

## Efficiency of Home-Based Rain Harvesting Irrigation Towards Selected Crop For Home Farming

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Received: 18 May 2021

Accepted: 10 June 2021

Published: 15 June 2021

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### Keywords:

Rain Harvesting System; Drip Irrigation, Re-cycle Product, Urban Farming, Home Farming, Mentha Aruensis L, Ocimum Sanctum, Alternanthera Sissoo

### Citation:

Razali MHBH. Efficiency of Home-Based Rain Harvesting Irrigation Towards Selected Crop For Home Farming. United J Agri Sci Res.2021; V1(3): 1-5.

### 1. Abstract

The outbreak of pandemic disease on recently has created opportunity on home farming or urban farming. This study is to gain a better insight on how effective home based rain harvesting irrigation by using recycle water bottle and rainwater in conjunction to that, drip irrigation is attached to the rain harvesting and channeled to the selected crop which are mint (*Mentha aruensis L*), Kemangi (*Ocimum sanctum*) and Brazilian spinach (*Alternanthera sissoo*). At the end of it, it is revealed that using rainwater as rain harvesting irrigation did not have side effect toward the crop as such it also effective to use.

### 2. Introduction

The impact of natural hazards on the agriculture sector can be devastating. To reduce the effects of climate change, farmers use strategies to counter effect the influence of a natural disaster. For example, saving rooftop rainwater can help during draught season. As such through the rainwater catchment, many irrigation systems can be use. For instance, drip irrigation, sprinkler irrigation, surface irrigation and manual irrigation. Irrigating crops can be a challenge for farmers during the dry season or in times of drought. Crop failure has detrimental effects on the livelihoods of families and their food and nutrition security. Access to sufficient as well as efficient use of water resources is highly important, in particular during the dry season (Figure 1). Lack of water increases the

work burden of women and children, who have to travel sometimes long distances to meet the household water needs. For households without stored water, water shortages in the dry season limit the production from homestead vegetable gardens. Unlike many other irrigation techniques, drip irrigation enables a watering regime that provides slow, regular and even soil wetting. In drip irrigation, water is directed through a series of plastic pipes directly to the plant roots, enabling plants to effectively use most of the available water, thereby limiting the amount of water lost to deep drainage, evaporation and runoff [6].



Figure 1: Plastic pot that have been made with drainage

In addition to efficient and effective use of water, less fertilizer is washed away and as a result, the cost of inputs needed is lower. The more controlled water release also results in fewer weeds, which means less labour is required also for watering to raise crops. Time is saved not only from collecting water, but also in having to water the crops [3]. Therefore, drip irrigation holds promise as a means for increasing water use efficiency, reducing labour requirements, and improving harvest quality and quantity. The use of rooftop rainwater collection as a valuable water source for drip irrigation can help farmers cultivate vegetables around the homestead. Vegetable cultivation is often done by women. As a result, this can help them to reduce the impact of drought and enable them to increase numbers of crops grown a year, which helps to generate additional income, diversify livelihoods and contribute to food and nutrition security [2].

Rooftop rainwater collection or rainwater harvesting is the utilization of scientific techniques to collect and store rainfall. It involves the collection of water from the surfaces that rain has fallen upon. The harvested water is filtered and subsequently used for both domestic and commercial purposes. Rainwater harvesting has been practiced since ancient times. New innovative methods have emerged as a result of technological advancements. Such methods have played a considerable role towards water conservation [1]. This is especially essential in arid areas, providing simple and cost-effective solutions for meeting water requirements. While water shortages may be sometimes inevitable, rainwater harvesting systems help people to prepare sufficiently for the eventuality. On the other hand, rainwater harvesting is a cheap and more reliable alternative to traditional water supply methods. It is the most effective method of conserving water, collecting rainwater into storage tanks to prevent wastage [5]. In conjunction, this system is most commonly used in metropolitan cities. The systems boost water security and improve the floral system as a whole. Rainwater harvesting also prevents erosion thus helping maintain the top layer of the soil. Floods are a significant menace, especially in populated areas and it reduces flooding, especially on roads.

Plastic is definitely something that we want to get rid of completely in the long term. It is one of the biggest toxic pollutants that just refuses to become a part of the planet even after spending decades in landfills. Because it is non-biodegradable, one of the better ways to deal with plastic, apart from reducing its usage considerably, is to reuse and recycle it as much as possible. Among the recycle products, plant pot using plastic container has been widely used especially in household due to their convenience characteristic [4]. As such, recycle plastic also other mean to use in home farming or the urban farming. Urban agriculture, urban farming, or urban gardening is the practice of cultivating, processing, and distributing food in or around urban areas [2]. On the positive side, urban farming provides food security. Organic produce in groceries is not cheap. A large number of families cannot even afford to buy organic food

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items. Food security means giving people access to nutritious food that is safe and sufficient for their families all over the world. Urban farming makes food affordable and available to more people. On top of that, carbon emissions can be reduced by cutting down the consumption of fossil fuel needed to package, transport, and sell food items. A typical meal must travel 4,200 miles from the farm to the table. Urban farming, aside from being accessible, reduces the carbon footprint.

Vegetables and herbs are the examples of plants that generally are grown in home farming. The reason why they are chosen is because due to several advantageous which are most vegetables are naturally low in fat and calories. Vegetables are important sources of many nutrients, including potassium, dietary fiber, vitamins. The systems boost water security and improve the floral system as a whole. Rainwater harvesting also prevents erosion thus helping maintain the top layer of the soil. Floods are a significant menace, especially in populated areas and it reduces flooding, especially on roads (Figure 2).



**Figure 2:** Rain harvesting irrigation system

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Figure 3: galaxy sensor apps to sensing the external factor

Table 1: The external factor before and after

Factor/time	Before	After
Temperature (°C)	36.4	38.5
Humidity (%)	37.8	36.4
Light (lux)	1598	1962
Pressure (hPa)	1.014	1.014
Altitude (m)	8.2	8.2

Vegetables and herbs are the examples of plant that generally be plant in home farming. The reason why they are chosen is because due to several advantageous which are most vegetables are naturally low in fat and calories. Vegetables are important sources of many nutrients, including potassium, dietary fibre, folate (folic acid), vitamin A, and vitamin C. Diets rich in potassium may help to maintain healthy blood pressure. For instance, Brazilian spinach

(*Alternanthera sissoo*) is leafy green vegetable that have a great source of calcium, vitamins, iron, and antioxidants. Due to its iron and calcium content, spinach is a great addition to any meat- or dairy-free diet. One cup of raw spinach is mostly made up of water and contains only 7 calories [4]. Other than that, tomatoes, chilly, salad etc is also suggested as urban farming.

In this experiment, a recycle water bottle is used as rain harvesting irrigation system and selected crop such as mint (*Mentha aruensis* L) or in Malay known as daun pudina, Kemangi (*Ocimum sanctum*) called daun selasih in Malay and Brazilian spinach (*Alternanthera*) (folic acid), vitamin A, and vitamin C. Diets rich in potassium may help to maintain healthy blood pressure. For instance, Brazilian spinach (*Alternanthera sissoo*) is leafy green vegetable that have a great source of calcium, vitamins, iron, and antioxidants. Due to its iron and calcium content, spinach is a great addition to any meat- or dairy-free diet. One cup of raw spinach is mostly made up of water and contains only 7 calories [4]. Other than that, tomatoes, chilly, salad etc is also suggested as urban farming.

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**3. Materials and Method**

**3.1. Site Selection:** The site of the experiment was at Kampung Alor Ara, Pekan Pahang. The soil sampling was collected at the area. Soil sample that used in this experiment was sandy clay soil that tested using feel method of soil texture. Step of determination of soil texture (feel method). Firstly, taken a handful of soil as a sample. After added some water, the soil was kneaded into play dough. If it does not form into a ball, it is sand types of soil. Later, the dough was form into flat sausage by gently press the soil using thumb and index finger to feel the texture. Lastly, formed ribbon was measured using ruler and result was predicted. More than 5cm with gritty texture is sandy clay

**3.2. Sample Preparation**

**3.2.1. Pot Preparation:** 7 collected recycle pots were used. The drainage was made on the pot by holing a hole under the pot. This is to remove excessive water during irrigation

**3.2.2. Rain Harvesting Irrigation System:** Recycle water bottle was used as rainwater harvester. The bottle was then attached with infusion tube with tooth prick as source of water flow. The infusion tube function as a channel the water meanwhile the tooth prick is for water flow out from the infusion tube (Figure 4). The flow of rainwater from the bottle to the pot was controlled by stopper.





**Figure 4:** Result of before and after the experiment carried out

**3.3. Planted Crop:** After the pot filled with soil, the crop was grown. In this experiment, mint (*Mentha aruensis* L), Kemangi (*Ocimum sanctum*) and Brazilian spinach (*Alternanthera sissoo*). All of these plants were using stem cutting with the height of 5cm respectively.

#### 4. Experimental Design

For rain harvesting irrigation experiment, Complete Randomized Design (CRD) was used which consist of three treatment with two replications. Each treatment was giving same amount of water. A completely randomized design (CRD) is one where the treatments are assigned completely at random so that each experimental unit has the same chance of receiving any one treatment. For the CRD, any difference among experimental units receiving the same treatment is considered as experimental error.

##### 4.1. Plant Analysis

**4.1.1. Plant Height:** Plant height was measured on 3rd days, 6th days, 9th days after planting by using measuring tape (cm). The second leaves of each plant were taken as diameter and the results were recorded.

**4.1.2. Number of Leaves:** The number of leaves was measured on 3rd days, 6th days, 9th days after planting by using manual counting

**4.2. External Factor Analysis:** The analysis was done by using galaxy sensor application. This apps were design for sensing temperature, humidity, light, pressure and altitude. By using this this sensor, the external factor result was obtained.

**4.2.1. Plant Height:** Rainwater was channeled to the crop using rain harvester during to reduce the water consumption. Based on

the result obtained on table 1, on the 9<sup>th</sup> DAP, Kemangi (***Ocimum sanctum***) has the highest height among the crop with average of 13.88cm from T1R1 and T1R2 (14.83cm and 14.29cm) respectively. Mint plant (***Mentha aruensis*** L) follows up with average of 13.88cm and this making the Brazilian spinach (*Alternanthera sissoo*) as the least height compared to two others crop. From this result, it can conclude that all of the crops are well grown; however Kemangi was the vigorous among others due to height and also contains flowers which indicate that it has entered the matured stage and ready to be harvested.

**4.2.2. Number of Leaves:** The (Table 2) indicate the leaves number of each crops. In this case, there is a stark contrast of results from the plant height whereby Brazilian spinach (*Alternanthera sissoo*) has abundance of leaves that are more than 35 leaves compared to others two crop. These place it on the highest collected leaves. Meanwhile, Kemangi (*Ocimum sanctum*) is the second higher of leaves plant with average of 29 respectively. As for Mint plant (*Mentha aruensis* L), it has 26 that is slight low than Kemangi and placed it as the least plant contains leaves. It can be deduced that, although Brazilian spinach lack in height, but on the other side, it has more leaves compared to others. Brazilian spinach is a leafy in nature and this prove that Brazilian spinach is also vigorous in grow.

As for mint, overall result apparently showed that it is still vigorous grow, however under certain circumstances such as soil conditions make it less competitive to Kemangi and Brazilian spinach (Table 3). In a nutshell, aside from herbs plant, vegetables can also be grown. This is because they have short lifespan, economic growth and convenient for sustainable farming.

**Table 2:** The height of plant on 1<sup>st</sup>, 3<sup>rd</sup>, 6<sup>th</sup> and 9<sup>th</sup> day after planting (DAP)

Days/plants	1st DAP	3rd DAP	6th DAP	9th DAP	Average
Mint ( <i>Mentha aruensis</i> L)					
T1R1	5cm	6.10cm	8.58cm	13.90cm	13.88cm
T1R2	5cm	6.22cm	8.91cm	13.85cm	
Kemangi ( <i>Ocimum sanctum</i> )					
T1R1	5cm	7.13cm	9.82cm	14.83cm	
T1R2	5cm	7.32cm	10.27cm	14.29cm	
Brazillian spinach ( <i>Alternanthera sissou</i> )					
T1R1	5cm	6.69cm	9.76cm	11.23cm	
T1R2	5cm	6.88cm	9.84cm	11.56cm	

**Table 3:** The number of leaves 1<sup>st</sup>, 3<sup>rd</sup>, 6<sup>th</sup> and 9<sup>th</sup> day after planting (DAP)

Days/plants	1st DAP	3rd DAP	6th DAP	9th DAP	Average
Mint ( <i>Mentha aruensis</i> L)					
T1R1	8	14	19	26	26
T1R2	8	15	20	25	
Kemangi ( <i>Ocimum sanctum</i> )					
T1R1	8	16	25	30	29
T1R2	8	15	24	28	
Brazillian spinach ( <i>Alternanthera sissou</i> )					
T1R1	8	17	28	>35	
T1R2	8	18	30	>35	

## 5. Conclusion

At the end of experiment, it revealed that the home based rain harvesting irrigation is effective to be used on home farming with the selected crop that has high resilience toward environmental condition. Vegetables and herbs plant are one of the examples that can be grown anywhere, any places, and anytime especially for household. Meanwhile, the efficacy of rain water to replace the daily water consumption is discovered. As a result, this can help them to reduce the impact of drought and enable them to increase numbers of crops grown a year, which helps to generate additional income, diversify livelihoods and contribute to food and nutrition security. By any mean, a sustainable farming or smart farming can be created using anything around us even the recycle product.

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