



### The Microbiological Quality of Harvested Rainwater System in a Rural Area in Malaysia

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#### General Introduction to Rainwater Harvesting System in Malaysia







- Malaysia as a developing nation has experiencing a rapid urbanization
- In rural and remote areas where access to safe drinking water is limited so that rainwater harvesting is the most common practice to be used as a supplementary resource
- Recently Rainwater has tackled the problem as an alternative source for domestic use
- Rainwater harvesting system is still considered as a new phenomenon in Malaysia
- Water management should be improved appropriately through the years, as the water is a key resource for human and development.
- Increasing world's population and to meet the water demands, more interest is growing in the utilization of rainwater harvesting system (RWH)
- Rainwater harvesting system in Malaysia has the potential to solve many problems which is access to safe drinking water in far rural areas and shall reduce the national demand for water supply
- The idea was initiated by the Malaysian government in 1998 after a severe drought in Kula Lumpur.
- Rainwater harvesting has been included in the National Urbanization Policy by a Ministry of Communication, Water and Technology.
- Federal Government also announced that Rainwater harvesting system is a mandatory in the country.





### Advantages of Using Rainwater Harvesting System

- Reducing the pressure of the mains water supply
- Reducing storm water runoff that can often degrade creek ecosystem health
- Providing an alternative water supply during times of water restrictions





#### INTRODUCTION TO THE STUDY AREA AND WASRA RAINWATER HARVESTING SYSTEM IN GAMBANG, PAHANG







#### **1.Description of the Study Area**

- The study monitoring was conducted at one harvesting system that is located in Gambang, Pahang state in Malaysia.
- The rainwater harvesting system was located in University of Malaysia Pahang, Gambang which is a small district of Kuantan that is a big city in Pahang state which is located to the south-east cost of Malaysia, (3°45'N 102° 30'E)
- The average perception through month is around 438 mm and the temperature range is usually from 22C to 32°C as maximum whereas the relative humidity varies from 62%, mild humidity to 96% very humid which is known as a monsoon season that is initiated from China and north Pacific start between November and February in Malaysia







### Description of WASRA RAINWATER HARVESTING SYSTEM IN GAMBANG

#### Figure (1) Shows Wasra Rainwater Harvesting System







#### Figure (2) Wasra (RWH) System









The rain water was collected from the cistern that is located inside the university and known as WASRA system, a small project for collecting and harvesting rainwater for domestic purposes use. Rainwater was collected from the top roof which is made of Galvanized through the side gutter to a collecting pipe down to the cistern inlet and there is a mesh prior entering the tank that rainwater is passed through. While there is a drainage pipe for overflow rainwater that is fed into nearby channel. The capacity of the rainwater harvesting tank is 1m<sup>3</sup>and it is placed on a concrete base as shown in previous Figures 1 & 2.





## **Objectives of The Study**

The objectives of this study were to:

- To examine and evaluate the microbiological quality of the rainwater harvesting system in a rural area in Malaysia, Pahang state, Gambang
- To determine the variability of microbial water quality over seasonal changes to produce a good quality of water for domestic use and to assess the potential risks of microbial contaminations so that the rainwater system was tested and monitored for fecal bacteria and the study was conducted in three-stages time period, through premonsoon season, monsoon and post monsoon to check the fecal variability in rainwater harvesting system.





### **Fecal Indicator Tested in this Study**

**Total Coliform** 



E. Coli







### **Rainwater Sampling**







### **Rainwater Samples Collection**

Rainwater samples were collected weekly for Two months' time period, during the pre-monsoon, monsoon and post monsoon season which is also known as the northeast monsoon season in Malaysia. Samples were collected directly from the top part and the bottom of the tank, and placed in glass sterilized bottles for microbiological analysis and put into ice-box container that is transported immediately to the laboratory of the university. A total of 40 samples were collected for microbiological assessment.





### Water Samples Processing







### Water Samples Testing for E.Coli and Total Coliform at the University Laboratory









All Samples were examined for the two widely used bacterial indicators total coliform and Escherichia coli (E. coli), by using the Colilert-Technology IDEXX- Quaniti- tray- Quanti Try 2000 technique, 57 wells, range 1-200 MPN/mLs at 35 C°, method number SM9223B (APHA, 1998). All samples were collected directly into separately sterilized bottles of 400 mL size and transported directly to the Environmental laboratory of the university in a chilled-cold box. The samples were analyzed on the same day they were collected from the project site if that was not possible to achieve then within 24 hours as maximum as all samples were reserved in a chiller inside the laboratory.







### Fecal Indicators MPN/100 mL by Using Quanti- Tray 2000 Technique







#### Results and Analysis (Total Coliform and E. Coli variation Concertation during Pre-monsoon, monsoon and post monsoon Season)







## The variation concertation of E. coli during the monsoon sampling







The variation concertation of E. coli during the Postmonsoon sampling







### The variation concertation of total coliform during the Pre-monsoon sampling



Dates of Pre-Monsoon Sampling





### The variation concertation of total coliform during the monsoon sampling



Dates of monsoon sampling





### The variation concertation of total coliform during the Post-monsoon sampling



Total coliform concetration of post-monsoon

Dates of Post monsoon Sampling





# The presence and concertation of E. coli in all water samples







### The presence and concertation of total coliform in all water samples







### **Descriptive Analysis**

#### Total Coliform (Number of Observations = 40), MPN/100 mL

Pre- Monsoon Monsoon	Mean = 465.8 Mean= 249.87	Min. = 301.5 Min. = 188.2	Max. = 616.4 Max. = 301.2

E. Coli (Number of Observations = 40), MPN/100mL

Pre- Monsoon	Mean = 12.807	Min = 10.5	Max. = 16.3
Monsoon	Mean = 9.030	Min. = 7.2	Max. = 10.9
Post- Monsoon	Mean = 5.012	Min. = 0	Max. = 7.4





#### Data Distribution by Using ANOVA Analysis for E. Coli







#### Data Distribution by Using ANOVA Analysis for Total Coliform







### **Key Findings**

- The performance of rainwater harvesting system was monitored for two months' interval cumulated time period through Pre-monsoon, monsoon and post-monsoon season. The rainwater harvesting system did not meet drinking water guidelines standards and it is contaminated with fecal bacteria. These findings are corresponding with a number of other studies that is indicating that collected rainwater makes poor quality drinking water due to the high levels of bacterial contaminations.
- There was a great variability of fecal quality over the course of the study and was demonstrated with plots and variance statistical analyses. We also found that microbial quality of harvester rainwater system was also varying through season changes, and this great variability is coherent with recommendation of a system disinfection.
- As a result, a first-flush and applying disinfectant to rainwater harvesting system could improve the quality of harvested rainwater and could be used for drinking purposes after a proper treatment.





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