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The Effect of Space Utilization under The Ground-Mounted Solar Farm on Power Generation

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A B S T R A C T

The ground-mounted solar farms are the most common type of Thailand solar power plant. Presently, the area under the solar panels in Thailand had not been utilized. This work was to investigate a suitable configuration for space utilization under the PV panels which could promote power production. The effect of space utilization was investigated for 3 configurations: a water pond, chili cultivation, and a grass plantation. Under the first PV string, the pond sizing 2.4 × 15 meter was created. Under the 2nd PV string, 60 chilies samples were planted. Moreover, the grass was planted under the third string. The intensity of solar radiation (W/m2), temperature, voltage and current of solar panels were also monitoring. The impact of all configurations on the power generation was evaluated and compared with a control. Results indicated that the space utilization of the first string (the pond) and of the second string (the chili cultivation) generated electricity at 1.6 kW. Both configurations could generate more power than control. The pond and the vegetable plantation were suitable configurations for promoting power production.

1. INTRODUCTION

The ground mounted photovoltaic power plants are the most common type of Thailand solar power plant which are similar to the United States [1]. The installed solar power plants covered an area of 9,020 ha. Their total solar power generation is 2,819 MW per day [2]. The government of Thailand is planning to install 6,000 MW solar farms in 2036. Therefore, expanding of solar power generation inevitably needed more area.

Presently, areas under the solar panels in Thailand have not been utilized. However, Valle, et al. [3] suggested that the total productivity of a land could be increased by agri-voltaic systems: a combination of solar power generation and a food production. Therefore, a suitable configuration for promoting the utilization of space under the PV panels and the power generation was investigated.

2. MATERIALS AND METHODS

2.1 The configuration of space under the PV panels utilization

The effect of space utilization was investigated in 3 configurations - a water pond, a chili cultivation and a grass plantation - and a control. The 25-kW PV farm at the Asian Development College for Community Economy and Technology (adiCET), Chiang Mai Rajabhat University, Thailand as show in the Fig. 1 was the experimental area.

The water pond sizing 2.4 × 15.0 m was built under the first PV string, with bricks and covered with plastic. Under the second PV string, 60 chilies (*Capsicum frutescens* Linn.) were planted. They were watered twice a day (07.00 am and 05.00 pm) with 500 L of water per day. In addition, 2.25 kg of organic compost per crop and pest control physical and mechanical means were applied as well as the use of organic pesticides. Soil under the third solar panel was raked for removing all rocks, large soil clods, and plant roots/sod chunks. After that, it was mixed with organic compost. Grasses (*Zoysia japonica*) were planted, and watered with 500 L per days at 07.00 am and 05.00 am.

2.2 The monitoring and evaluation

The solar radiation, temperature, voltage and current were monitoring meanwhile the surface area of solar panels was measured. The data was used to evaluate the solar power generation comparing with control.

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Fig. 1. The configuration for space utilization under the PV panels

3. RESULT AND DISCUSSION

3.1 The Solar radiation

The solar radiation was monitored on 1 – 7 February, 2018. The solar radiation data from 06.00 am to 06.00 pm as show in Fig. 2 indicated that the highest solar radiation intensity of 801 W/m2, approximately, was obtained at noon.

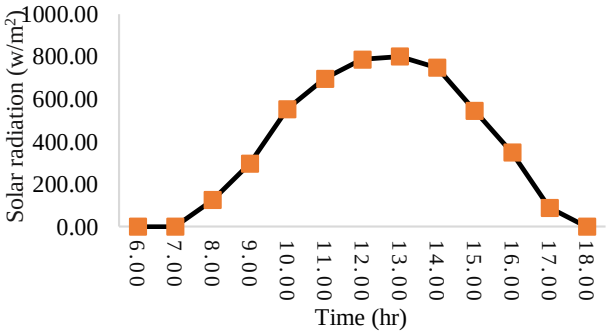

Fig. 2. The solar radiation

3.2 Temperature

The temperature of each solar panel including with control was monitored from 06.00 am to 06.00 pm. Although their temperatures were higher than the ambient temperature as show in Fig. 3, they were lower than the previous.

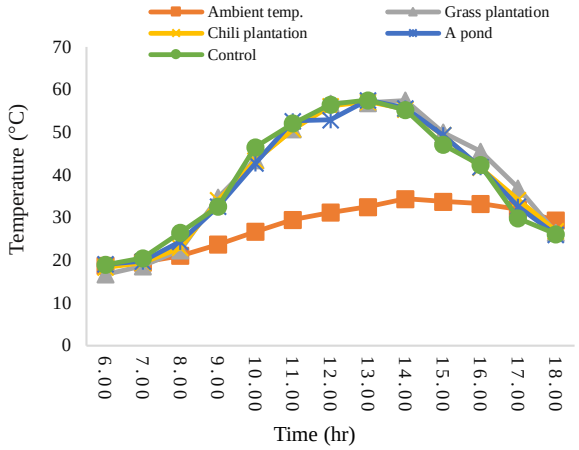

Fig. 3. The temperature of each solar panel before setting up the configurations

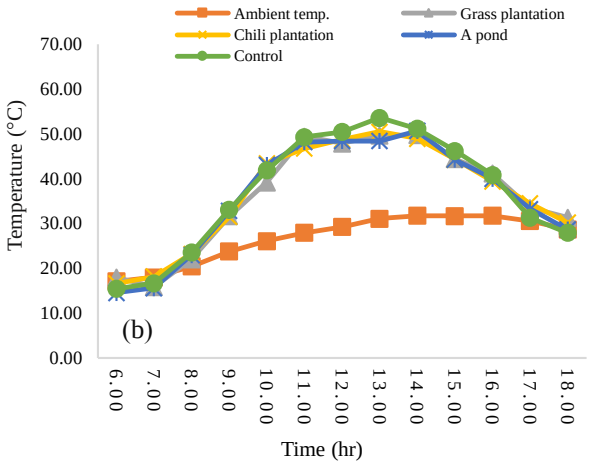

Fig.4. The temperature of each solar panel after setting up the configurations

3.3 Voltage and current

After setting up, the first string, the second string, the third string and control could generate the average voltage of 272.5, 272.3, 272.1 and 272.8 V, respectively. Moreover, the average current of all configurations including with control was 5.9, 5.7, 5.6 and 4.6 A, respectively. Results indicated that the voltage of all string were quite similar to earlier, however, their currents were higher than earlier and control.

3.3 The solar power generation

Results as show in the Fig. 4 found that all of the configurations could generate power higher than the control. However. the solar power generation met the highest average of 1.6 kW in 2 configurations which were the water pond and a chili cultivation.

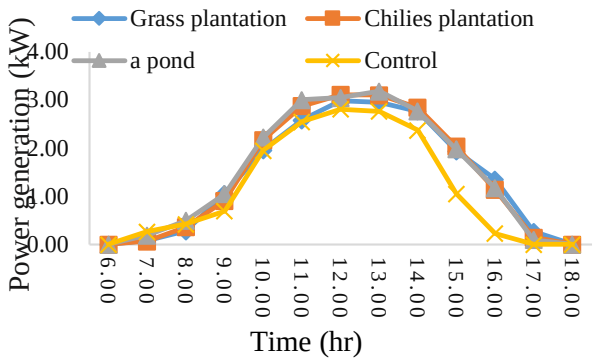

Fig. 4. The solar power generation

4. CONCLUSION

The space under the PV panels utilization in the water pond and the chili cultivation configuration could generate the power higher than the other. Therefore, they were suitable configuration for promoting the power production.

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REFERENCE

[1]. Ong, S., Campbell, C., Denholm, P., Margolis, R., & Heath, G. (2013). Land-use requirements for solar power plants in the United States (No. NREL/TP-6A20-56290). National Renewable Energy Lab. (NREL), Golden, CO (United States).

[2]. Chimres, N., & Wongwises, S. (2016). Critical review of the current status of solar energy in Thailand. Renewable and Sustainable Energy Reviews, 58, 198-207.

[3]. Valle, B., Simonneau, T., Sourd, F., Pechier, P., Hamard, P., Frisson, T., & Christophe, A. (2017). Increasing the total productivity of a land by combining mobile photovoltaic panels and food crops. Applied Energy, 206, 1495-1507

 https://doi.org/10.29165/ajarcde.v3i1.15