Evaluating the Impact of Technological Adoption Policy for Rural Coastal Communities

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Abstract. The solar power plant program is the policy issued by the Indonesian government to assist the rural community on electrical supply in remote islands. However, there is no study to evaluate the implementation of the program for rural coastal areas. In this paper, we examine the impact of new technology adoption for rural coastal communities. We focused on the economic effect of adopting solar power generation in Karimun Regency, Kepulauan Riau. The data were collected using a survey on 262 households in two villages. Using a before-after evaluation strategy, we analyse how the economic condition of the society before and after implementing the new equipment. We find that the implementation of a solar power plant has a positive impact on increasing the household's income. The results contribute to our understanding of how the effect of adopting the technological policy for rural coastal communities.

1 Introduction

As one of the widely archipelagic countries in the world, Indonesia has a thousand small islands a limited number of electrical demands. Many regions in Indonesia have not received properly yet electricity until today. Besides the problem of the archipelago's problems, the current crisis of fossil resources in Indonesia, which fuels electricity generation, is a reason for Indonesia to create new alternatives energy to meet the needs of the community. Solar power generation can be an alternative to address these two obstacles [1]. This is supported by the geographical situation of Indonesia which is a tropical region so that it will get more sun exposure

The Indonesian government, through the Ministry of Energy and Mineral Resources and the Ministry of Marine and Fisheries, provides solar power plants to help the people in small islands in remote areas in fulfilling an electrical need. The programme is set up through GIZ's (*Deutsche Gesellschaft für Internationale Zusammenarbeit*) aid [2]. Generally, this aid aims

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at ensuring fairly equality and prosperity for the community in remote islands. Since its implementation, the solar power plants have been installed as much of 135.01 MWp in several regions in Indonesia. The government has been an optimistic plan to enhance the program until 250 MWp by 2025 [3].

Kepulauan Riau is one of the regions receiving assistance since 2015. Tanjung Hutan and Tanjung Batu Kecil are two villages in Karimun Regency, gaining lighting assistance from the solar power plants. Based on the data from village administration, each village receives 75 KWp with a quota of 300 watts per day. Since 2016, solar power plants were able to be perceived by the community in the villages. There are around 534 households in Tanjung Hutan and 595 Family households in Tanjung Batu Kecil gaining the programme. Although relatively few people still obtain it, the communities in two villages positively accept the programme.

Recent research has been conducted by scholars to seek the impact of renewable energies to the community. For instance, Tiwary et al. evaluated the use of a hybrid renewable energy system for electricity used by the community in the UK and Bulgaria. They found that The most significant share of electricity generation from the biogas generator is found, offering a stable community-wide basal electric power production potential, along with a decrease in local waste disposal costs [4]. Terrapin-Pfaff et al. analysed social impact of a solar thermal power plant in Morocco [5]. Their study suggested that there were almost 30 impacts and their importance rates for different stakeholder groups like farmers, young people, women, community members, and owners of small and medium enterprises. However, there is no study specifically analysing the program in a rural coastal area. Our study provides an empirical novelty by addressing the issue in the context of the islands community. Therefore, the aim of this paper is to analyse the economic effects of adoption of solar power generation by households in rural coastal area. In this research, we focused on evaluating the program. We also examine the perceived impact by the community before and after obtaining solar power plants.

2 Methods

We used qualitative policy evaluation research because this study was designed to evaluate the effectiveness of the program. The evaluation employed a before-after evaluation model [6]. Practically, evaluation research can be used to deliver a specific recommendation for policymakers. A survey was used to answer our research questions. The items in the questionnaire were proposed to seek economic transformation both before and after policy implementation and how it affects the community.

This research was carried out in two villages in Karimun Regency, Kepulauan Riau, which was Desa Tanjung Batu Kecil dan Desa Tanjung Hutan. We chose the villages because they had not gained properly electrical assistance from the government to fulfil their basic needs. Because of the unfavourable condition, the government offered solar power generation. In the villages, we distributed 300 questionnaires to households. Respondents were asked to give their opinion about the perceived impact after implementing the program. Two hundred eighty questionnaires were returned, and 262 questionnaires were valid for further analysis. Thus, this study reached 87.33 percent of the response rates.

3 Results and Discussion

3.1 Demographical Characteristics

Table 1 presents the demographical conditions of the respondents of the research. The data show that the proportion of respondents based on age relatively shows a proportional distribution. The educational level of the respondents is dominated by elementary school to junior high school. It indicates that the majority of the community in the rural coastal area in Kepulauan Riau has not obtained sufficiently educated yet [7]. The expenditure rate of the respondents is between Rp.1000.000-Rp.1800.000 (56.49%).

Table 1. Demographical background of the respondents

Variable	Item	Frequency	Percentage
Age	21-40 >40	101 161	38.55 61.45
Sex	Male Female	103 159	39.31 60.69
Education	≤Junior High School Senior High School Diploma and Bachelor	216 41 5	82.44 15.65 1.91
Expenditure (IDR)	<600.000 600.000-1.000.000 1.000.000-1.800.000 1.800.000-3.000.000 >3.000.000	6 78 148 29 1	2.29 29.77 56.49 11.07 0.38

3.2 Findings

In this section, we analyse the impact of the adoption of new technological features for Tanjung Batu Kecil and Tanjung Hutan households. The analysis is conducted by comparing the perception of the community about the economic circumstances of the families, before and after the implementation of a solar power plant (SPP). At the income side, as seen in Figure 1, the increase of household's earning not grow significantly before and after implementing the policy. The growth merely occurs around 1 percent on the coastal households with earning of Rp.1000.000-Rp.1.800.000. However, the decreasing of income is perceived by the families with lower income, the people with earning of Rp.600.000-Rp.1000.000 and <Rp.600.000.

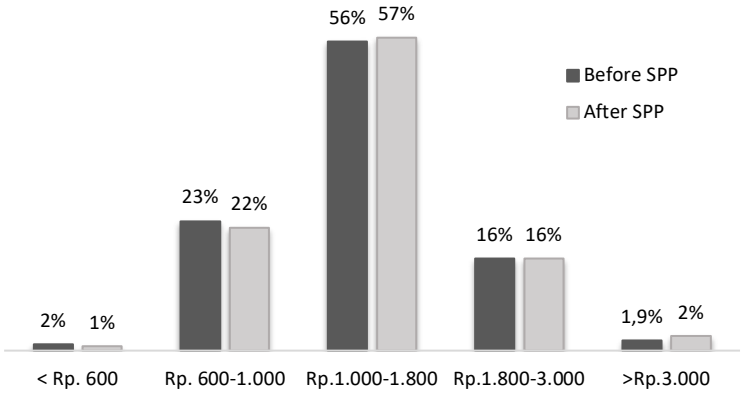

Fig. 1. The monthly income rates of the households before and after implementing solar power plant (thousand)

The programme of solar power plants negatively affects household expenditure. After introducing the programme, respondents revealed that their spending decreased. Figure 2 shows that two percent of the households with the expenditure rates of Rp.400.000-Rp.1000.000 and Rp.1000.000-1.800.000 perceives expenditure falling after adopting solar power plant. This is in line with the perception of the respondents about the effect of the programme on their expenditure, as asserted in Figure 3. It can be seen that 88 percent of the respondents exhibit that the programmed decreases their cost.

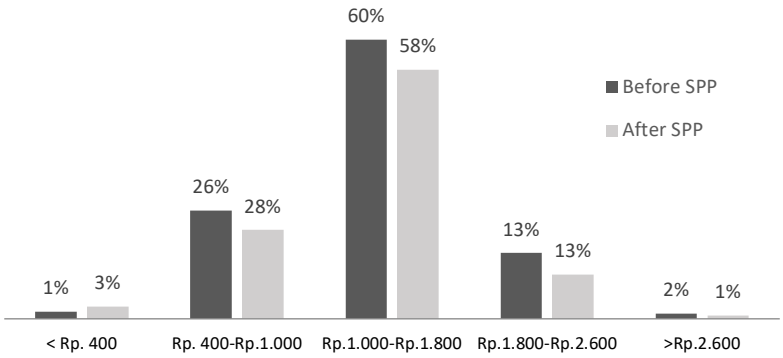

Fig. 2. The monthly expenditure rates of the households before and after implementing solar power plant (thousand)

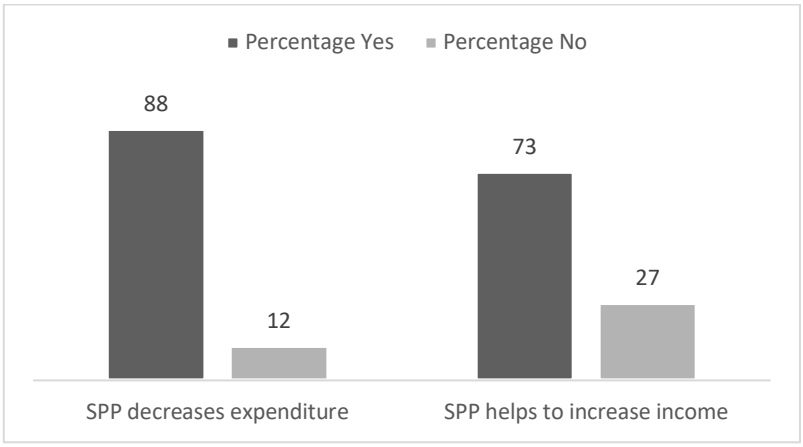

Fig. 3. The perceptions on the effect of the program on income and expenditure

The solar power plant programme has opened many business opportunities for the households in Tanjung Hutan and Tanjung Batu Kecil. Relied on the research data, it is known that there are various business activities applied by households, such as entering a small shop (*warung*), selling ice cube and snacks, washing motor cycle, and barber. Data in Figure 3 displays that most of the people choose to enter the small shop and selling ice cube. They maximize the opportunity to enhance households' income.

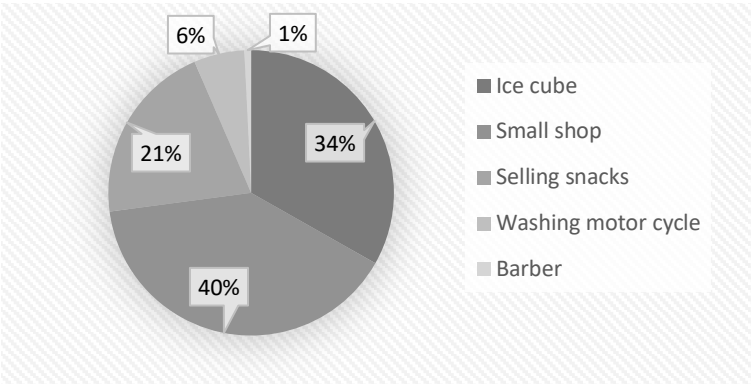

Fig. 3. Business opportunities generated after implementing the program

3.3 Discussion

The government approves national development to realize prosperity by meeting the needs of the community. Solar power generation is a breakthrough from the government to overcome the problem of unequal electricity. Previously, Tanjung Hutan and Tanjung Batu Kecil had never perceived electrical generation. The programme of solar power plants offers an opportunity for the communities to enjoy the electricity. The households only pay Rp.40.000/month as compensation to gain the programme. Our findings suggest that the programme economically affect the communities' circumstance. The positive effect is perceived in terms of income and expenditure of the households. Yet, the impact has still not significant because the energy distributed simply 75 KWp for each village. Because of the limited number of powers, the people merely perceive the electricity in the afternoon. At night, they obliged to use a fuel generator.

The results also indicate that there is a decrease in households' expenditure. However, it is still not too significant. It is occurred because the communities are accustomed to turning on the fuel generator at night. They utilize solar power plant for daytime for watching TV and charging a mobile phone.

This study enriches the study of the impact of policy adoption of renewable energy by addressing the case of rural coastal communities. The findings confirm the research of Petrakopoulou et al., showing that the adoption of solar and wind power has a positive impact on the community in the remote area in Greek islands [8]. Our results are quietly similar to Banedek's study evaluating the application of renewable energy in peripheral areas. They found that The future renewable energies maps are well-predicted in accordance with a multidimensional index that reflects the local level of growth of renewable energy sources [9]. The results also corroborate the findings of Yudiatmaja et al. [10] and Yudiatmaja et al. [11] stressing the socio-economic features of Kepulauan Riau community to introduce a transformation.

4. Conclusion

The purpose of this study is to examine the economic impact of solar power plant programme in the rural coastal communities in Indonesia. Although the programme success to deliver cheap electricity to the communities, we suggest that the programme has not significantly affected of household economy. The findings of this study contribute to the body of knowledge on the evaluation of technological adoption. Our work also provides an essential recommendation to the government to enhance the capacity of solar power plants supplied to the village in Indonesia.

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