ISSN (Online): 2455-3662
EPRA International Journal of Multidisciplinary Research (IJMR) - Peer Reviewed Journal
Volume: 10| Issue: 10| October 2024|| Journal DOI: 10.36713/epra2013 || SJIF Impact Factor 2024: 8.402 || ISI Value: 1.188

RAINWATER HARVESTING AND ENERGY GENERATION USING MICRO-TURBINES IN DOWNPIPES – A REVIEW

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ABSTRACT

As the world population increases, the demand increases for quality drinking water. Surface and groundwater resources are being utilized faster than they can be recharged. Rainwater harvesting is an old practice that is being adopted by many nations as a viable decentralized water source. This paper reviews the methods, design of rainwater harvesting systems, and its impacts adopted in all parts of the world. Renewable energy sources are rapidly increasing in demand and importance as governments and countries around the globe begin to understand their vital role in reducing climate change. This project aimed to design and create an optimised micro-hydro turbine system for downpipes to harness the currently untapped potential energy from rainwater. The study determined that, during average rainfall in the UK, a single turbine could produce a maximum of 7.21 V of DC voltage, or 50.49 V during heavy rainfall – enough energy to power a mobile device charger or a vacuum cleaner, respectively. Therefore, this proves a high potential in rainwater energy harvesting as a renewable energy source.

KEYWORDS: *(RWH), electromagnetic induction, rainwater, renewables, optimisation*

INTRODUCTION

Individual rainwater harvesting systems are one of the many tools to meeting the growing water demand. Rainwater harvesting is an environmentally sound solution to address issues brought forth by large projects utilizing centralized water management approaches. Population growth all over the world is causing similar problems and concerns of how to supply quality water to all. As land pressure rises, cities are growing vertical and in countryside more forest areas are encroached and being used for agriculture. In India the small farmers depend on Monsoon where rainfall is from June to October and much of the precious water is soon lost as surface runoff. While irrigation may be the most obvious response to drought, it has proved costly and can only benefit a fortunate few. There is now increasing interest in the low cost alternative-generally referred to as 'Rain Water Harvesting' (RWH).Rapid advances in technology and an ever-growing population have led global energy demand to increase rapidly in the last decade. Between 2000 and 2040, global energy consumption is expected to increase by 77% , reaching around 740 million terajoules. Roughly 84% of the world's primary energy consumption in 2019 was produced from fossil fuels . These unsustainable resources cause grave effects on the planet including environmental pollution, greenhouse effects, and CO_2 emissions. To ensure a clean and sustainable environment for future generations, governments have realised the importance of investing in greener energy sources, with the UK setting targets to generate 100% of its power from renewable energy by 2035 . With rapid improvements in technology, decreasing costs of renewable energy resources, and increased competitiveness of battery storage, renewables have become among the most competitive sources of energy in many countries. India has a long tradition of water harvesting. Many of the traditional water harvesting systems have either fallen into disuse due to a variety of physical, social, economic, cultural and political factors which have caused their deterioration, decline of institutions which have nurtured them (Agarwal and Narain, 1997) or have lost their relevance in the modern day context due to their inability to meet the desires of the communities.

While the first dimension of the decline in water harvesting tradition has been well researched and documented, the second dimension is much less understood and appreciated. The fact that different periods in history are marked by the genesis, rise and fall of some new water harvesting tradition (Pandey et al., 2003), is also not appreciated.

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METHODOLOGY

1. **Rooftop collection**
   Collect rainwater from a roof using a gutter and direct it to a storage tank or cistern. A filter can be used to remove debris from the water.
2. **Permeable surfaces**
   Create surfaces that allow rainwater to seep into the ground, such as using gravel, permeable pavers, or grass.
3. **Percolation pits**
   Dig pits and fill them with porous materials like pebbles or broken bricks to help rainwater seep into the soil.
4. **Groundwater recharge**
   Use artificial techniques to recharge groundwater aquifers with surplus rainwater.
5. **Treatment**
   Treat rainwater with disinfection methods like chlorination, ultraviolet disinfection, or heat treatment before using it.
6. **Energy conversion**
   When water will flow from the pipe the t pressure of water will come on turbines then the hydraulic power will convert into electrical energy. This electrical energy is used for generation of street light.

LITERATURE REVIEW

1. A relatively new water-harvesting treatment is the application of paraffin wax to soils to create a water-repellent catchment surface. The first two such catchments were installed at the Granite Reef test site in 1972 by applying ground paraffin wax (0.7 kg/m^2 average rate) atop smoothed, rain-compacted soils. Solar energy melted the wax into the soil. The catchments are still operational after 7 years of natural weathering. YEAR averaged 87% for the 7 years. Year 7 averages were 85%, i.e., only 2% less than the 7-year average. Also, the 7-year average runoff efficiency of the two catchments was only 10% less than that of a plastic membrane, but was more than four times greater than that of a simple, cleared and smoothed soil surface and nearly six times greater than that of a small untreated, natural desert watershed. Several operational wax-treated catchments have been built to supply water to livestock on arid rangeland. Ranchers are pleased with them — equating them to permanent springs. Both laboratory and field tests indicated that the wax treatment is most successful on sandy soils containing less then 20–25% clay plus fine silt**.**
2. Abhijeet Keskar, Satish et al. Investigated the rain water harvesting (RWH) system as an alternative source of water at the Government College of Engineering, Aurangabad (GECA) campus in the Indian state of Maharashtra. The study's expected outcome is the development of a rainwater harvesting system for the campus catchment area, which includes the parking lot, workshop area, and some of the electronics department area up to Hostel 'A.' According to the analysis, the current RWH system has a storage capacity of 53,96,816 litres per year and a construction cost of Rs.5 lakhs, and it performs reasonably well in comparison to conventional water sources. By taking almost all technical aspects into account, the developed system meets social requirements and can be implemented in rural areas.
3. Project Report on Design of Rainwater Harvesting System Lingaya's University, Faridabad :- The specialized parts of this paper are water gathering gathered from housetop which is thought to be catchment territories from all lodgings and Institutes departmental working at Lingaya's Institute of Management and Technology, Faridabad Campus. As a matter of first importance, required information are gathered i.e. catchment zones and hydrological precipitation information. Water gathering potential for the inns and workforce flats was ascertained, and the tank limit with appropriate plan is being considered. Rain Water Harvesting-A Campus Study, Govt College of Aurangabad: - The aim of this study is to use rainwater and thus taking close to the concept of nature conservation. In this study, the rain water harvesting system is analysed as a alternative source of water at campus of government college of engineering, Aurangabad in the state of Maharashtra, India. The expected outcome of the study is the development of rainwater harvesting system for catchment area of campus from parking area, workshop area, some of the electronics department area up to hostel. The result analysis shows that the present rain water harvesting system is having the storage 53,96,816 litres/year and construction cost of rs.5 lakhs respectively and is reasonably well in comparison

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