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Suitability analysis for implementing a renewable energy powered water purification system

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Abstract

In the developing world, people not only lack access of grid electricity, but also safe drinking water. There are many causes of waterborne diseases due to drinking unsafe water use from surface water sources. Under these circumstances, renewable energy based water purification can be an appropriate solution. Applying Geographical Information System (GIS) technique for implementing decentralized renewable energy based system to provide safe drinking water to vulnerable communities can be a useful tool to policy makers and administrative authorities in finding sustainable options. This paper presents a concept of using GIS bound renewable energy based water purification system. Using GIS as a tool, suitable areas can be identified for using such a system, and this can also be used to estimate water demand, energy demand and the nature of the water purification system at household and community level. The proposed concept was applied in Pathumthani province, Thailand as a study area. The renewable energy potential from PV, water demand, energy demand and the sensitivity to the system identification due to the influence of various parameters have been estimated and presented.

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Keywords: Geographic Information System (GIS); Photovoltaic; Renewable energy; Water purification system; Sustainable development

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1. Introduction

Lack of hygienic drinking water and lack of basic sanitation is the major cause for many water related diseases. There are many causes of waterborne diseases due to drinking unsafe water use from surface water sources. Under these circumstances, a renewable energy based water treatment system could be useful in areas that lack both grid electricity and hygienic drinking water facilities and could be a good stand alone solution for this problem [1]. This type of system may have a dual benefit wherein hygienic drinking water will improve the quality of life and the use of renewable energy will help in reducing the use of fossil fuels [2, 3].

Alternatively, there are many technologies that are available to combine renewable energy technology with a water purification system, such as PV powered reverse osmosis (PV-RO), wind powered reverse osmosis (Wind-RO), PV powered UV disinfections and solar photo-catalysis, in which, sunlight and a reusable reaction medium such as Titanium dioxide (TiO_2) is used to remove toxins from ground water [4, 5]. Another possible combination can be PV powered pumping with ultra filtration membrane technology (UF) [6, 7]. This type of system could be simple, compact and easy to operate. Fig. 1 presents a schematic of PV pumping and a membrane based water purification system. This type of system may consist of a UF membrane, a PV array, a PV pump, and a water storage system. This kind of sustainable technology can be used where surface water is available but the water is not safe for drinking.

Considering the need to provide safe drinking water to the households and communities that do not have this access, the following issues need to be resolved by government administrative authorities:

- How much water (not necessarily safe) is available in the vicinity of the population to be supplied – this requires mapping of the households and communities, knowledge of the streams and water bodies that can be the source of water,
- How to bring this water to the population (the energy resource available at the location of interest, and the technologies required – electricity by grid or through de-centralized electricity supply systems such as PV, wind, diesel, etc), and
- Information on the quality of water available for this purpose, and what are the options available to treat the water to make it safe for drinking.

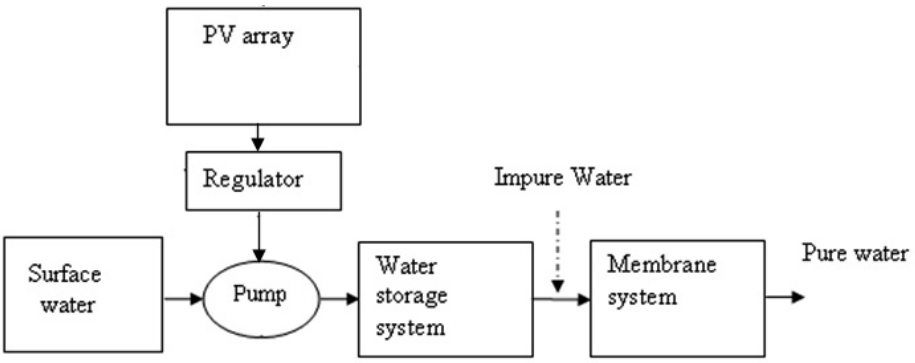

Fig. 1. Schematic diagram of solar photovoltaic based water purification system