FEWSG DAM (Flood = Electricity + Water + Storage + Solar Garbage Trapper) DAM

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ABSTRACT

During heavy rainfall, low-lying places may face flood and storm water. Instead, it can cause runoff and eroding soil, thus, leading to another unwanted abundance garbage. However, every problem creates an opportunity. This paper proposes how flood can be manipulated as a source of clean water and renewable electricity. Mini turbine and solar trap technologies allow it to operate in a limited space, especially in traditional villages. At the same time, excess treated flood water can be stored underground for a future use. This green technology may give new hope to those who are often hit by flood problems over the years.

Key Words: Continuous Energy, Sustainable Energy, Water Supply

INTRODUCTION

Nowadays, coal, gas and petroleum are among resources for producing electricity. However, the resources start decreasing, while world population keep increasing. Furthermore, use of these resources may impact in a negative way, especially in producing carbon dioxide (CO_2). This leads to more dangerous conditions such as global warming and acid rain (McLamb, 2011). In parallel, need for clean water and renewable energy is increasing due to an increase in world population (United Nations, 2018). Although there are other alternative sources such as solar, wind and wave, there are limited to large-scale use. Hence, more small-scale methodologies need to be studied and practiced in enabling the technologies to be adopted by communities around the world.

LITERATURE REVIEW

Hydroelectric Turbine Dam

Electricity has becomes one of basic essentials for living. Hydropower plays a significant role in supplying electricity using renewal energy which is water. At the same time, it is an alternative for fossil-based power plant (Kellogg & Hobbs, 2016). Hydropower is a combination of water flow energy and pressure head that convert into a useful mechanical form (Wazed & Ahmed, 2008; Jawahar & Michael, 2017). The kinetic energy produced may move turbine, thereby generating electricity. On the other hand, micro hydropower system is able to generate power within 100 kW. This is used in supplying electricity to a small population (Khurana & Kumar, 2011). In a smaller scale, a stand-alone power generation tool called generator is a highly demanded product, especially for those living in remote areas (Kanase-Patil et al., 2010).

Groundwater

Liquid freshwater for Earth's living, basically, not lying in lakes and rivers, but stored underground in aquifers. During drought season, this valuable source supply water to rivers (Morris et al., 2003). Groundwater is located between fractured rocks and soil particles (Massarsch & Westerberg, 1995). Groundwater is widely used around the world as a result of its accessibility and practicality (Konikow & Kendy, 2005). However, the volume decreased due to its growing demand and its quality can be argued due to pollution on the soil (Currell et al., 2012). In overcoming this problem, more man-made underground water, sourced from surface runoff and rainfall need to be built. This is to enable the underground water to accumulate in a large volume and continuously sustain throughout the year (Alvarez-Cobelas et al., 2001).

Solar Power

The sun is the major source of renewable energies. Its light, also known as solar radiation is capable in producing electricity (EIA, 2017). Employment of high-efficiency nanophotocatalysts, enables the solar power plant in capturing the energy before kept in special batteries (Kamat, 2007). This also avoids pollution, following lack of waste generated from this energy generation process (Twomey, 1974). For that reason, more countries are keen to implement it on a large scale to compensate for excessive use of fossil materials (Zahedi, 2011). Statistically, consumed amount of energy in the US is only about 0.15% of the solar energy received (Williams, 1974). In other words, too much focus on conventional sources, made people forgot about this free and sustainable energy.

OBJECTIVES

In proposing this type of dam, these three objectives are the main goals:

i) to provide a continuous and sustainable energy for present and future,
ii) to provide a continuous water supply sourcing from the nature itself, and
iii) to develop an environment-friendly garbage trapper.

METHODOLOGY

Small Hydroelectric Turbine Dam

Equipment and Parameters Involved

In designing a standard small hydroelectric turbine dam, cost of components, pipeline (diameter and length), water intake in galloon per meter (gpm), water flow to be generated (L/s), pressure head (vertical distance between head and turbine), amount of electricity generated (kWatt), and power house (for both turbine and control panel) are among the equipment and parameters should be considered, as written in Dametew (2016). This is very important in ensuring effectiveness and efficiency of this dam. It is expected that this dam may reach its 70% of efficiency level during operational period.

Designing Dam

Generation of power amount for target population is the biggest consideration under this stage, as highlighted by Jager & Smith (2008).The water intake into the dam should be affiliated with projected power amount. Therefore, dimensional values for the dam are suggested in Table 1. In addition, Figure 1 shows a sketching diagram for FEWSG Dam.

Table 1 Dimensional Values for Dam

Dimension	Value
Depth (D)	6m
Length (l)	2m
Diameter (d)	7m
Water flowrate (Q)	500 L/s (with efficiency range from 70%)
Head (h)	5m (buried underground to reduce the friction loss)

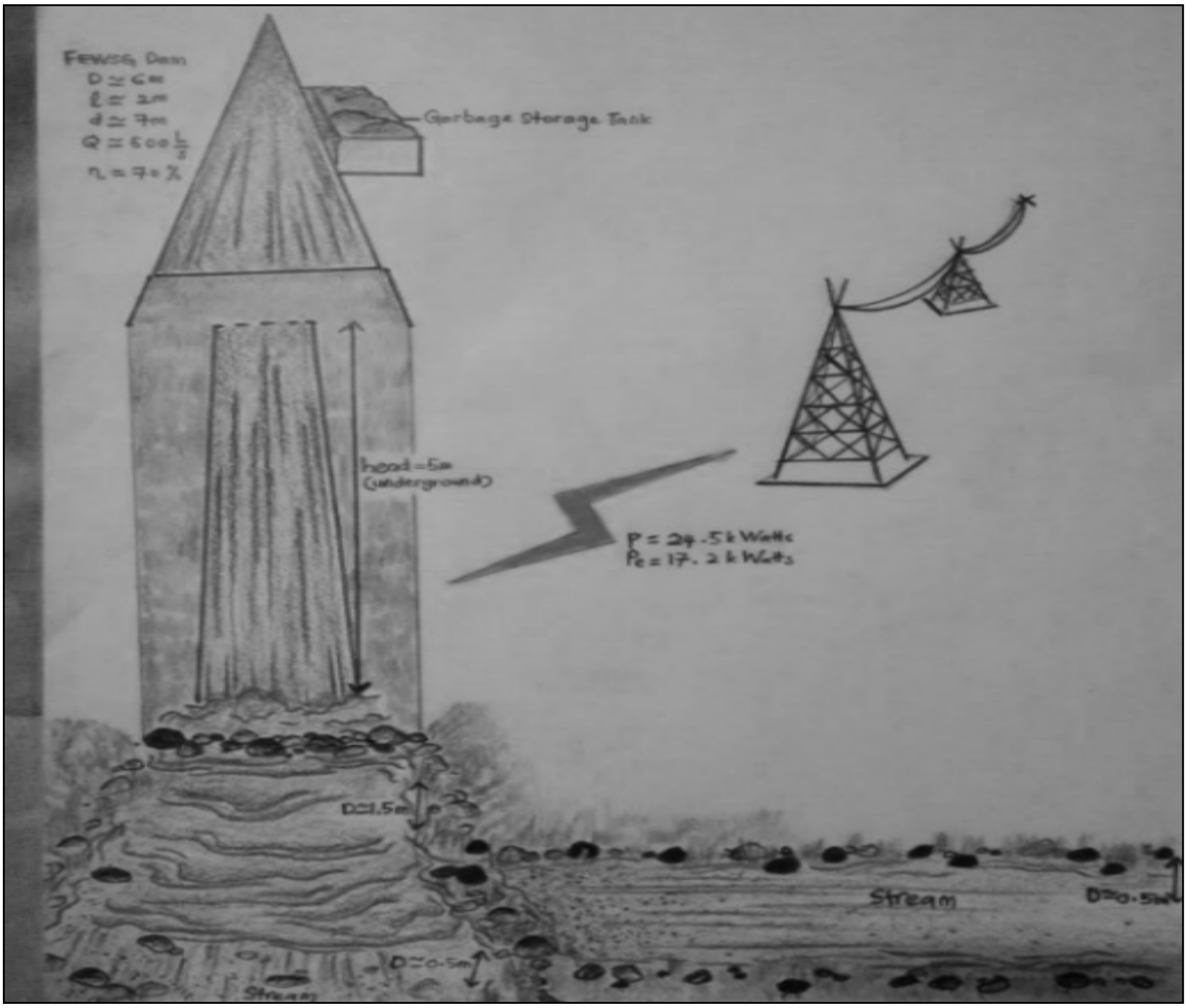

Figure 1 FEWSG Dam Set-up

Underground Water Storage

Parameters Involved

In designing a man-made storage for underground water, knowing groundwater characteristics is crucial. As explained by Ambroggi (1977), groundwater is natural water that comes out from the inner Earth's surface. Hence, it is susceptible to potential pollution if not properly managed. For that reason, various parameters need to be met to avoid this problem. The parameters include depth of storage tank from natural groundwater level, soil characteristics, pressure to avoid storage crack and leakage, water inlet flowrate (L/s) and intake in gallon per meter (gpm), and dimensions of storage tank (Promax, 2017), as shown in Table 2.

Table 2 Dimensional Design for Underground Water Storage

Dimension	Value
Depth (D)	6m
Length (l)	2m
Diameter (d)	7m
Water flowrate (Q)	500 L/s
Expected amount of water can be stored	100 gallon

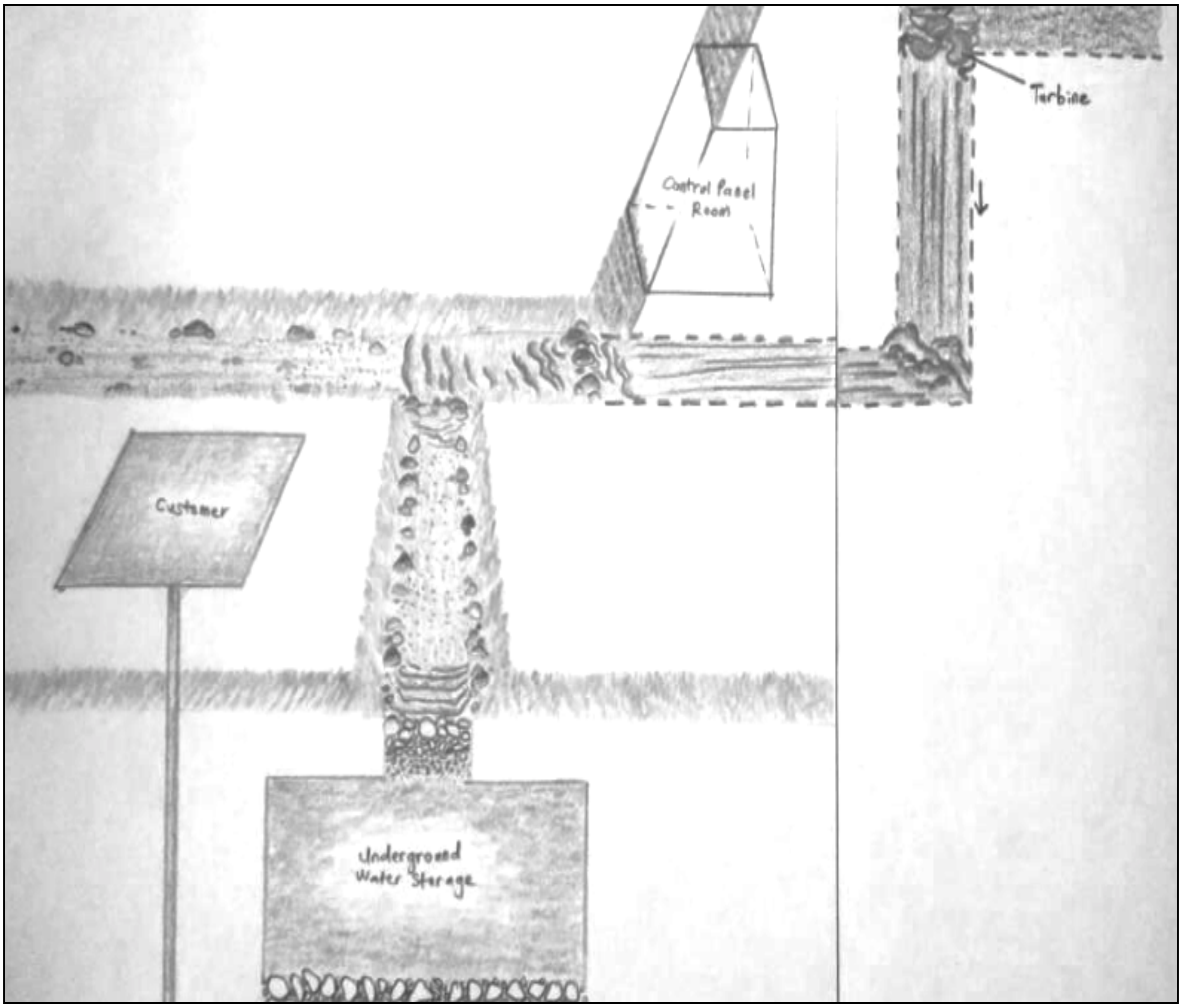

Figure 2 Underground Water Storage

Designing Storage

For storage tank, concrete tank is the best material. This selection is supported by Promax (2017), where concrete and ferro-cement water tanks are generally strong and long-lasting. In addition, the water kept becomes cooler due to its insulation value. From a contradicting point of view, the concrete tank is very heavy and difficult to handle. Plus, it may leach lime, thus increases pH of water (Stewart et al., 2006). Thus it may need several flushes before use. For better maintenance, the concrete tank needs a consistent wash every few years in reducing this leaching problem (Van der Sloot, 2002). Figure 2 depicts a design sketched for underground water storage.

Solar Garbage Trapper

Designing Solar Garbage Trapper

In designing solar garbage trapper, material for buoyancy is the biggest consideration. As stated in the Archimedes' principle, upwards buoyant force on an object is equal to weight of water that it displaces (Lass et al., 2018). Thus, rubber raft has been chosen as it is light in volume (Lebreton et al., 2018). The trapper is designed to be semi-sphere shaped. Half of it is a control power house for solar panel, while the other provides temporary garbage storage. It moves forward with paddle, which is designed to trap garbage using circular motion. The paddle is also equipped with a filter function, in reducing leachate accumulation. The power is generated mainly from the sun. Alternatively, other light resources such as moonlight, fire and lamp may supply energy for the trapper. Figure 3 and 4 illustrate sketched diagrams for this solar garbage trapper, which traps all garbage caused by a flood.

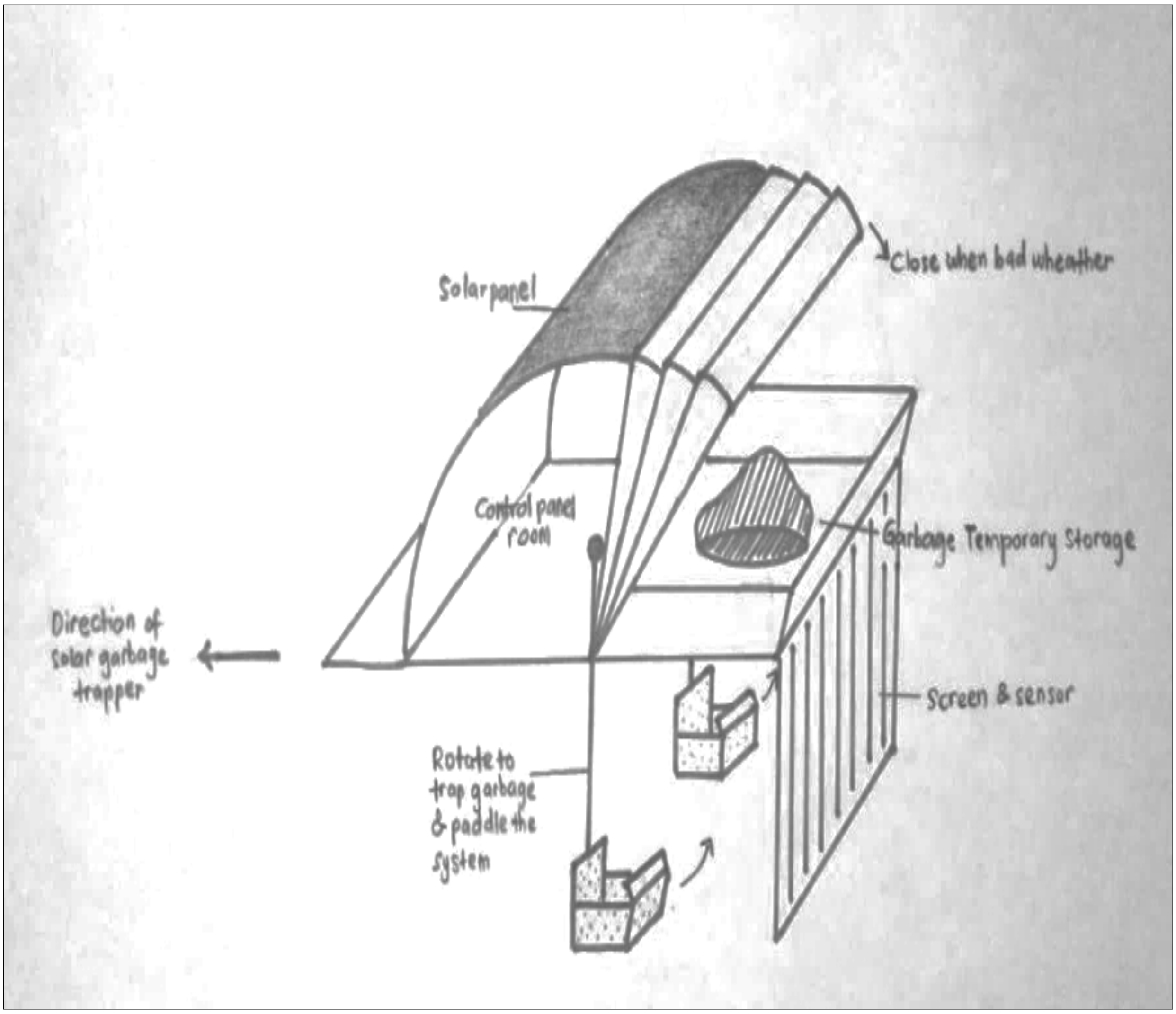

Figure 3 Solar Garbage Trapper (Design)

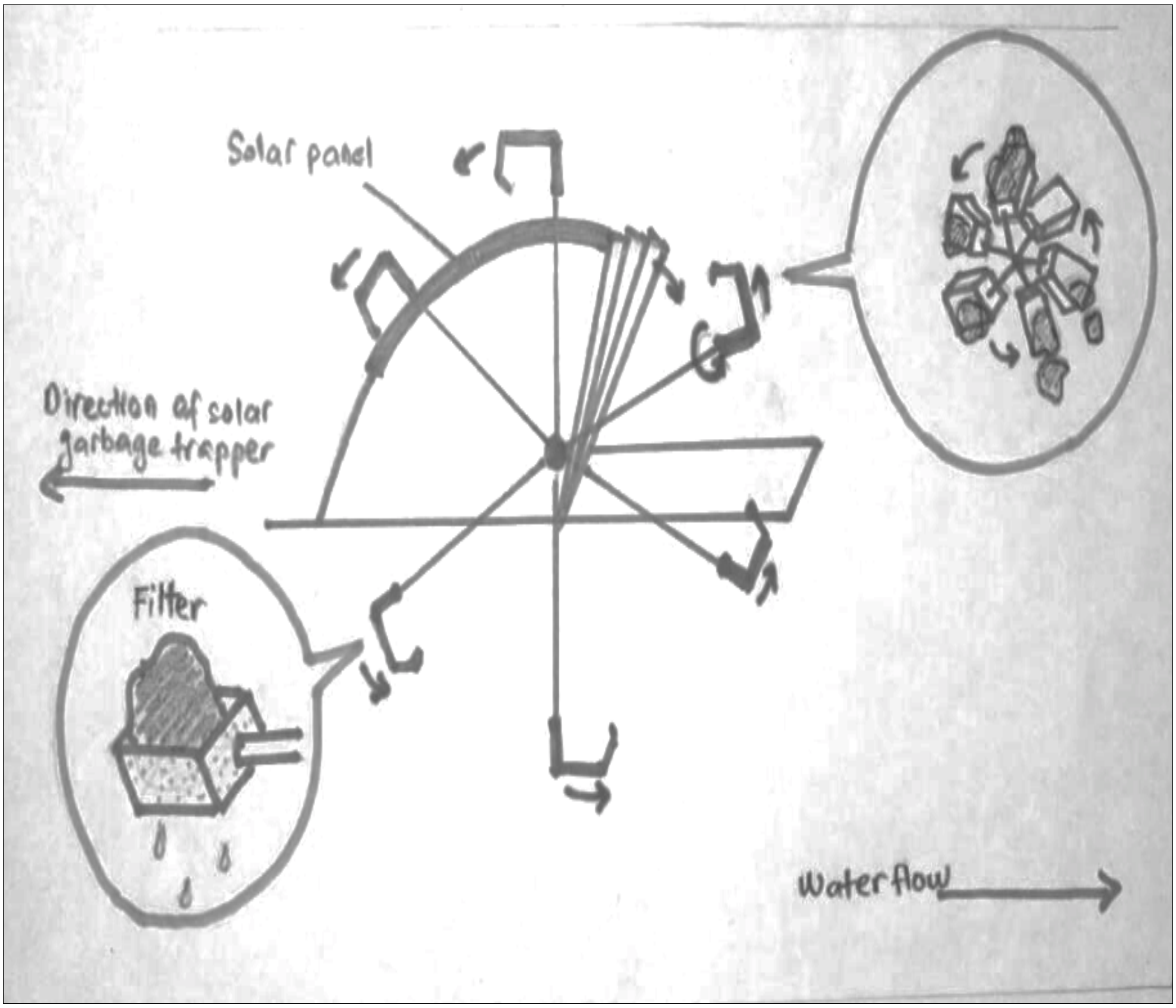

Figure 4 Solar Garbage Trapper (Rotation)

EXPECTED RESULTS

One village house with an area of 100m^3 needs at least 5kWatt. Approximately, 70kWatt.hr of power will be needed for 24 hours of usage. The electricity generated from this FEWSG DAM, enable to support electricity of three (3) small houses. For the underground water storage, it is capable to store up to 500 gallons. This is equal to water usage of five (5) small houses. Table 3 and Table 4 summarize expected results from both electricity and water aspects.

Table 3 Parameters for Small Hydro Dam

Parameter	Value	Unit
Total power generated	24.5	kWatt
Efficiency	70%	%
Amount of efficient power to be generated	17.2	kWatt
Amount of electricity per house	5	kWatt
Amount of house to be supplied	3	-

Table 4 Parameters for Underground Water Storage

Parameter	Value	Unit
Amount of water to be stored	500	gallon
Amount of water used per house	100	gallon
Amount of house to be supplied	5	-

Before the water can be used for generating electricity and kept as storage, the water source which is flood and surface runoff will be treated. Using solar garbage trapper, it is able to remove pebbles, sand and rocks. In addition, it acts as filter for the water turbidity and able to remove flood colour. The use of light based energy is very practical, given the possibility of the breakdown of electricity during floods is very high and inevitable.

CONCLUSION

It is a hope that this project can bring huge benefits to the public. Providing electricity source and supplying clean water, using environmental friendly approach are the novelty of this innovation. Although it is still at the stage of idea and only exist on sketching basis, everything can be a reality with the support of various parties as well as determination by the authors.

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