FACTORS AND CONSEQUENCES OF THE USE OF THE SOLAR POWERED WATER PUMPING SYSTEM IN AGRICULTURE

Chutchanun Tanomvorsin, Assoc.Prof.Dr.Siravit Koolrojanapat and Asst.Prof.Dr.Duangsamorn Rungsawanpho

Suan Sunandha Rajabhat University, 1 U-Thong Nok Road, Dusit, Bangkok, 10300, Thailand

ABSTRACT

From the past to present, a drought has been one of the natural disasters affecting agricultural condition of the country. It causes agriculturists to have less and insufficient income to pay for their livings. This problem in turn affected the total GDP of the country which appears to be lower. Upon realizing this problem, an approach to deal with a drought should be examined. The objectives of the research were to: 1) study the current state of ecological aspect, physical aspect, and human activities related to the use of solar energy system in agriculture; and 2) examine consequences of using solar energy system in agriculture. This study used an experiment research approach. The experience was conducted by growing rice and sugar cane in areas of districts of Suphan Buri Province including Muang District, Don Chedi District, and Sam Chuk District. These areas were located around 500 meters in distance from four solar powered water pumping systems. Data were collected from five experts who were executives of government organizations who were in charge of water management and 40 agriculturists who used ground water for their farms from the solar powered pumping system. The data were analyzed with basic statistics including percentage, mean, and standard deviation. Data from in-depth interviews were analyzed with content analysis. In addition, statistics were also used to test and compare the outcomes before and after using the solar powered water pumping systems for agriculture. The research findings revealed that in terms of physical condition of areas where solar energy system had been used for agriculture, the condition of soil, weather, and other general environment were suitable for agriculture. As for the ecological aspect, it was found that there were animals and insects, both insect pests and beneficial insects, in the areas where solar energy system has been used. For the human activities, the research findings reported that agriculturists believed that a solar powered water pumping system would not cause pollution that negatively affected the environment and human health. They also thought that using such system was beneficial because it was an effective way of utilizing natural resources; 2) after utilizing the solar energy system in agriculture, agriculturists could enjoy higher quantity of water for their farms which in turn benefited their products because more water could make agricultural products to grow faster. Apart from that, it was also found that ecological and physical conditions as well as human activities were in better conditions than before using such system, with a .01 level of statistical significance; and 3) the solar energy system required lower investment than a dynamo water pump because it used less electrical energy and could be used for long-term. However, the solar energy system also required proper maintenance by a skillful mechanic.

Keywords Ground Water Pumping System, Solar Cell Panels, Agriculture

INTRODUCTION

A drought negatively affects agriculture in many countries, especially in Thailand because the majority of people in the country are agriculturists. A drought caused soil to dry and lack of moisture. Moreover, with mild water deficiency, plants and crops are usually slow growing and stunted. The amount of plants and crops will be of less quantity and low quality. These will consequently cause agriculturists to earn less and insufficient income to pay for their living, and in turn cause the country GDP to be lower. Upon realizing this problem, this research was conducted with the aim to examine an approach to solve a drought for agriculturists.

Research Objectives

1) To study the current state of ecological aspect, physical aspect, and human activities related to the use of solar energy system in agriculture

2) To examine consequences of using solar energy system in agriculture.

METHODOLOGY

This study used an experiment research approach. The experience was conducted by growing rice and sugar cane in areas of districts of Suphan Buri Province including Muang District, Don Chedi District, and Sam Chuk District. These areas were located around 500 meters in distance from four solar powered water pumping systems. Data were collected from five experts who were executives of government organizations who were in charge of water management and 40 agriculturists who used ground water for their farms from the solar powered pumping system. The data were analyzed with basic statistics including percentage, mean, and standard deviation. Data from in-depth interviews were analyzed with content analysis. In addition, statistics were also used to test and compare the outcomes before and after using the solar powered water pumping systems for agriculture.

FINDINGS AND DISCUSSION

1. According to the first research objective which aimed to study current state of ecological aspect, physical aspect, and human activities related to the use of solar energy system in agriculture, the research findings revealed that in terms of physical condition of areas where solar energy system had been used for agriculture, the condition of soil, weather, and other general environment were suitable for agriculture.. As for the ecological aspect, it was found that there were animals and insects, both insect pests and beneficial insects, in the areas where solar energy system has been used. For the human activities, the research findings reported that agriculturists believed that a solar powered water pumping system would not cause pollution that negatively affected the environment and human health. They also thought that using such system was beneficial because it was an effective way of utilizing natural resources. The research findings also showed that using a solar powered water pumping system was a wise way of using ground water to solve a problem of a drought because ground water is valuable natural resource. However, there were also other human activities that could cause negative effect to environment and natural resources. Included are activities in industry that neglected the condition of environment, used a large amount of natural resources, and caused pollution to environment. For example, a mining industry which involved stripping that caused soil erosion and waste water that flowed from a mine to water source and caused water pollution. Another example of human activity was agriculture such as using insecticide to

increase agricultural products. Such activity could be harmful to environment and human health because toxin from insecticide were accumulated in human body and made people sick. In addition, the toxin also affected the quality of environment. Moreover, human consumption also affected the amount of natural resources which would be less continuously and caused higher number of waste which were difficult to eliminate.

However, we should also be aware that causes of a drought could be various. Included were climate change, changes of environment, increased demand for water, insufficient water sources, both man made sources and natural sources, and deforestation, and low quality of water sources, lack of awareness of water usage and conservation, poor city planning, and inefficient water management and water sources development.

2. According the second objective which aimed to examine consequences of using solar energy system in agriculture, the research findings showed that:

2.1 After utilizing the solar energy system in agriculture, agriculturists could enjoy higher quantity of water for their farms which in turn benefited their products because more water could make agricultural products to grow faster. Apart from that, it was also found that ecological and physical conditions as well as human activities were in better conditions than before using such system, with a .01 level of statistical significance.

2.2 The solar energy system required lower investment than a dynamo water pump because it used less electrical energy and could be used for long-term. However, the solar energy system also required proper maintenance by a skillful mechanic.

Based on the research findings of this study, it was found that the findings are in agreement with the findings of Pinichnand Samaarphat and Tanit Ruangrungchaikul (2015)'s study which assesses the economic value of a solar powered water pumping system used for agriculture. They collected the data by conducting interviews with three agriculturists who changed from using a dynamo water pump to a solar powered pumping system in their farms and the system they were using was a big system requiring 2,400 watts. The findings of this study showed that the solar powered pumping system was worth for investment because it could help them save money for fuel and maintenance, as compared to the old system. (the payback period for this system was around 2.86-6.22 years). Additionally, this study also found that in a case of using the solar powered pumping system without having a dynamo water pump in place, the system was found to be more worth for investment. The payback period for the system in this case was around 2.68-5.15 years. The solar powered pumping system could be more efficient if solar cell panels were designed and installed in a way that enabled them to be movable according to the sun and mirrors were also installed. This latter point was also found in the study of Supachai Kawinvuthikul (2013) which examines the benefits of using a sun tracking system for solar sell. This study used an experiment research with the purpose to determine an increase in efficiency of Amorphous Silicon Solar Cell panels by using mirrors to increase solar radiation intensity to the panels and moving the panels according the movement of the sun. This study also compared the efficiency of similar pairs of solar cell panels that were used differently. For the first pair which were not moved according to the movement of sun, one panel had a mirror installed with it whereas another had no mirror. As for the second pair which were moved according to the movement of the sun, one panel had a mirror installed with it whereas another had no mirror. The research findings showed that the efficiency of a panel which had a mirror installed with it and was moved according to the movement of the sun increased by 15.33% and its efficiency was higher than a panel that was moved according to the sun and had no mirror by14.12 %. As for a panel that had a mirror installed with it and was not moved according to the movement of the sun, its efficiency increased 13.05 % and its efficiency was higher than a panel that was not moved according to the movement of the sun and had no mirror with in by 11.89 %. Apart from the study on how

to design a solar cell panel installation system to make it more efficient, there is another related study which is a study of Thanapat Phromwatanapakdee (2009) which examine a way to increase an efficiency of a solar cell panel by using a digital sun tracking system. The digital sun tracking system was designed and developed to be able to adjust the position of a solar panel so that it could be moved according to the sun movement. The panel could be adjusted in two ways which were by the Altitude and the Azimuth. This system used a microcontroller to control a motor to adjust the position of the solar sell panel and a transistor to monitor the solar radiator. Based on an experiment, it was found that the digital sun movement monitor could work efficiently. It was also found that when a solar cell panel moved according to the sun movement at 15 degree angle, the panel could generate more electric energy than it moved according to the sun movement at 30 and 45 degree angle. When comparing the amount of electric energy generated from a panel which moved at 15 degree angle and a panel which stayed still, it was found that the first one which had a size of 5 Wp could generate higher electric energy by16.91 %, the one with a size of 30 Wp could generate higher electric energy by 18.85 %, and the one with a size of 50 Wp could generate higher electric energy by15.52 %.

SUGGESTION

Department of Groundwater Resources should determine a specific policy and guidelines for utilizing a solar powered water pumping system for the purpose of agriculture, especially for the provinces where agriculture is the main occupation of local residents. Moreover, the government should also provide budget for such system for agriculturists.

REFERENCES

A Solar Energy System Installation (2012). Retrieved on 22 March 2012, from http://www.greenpower.9nha.com/solar130w.html

Using SPSS for Data Analysis. (online). Retrieved from www. watpon.com/spss

Charoen Phrian Charoen. 1997. Groundwater – Artesian Well. Bangkok: Department of Groundwater Control, Department of Mineral Resources.

Department of Groundwater Resources, Ministry of Natural Resources and Environment. (2005). Ground Water Development Technology Manual. Bangkok: One Family Printing Service.

Department of Groundwater Resources, Ministry of Natural Resources and Environment. (2007). The Conference on Groundwater Resources 2007. Bangkok.

Department of Groundwater Resources, Ministry of Natural Resources and Environment. (2010). Interesting things of Groundwater. Bangkok: Sinthaweekit Printing.

Patchareeporn Mhongkolwatthanakul and Penporn Sirilatthaporn (2005). A Comparative Study of Energy Generated from Solar Cell Panels with a Position Controller, a Sun Movement Monitor, and Solar Radiator Intensity Monitor. The Mechanical Engineer Project, Master of Engineer Program, Kasetsart University, 12(1), pp. 11-16.

Pinichnand Samaarphat and Tanit Ruangrungchaikul (2015). Assessment of the Economic Value of Solar Water Pumping System for Agriculture. Thai Journal of Science and Technology, 4(3) September-December 2015, pp. 217 - 266

Panuwat Naueytong et al. (2005). Controlling the Position of Solar Cell Panels by Specifying the Position of the Sun and Monitoring the Solar Radiation Intensity. The 19th Conference of Mechanical Engineering Network of Thailand. 19 (1), pp. 56-61.

Siravit Koolrojanapat (1998). Research: Principles and Practice. Bangkok: King Mongkut's University of Technology North Bangkok.
Anucha Deephang et al. (2005) The Sun Tracking System by Digital Sun Position Sensor. The 1st Conference on Energy Network of Thailand. 1(1), pp.101-103.
Konar, M Phil and A.K. Mandal. (1991). Microprocessor base automatic sun tracker.
a. IEEProceedings-A. 1(1), pp.138-141.
Koyunc B. and.Balasubramanian K. (1991). Microprocessor Controlled Automatic Sun Tracker." The 23rd IEEE Photovoltaic Specialists Conference. 23(1), pp.913-917.
Jame W. Stewart and Chao-Ying Wang (2001). "CPLD Foundation Design and SimulationSoftware." Prentice-Hall. 23(1), pp. 913-917.
John A. Duffie and William A. Backman (1980). Solar Engineering of Thermal Processes. John Wiley & SonsInc. 1980.
John W. Best (1981). Research in Educatiou.Newyorh :Haper and Row.
Napat Watjanatepin and Chaiyant Boonmee (2006). Performance and Economical Analysis of The a-SiGPV System at RMUTSB, THAILAND. 21st European Photovoltaic Solar Energy Conference, Vol. 2 No. 6, pp. 56
Roth, A. G. and Boudinov H. (2004). "Design and construction of a system for suntracking."Renewable Energy. 2(6), pp. 393-402.
Soteris A. Kalogirou.1996. "Design and Construction of A One-Axis Sun-Tracking." Solar Energy. Vol. 3(1), pp.465-469.