Analysis of the socio-economic impact of renewable energy hybrid electricity utilization for rural community development (case study: Pantai Anyar, Yogyakarta special region, Indonesia)

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Abstract. The aim of this research were to: (1) study on socio-economics from Renewable Energy Hybrid Power Plant (PLTH) electricity development for rural communities, (2) find out information related to average households beneficiaries of electricity (pre and post the utilization of electrical energy hybrid electricity at Baru Beach. The research was conducted at Baru Beach, Yogyakarta Special Region on November – December, 2017. The data used were primary and secondary data. The research was conducted by surveying 68 respondents who are direct beneficiaries of hybrid electric energy utilization activities in Baru Beach. The analytical method used in this part of the study is the visualization analysis of the Baru Beach map area for 2007-2017, analysis of household income, and Paired Sample T-test. The results showed that: (1) based on changes in the map of Pantai Baru area in 2007-2017, changes in road changes, the access and connectivity of this region to other regions have become much better. In the analysis of income obtained, post PLTH was developed at Baru Beach. The income analysis was found that, post PLTH was developed in Baru Beach, there was an increase in the average income in the non-agricultural sector and household income for PLTH electricity beneficiaries, but there was a decrease in the average income value in the agricultural sector, (2) based on Paired Sample T-Test analysis show there is a significant difference the average household income post PLTH developed at Baru Beach with a significance level of 0.041. Thus the results of this research conclude that there is any a socio-economic impact from the utilization of renewable electricity not only for the beneficiaries of electricity in rural communities, but also for the development of local area.

Keywords: electricity beneficiaries, renewable energy hybrid power plant, rural community development.
1. Introduction

Energy access is a prerequisite for the realization of a country's socio-economic development. The availability of energy is enough to open up opportunities for people to carry out productive activities and work more effectively, so they can contribute to economic and social progress. The economic and social progress that occurs will drive demand for increasingly quality energy. The availability of electricity is very important, because it can trigger the emergence of productive economic activities. Enough lighting at night provides opportunities for children to learn, read books and do school work. People can access information via television or access the internet. Besides that, there is also access to electricity, besides being able to support activities in the primary sector (agriculture, fisheries and livestock) that already exist in the village, but also the presence of electricity can trigger the emergence of secondary sectors, such as: trade and tourism in the village. So that access to electricity is not just to provide access to electricity to the village community, but also in the broader sense that the emergence of electricity in rural areas is important because it can encourage existing economic growth and move potential sectors to be developed in the village.

Although most literature agrees that electricity access is necessary for poverty reduction, the causal chains suggested for this dependence are various. This is to be expected given that researchers must deal with multi-factorial systems, with energy only one of a linked set of variables that determine poverty outcomes. The most frequently reported causal chains linking electricity access to poverty impacts are: (1) the improved productivity or output of enterprises using electricity for their activities [12,16,15,18,19,20,21,22,37], (2) the freeing up of time for paid work, which would increase labour supply [5,8,12,16,18,28,31,32,34].

Besides that, the availability of access to electricity in remote areas that is empirically empirical can also have significant social and economic impacts. For example: in supporting human life [23,35], improving educational facilities [29], increasing water supply [9], enabling gender and youth empowerment [33,25], and enables the creation of productive activities in the village [26,4,7]. This statement is confirmed by the results of the research by [3,6,17,36] which explains that, access to electricity is usually always in tandem with sustainable activities that allow contributions to improving education, entrepreneurship, gender equality, and increasing income at the local level, as well as social and economic benefits for development in rural [27]. The results of research conducted by [13] also state that, in an electrification program if supported by other possible activities in the countryside, in the rural context it can provide positive feedback in the future. Another economic benefit of electrification in the countryside is the virtuouse circle of development driven by investment activities in other infrastructure services in the countryside, such as: water supply, street lighting, health services, education which in turn will have an impact on increasing electricity affordability and increasing investment others in the countryside [17].

The development of renewable hybrid electric energy held in Ngentak Hamlet was carried out in 2008 located in Pantai Baru, Poncosari Village, Srandakan District, Bantul Regency, Special Region of Yogyakarta. Before the existence of Hybrid Electric Energy Development activities at the New Coast At that time, Ngentak Hamlet was one of the hamlets in Batul Regency which was categorized as a lagging village, this area was originally a closed area from outside communities, this was due to the inaccessible network in this region, in addition to the limited road infrastructure to the region, this region is increasingly difficult to reach by the local community and surrounding communities.

Lack of access to electricity is seen as a major constraint to economic growth and increased welfare in developing countries. However, having good access to electricity requires more than the existence of physical connection or a source of electrical generation. Numerous attributes (such as duration, affordability, safety and convenience, among others), drive the extent to which people and enterprises can make use of electricity and affect their ability to improve lives and livelihoods. Geographically Pantai Baru in Ngentak Hamlet is directly facing the Indian Ocean, this causes Pantai Baru to have abundant wind energy and solar energy potential. The development of a Hybrid Power Plant (PLTH) is a realization of a series of Regional Innovation Systems (SIDa) in Bantul Regency, initiated by the Ministry of Research and Technology, National Aeronautics and Space Agency.
The productive use of electricity offers the potential for sustained poverty reduction (Omri 2014) as well as inequality in accessing electricity, especially for rural communities living in remote areas. The three main pillars of the development of renewable electricity in Pantai Baru are through: technology, community empowerment, and institutions. In this study, researchers focused more on aspects of community empowerment in an effort to develop renewable hybrid electric energy through business activities developed at Pantai Baru. Thus, some of the research questions to be analyzed in this study are: (1) how the impact of changes in the development of renewable hybrid electricity (PLTH) at Pantai Baru on the socio-economic conditions of PLTH electricity beneficiaries and local village communities (2) whether there are significant changes to the income of household beneficiaries by comparing conditions before and after the existence of PLTH.

Based on the research questions that have been formulated, the objectives of this study are as follows:

1) Identified the impact of changes in the development of renewable hybrid electricity (PLTH) on the socio-economic conditions of PLTH electricity beneficiaries and local village communities;
2) Analyze the income of household PLTH electricity beneficiaries before and after PLTH was developed at Pantai Baru.

2. Methodology

The research were designed as survey research, with 68 respondents who are PLTH electricity beneficiaries. The data used are primary and secondary data. Primary data is obtained from the results of direct observations in the field, and structured and in-depth interviews through questionnaires of research questionnaires aimed at: PLTH electricity beneficiaries, tourist visitors, and local community leaders.

The analytical method used in this study are: (1) descriptive analysis and analysis of household income. Descriptive analysis is used as supporting information from the quantitative analysis used. Analysis of household income obtained from income obtained from the agricultural and non-agricultural sectors is reduced by total costs, and (2) Paired Sample T-Test to find out whether there are significant differences between household income of PLTH electricity beneficiaries at conditions before and after PLTH were developed at Pantai Baru.

2.1. Household Income Analysis on Agriculture Sector

Analysis of household income obtained from the agricultural sector is formulated as follows:

\[ TR_t = P_t \times Q_t \]  \hspace{1cm} (1)

Where,

- \( TR_t \) = Total farm income (Rupiah/month)
- \( P_t \) = Selling price per unit of output (Rupiah)
- \( Q_t \) = Total output (tons)

In farming, it is also necessary to calculate the amount of total production costs needed to produce output in one production period. Mathematically written as follows:

\[ TC_t = TFC_t + TVC_t \]  \hspace{1cm} (2)

Where,

- \( TC_t \) = Total production costs originating from the agriculture sector (Rupiahs/month)
- \( TFC_t \) = Total fixed costs originating from agriculture sector (Rupiahs/month)
- \( TVC_t \) = Total variable costs originating from agriculture sector (Rupiahs/month).
Income originating from agriculture sector are obtained from from the difference in total revenues originating from sales on farm with the total cost on farm production. Mathematically, it is written as follows:

\[ I_t = TR_t - TC_t \]  \hspace{1cm} (3)

Where,
\[ I_t = \text{Income originating from the agriculture sector (Rupiahs/month)} \]
\[ TR_t = \text{Total revenue from farming (Rupiahs/month)} \]
\[ TC_t = \text{Total costs incurred from farming (Rupiahs)} \]

2.2. Businesses Analysis Non-Agriculture Sector

Business analysis in the non-agriculture sector is calculated based on wages received by PLTH electricity beneficiaries from non-farming activities \( I_n \), namely wages received outside of tourism and farming businesses, such as: private employment / PNS, PLTH honorary staff, teachers, and tourism businesses that are calculated based on the wages received by respondents per month. Therefore, the revenue and total costs of non-farming are calculated by the formula:

\[ TR_n = Pn \times Qn \]  \hspace{1cm} (4)

Where,
\[ TR_n = \text{Total revenue originating from non-agriculture sector (Rupiahs/month)} \]
\[ TC_n = \text{Total costs originating from non-agriculture sector (Rupiahs/month)} \]

Revenues earned from non-agriculture sector are calculated using the formula:

\[ I_n = TR_n - TC_n \]  \hspace{1cm} (5)

Where,
\[ I_n = \text{Income originating from non-agriculture sector (Rupiahs/month)} \]
\[ TR_n = \text{Total revenue originating from non-agriculture sector (Rupiahs/month)} \]
\[ TC_n = \text{Total costs originating from agriculture sector (Rupiahs/month)} \]

Household income obtained by the beneficiaries of electricity is calculated by the formula:

\[ I_H = \sum_{i=1}^{n} I_t + \sum_{k=1}^{n} I_n \]  \hspace{1cm} (6)

Where,
\[ I_{RT} = \text{Household income (Rupiahs/month)} \]
\[ I_t = \text{Income originating from agriculture sector (Rupiahs/month)} \]
\[ I_n = \text{Income originating from non-agriculture sector (Rupiahs/month)} \]

In this analysis taking into account the inflation value for the years 2007 - 2017. The compound factor method is carried out from the value of the household income. Then the value was analyzed using Paired Sample T-Test to compare the value of household income for the year. Calculated by the formula:

\[ FV = PV \times (1 + i)^t \]  \hspace{1cm} (7)

Where,
\[ FV = \text{Future value of 2017 household electricity beneficiaries (Rupiahs/month)} \]
\[ PV = \text{Present value of 2007 household electricity beneficiaries (Rupiahs/month)} \]
\[ i = \text{Average inflation rate for DIY Province in 2007 - 2017 (percent) = 5.44\% (BPS Province of DIY. 2017).} \]
\[ t = \text{Year to be corrected (year of 2007 until 2017 = 10 years)} \]
3. Results and Discussion

3.1. The Socio-Economic Impact of Electric Energy Development for Rural Community Development

Socio-economic impacts are impacts or benefits arising from social, economic and infrastructure aspects for the development of PLTH electricity in Baru Beach. The aspects that will be discussed in this section are: the condition of road infrastructure along the Pantai Baru area, the household income of PLTH electricity beneficiaries, the number of visitors to the Pantai Baru tourism, and the Regional Original Revenue (PAD) of Bantul Regency originating from Pantai Baru.

3.2. Road Infrastructure Throughout Baru Beach Before and After PLTH Electric Energy Development

![Picture 1](2.5 m to 7 m)

Based on a map visualization analysis at the same location in Pantai Baru, it is not only access roads along the Pantai Baru area that are much better, but also the width of the road along the area is now much wider. In addition, the improvement of road infrastructure is important, because this region connects the southern part of Bantul Regency with Kulon Progo Regency, so that improved access to the road facilitates interconnection between regions.

3.3. Household Income from PLTH Electricity Beneficiaries Before and After PLTH Developed at Baru Beach

Based on the results of the analysis show that, before PLTH was developed at Pantai Baru (in 2007), the average income in the agricultural sector was Rp 2,262,367 per month, the average income in the non-agricultural sector was Rp 630,119 per month, and the average household income of the beneficiaries before PLTH was developed at Pantai Baru in the amount of Rp 4,038,102 per month. After PLTH was developed in Pantai Baru, the livelihoods of the local people not only relied on the agricultural and non-agricultural sectors, but also the tourism sector. household income before PLTH was developed at Baru Beach, with the average income obtained by PLTH electricity beneficiaries from the agricultural sector amounting to Rp 1,388,897, the average income in the non-agricultural sector was Rp 3,600,074 / month, and the average total household income after PLTH was developed on Pantai Baru that is equal to Rp 4,988,981 / month. Thus, after PLTH was developed at this location, there was an increase in the average income in the non-agricultural sector and household income from PLTH electricity beneficiaries, but there was a decrease in the average value of income in the agricultural sector.

Thus, it can be concluded that household income before PLTH was developed (in 2007) after PLTH was developed (in 2018) after it was corrected with the average inflation rate for 2007 - 2018 indicating...
that the household income of PLTH electricity beneficiaries increased with the average household income in 2007 amounting to Rp 4,038,102 / month, while the average household income in 2017 is Rp 4,988,981 / month. This means that in 2017 there was an increase in household income of PLTH electricity beneficiaries around 24.54% or in other words that there was an increase in household income compared to household income in 2007.

3.4. Different Household Income Test Results Before and After PLTH Developed at Pantai Baru

Based on the results of different pairing tests also showed that, the significance value (2-tailed) of the income before and after the existence of PLTH was 0.041 (<0.05), it can be concluded that there was a significant difference between the average household income before and after the PLTH. Thus, the conditions before and after the existence of PLTH at Pantai Baru are not the same as Zero or in other words that, the hypothesis is accepted. Add standard deviation explanation.

Table 1. Different Paired Test Results Average Income of Electric Beneficiary Households Before and After the Availability of PLTH

| Household Income          | Mean  | N   | Std. Deviation | Std. Error Mean |
|---------------------------|-------|-----|----------------|-----------------|
| Before PLTH existed       | 4.038.101 | 68  | 3.315.972,2    | 402.120,69      |
| After PLTH existed        | 4.988.970  | 68  | 1.799.727,3    | 218.248,99      |

Source: Result of analysis. 2019.

In otherwise, based on the results of observations in the field it was found that, since the development of PLTH at Pantai Baru proved to be able to provide alternative business income for hamlet women to help the family economy. This can be seen from 79.41% of business managers on the beach are women. The results of the analysis also show that the value of the standard deviation of household income from the beneficiaries of electricity after the existence of PLTH developed in Pantai Baru has decreased from Rp 3,315,972.2 to Rp 1,799,727.3. This shows that after the existence of PLTH in Pantai Baru the income gap of beneficiary households has decreased, meaning that the income of household beneficiaries of PLTH electricity is more evenly distributed (Table 1).

3.5. Number of Tourist Visitors and New Coast Regional Income

Based on data from the [2], it shows that, from 2012 to 2018, the number of tourist visitors who visit New Beach in general continues to increase, with average tourist visitors in 2012 - 2018 total 284,579 visitors / year, both tourist visitors originating from Yogyakarta and from outside Yogyakarta. This has an impact on the increase in the value of regional original income obtained from the regional levies obtained from Pantai Baru in 2018 obtained at Rp. 5,655,731,250/year.

Table 2. Number of Tourist Visitors and Regional Retribution from the Sector of Tourism Baru Beach in 2012 - 2018

| Year | Number of Visitors (Person / year) | Regional Retribution (Rupiahs/year) |
|------|-----------------------------------|------------------------------------|
| 2012 | 128.648                           | 259,000,000                        |
| 2013 | 129.055                           | 319,682,250                        |
| 2014 | 141.573                           | 400,798,750                        |
| 2015 | 163.109                           | 496,234,750                        |
| 2016 | 140.050                           | 499,227,500                        |
| 2017 | 558.740                           | 2,536,114,750                      |
| 2018 | 730.875                           | 5,655,731,250                      |
| Rerata | 284.579                          | 1,863,398,464                      |

Source: Local Regional Income of Bantul Regency Tourism Sector 2012 – 2018. Bantul Regency Tourism Office. 2018.
4. Conclusion
Based on the results of the analysis of this study shows that the presence of PLTH has had a positive impact both from many aspects: there are the access of infrastructure and better electricity. In addition, the presence of PLTH in Pantai Baru has contributed to the Original Regional Income (PAD) of Bantul Regency. Based on the analysis of household income, it shows that the average income of household beneficiaries of electricity when compared to the conditions before and after the PLTH in Pantai Baru shows an increase. Likewise, based on the results of the paired sample t-test, there is a significant difference in the income of PLTH electricity beneficiary households (before and after) PLTH in Pantai Baru. The analysis also shows that the income earned by PLTH electricity beneficiaries has a decreased standard deviation, meaning that the household income of PLTH electricity beneficiaries is more evenly distributed (well distributed).

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