rainwater system that separate clean water and rain water, with a focus on identifying the total amount of rainwater a neighborhood would divert if all single family residences in neighborhood used rainwater to supplement municipal water.
- 3) Identifying the ideal cistern size and indoor water use for rainwater to maximize the amount of rainwater diverted from the pure water system.
- 4) Analysis of return of investment for rainwater harvesting system.

1.6 Scope

Basically, the main focus of this study is on how to save the water usage, work study is also implemented in this study in order to obtain the result and comparison. This research will covered the design of rainwater catchments system in lowest cost. Rainfall data also investigate to determine tank size. This study is only focus on Malaysia residents house especially area which have high distribution of rainwater. The

improvement and suggestion are also included as extra information in this study. This study will be conducted from July 2008 until April 2009.

1.7 Report Outline

This project will be divided into two parts which is Projek Sarjana Muda (PSM) 1 and PSM 2. PSM 1 contains of three chapters which are introduction, literature review and methodology. Introduction discusses about the definition, objectives, scope and the problems statement related to the project. Literature review will briefly explain in term of method and measurement used to gain the result. Methodology consists of the technique used in obtaining the data. Result and discussion mainly explain about the result and how the data is being analyzed after the implementation of work study. Conclusion is the final chapter and the objectives that had been determined before will be concluded in this chapter.

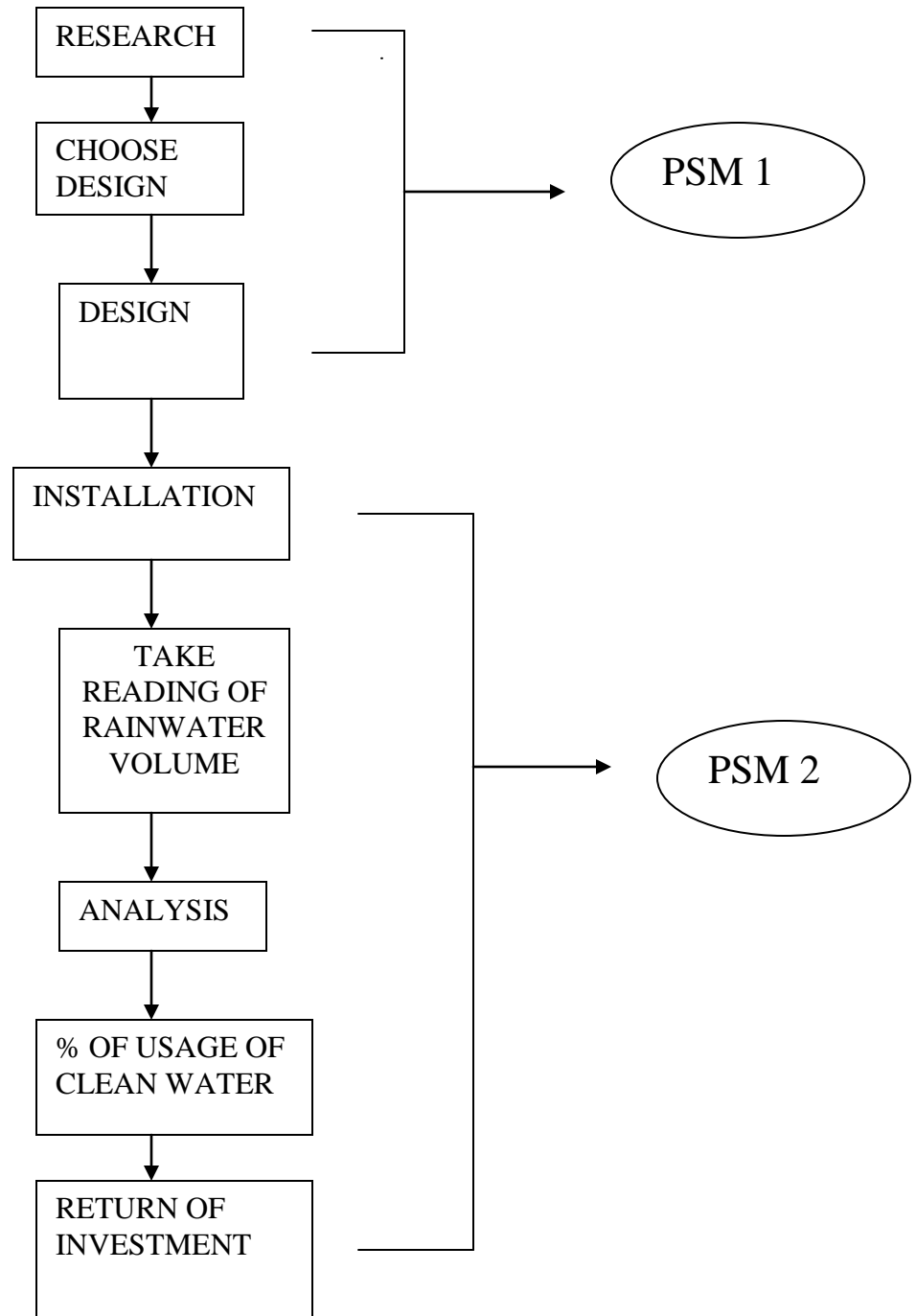


Figure 1.1: Methodology Sequence Process

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Rainwater harvesting is the gathering, or accumulating and storing, of rainwater. Traditionally, rainwater harvesting has been practiced in arid and semi-arid areas, and has provided drinking water, domestic water, water for livestock, water for small irrigation and a way to replenish ground water levels.

2.2 System

There are many types of systems to harvest rainwater. Notable systems are systems for runoff rainwater (eg hillside run-off) and rooftop rainwater harvesting systems. The type used depends greatly on the purpose (domestic or industrial use) and to some extent also on economics and physical and human considerations. Generally speaking, rooftop rainwater systems are most used as they are most economical (if there is more than 254mm of precipitation a year. To determine the amount of precipitation falling in area especially in big city that face flood problem. Refer to (Eartship (2001),volume2: “system and components”).)

2.2.1 System Types

At the moment, 2 types of systems are generally used. These include DIY and commercial systems. Both of these systems are known under the term water harvesters and require only a limited amount of knowledge to set up (if basic systems are used). In both cases, the system consists of a storage tank to store the water and piping (to guide the water in). Additionally, extra pressuring equipment as pressure vessels, inline pump controllers or pressure sensitive pumps may also be required. Finally, water purifying equipment as water-purifying plants, UV-lights or distillation equipment are sometimes added to purify the collected water. The system is then called a Greywater treatment system. Greywater systems are usually preferred over regular water harvesters as they allow the system to not only treat the rainwater, but water from other sources as well (eg the watercloset; if plants are used). However, this feature may also be averted by using a UV-lamp and composting toilet instead.

Depending on local circumstances, a gravity-fed system may already be enough to have a pressured water collection system. In the latter case, no pumps/pressure vessels are thus required to have a pressured system. In practice, gravity-controlled systems are usually created by placing the water harvester on an elevation (eg rooftops). Refer (Pushard (2005)

2.2.2 DIY (do it yourself) Domestic Systems

As **water conservation** is becoming more and more popular, more people have begun to make their own homebrew installation. These systems range from traditional technologies like rain barrels to more complex greywater systems. Through the internet, plans and accurate construction information have become available. (Spence 2007)

In Jason Frey(2005), installation of system is depends on the degree of personal skill and preference, a more basic with regular water tank and piping or more advanced with pressured systems and water treatment system is chosen.

2.2.3 Rainwater Harvesting System in Industrial Systems

Rainwater may also be used for groundwater recharge, where the runoff on the ground is collected and allowed to be absorbed, adding to the groundwater. In US, rooftop rainwater is collected and stored in sump. Refer to (Singh(2007)), in India this includes Bawdis and johads, or ponds which collect the run-off from small streams in wide area.

Many industries buy water from water tankers too. Some buy bottled water for drinking purpose and if soft water is required as part of the process requirement; water softeners or reverse osmosis systems are opted for. It therefore makes famous sense for industries to harvest rainwater because it saves money, it replenishes the ground water and it brings to productive use of soft rain water.

Modern tools such as google earth help identify the catchments of industry if it is large, the slopes and the overall context where it is located in the urban break point. This helps plan design and implement rainwater harvesting systems better from a couple of acres to thousands of acres.

2.2.4 Rainwater Harvesting System at Mosque.

The rainwater collected is stored in the storage tank (underground) and pumped to the toilets and standpipes. The system component consists of a catchments subsystem, filtering cum conveyance system, storage subsystem, pumps, and internal plumbing. The schematic arrangement of the system and the site plan of the mosque are shown in Appendix O.

2.3 Steps to Plan a Home Rain Water Catchments System

As water conservation becomes more important, people look to use water more wisely. Using rain water can be a simple and effective way to cut down on household water usage and save money. The key to a rain water collection system is a rain barrel. These steps are followed to plan a rain water collection system for your home.

Step 1

Calculate the amount of rain water your roof collects in a year. An inch of rain produces 2728L of rain. Multiply 600 by the average number of inches of rainfall in studied area. Multiply that number by how many thousands of meters square of roof you have. That's how many liters of water can save by using a water tank collection system.

Step2

Figure out what need for rain water collection. If already have the main ingredient, a roof. Most homes come equipped with down pipes from the roof.

Step3

Buy a rain barrel with a faucet or spigot on it or attach a faucet to an existing rain barrel. This faucet attaches to your garden hose for watering. Rain barrel sizes range from 546 liters to 614 liters.

Step4

Cover the barrel with wire mesh or a screen to keep bugs and debris out. Think about childproofing the top of the barrel to keep children out.

Step5

Check options that might be need, like an overflow valve that redirects water when the tank is full. See if there is a way to connect two or more rain barrels if one wants to expand rain water collection system.

Step6

Connect water tank to a down pipe from a roof,

eHow Home & Garden Editor(2000)