Village Development Index of Probolinggo Coastal Villages
Case study: Bhinor Village, Paiton District

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Abstract. One of the factors affecting the development of villages through Village Development Index (IDM) is the access to information and communication technology. Paiton District has the highest level of tele-density and serves as strategic areas of Probolinggo Regency. The activities of the Paiton Steam Power Plant affect the socio-economic conditions of Bhinor community as well as an expansion of the coastline. This research aimed to find out IDM in Bhinor Village related to the existence of the Paiton Steam Power Plant. This study employed IDM composite index and literature review. The results indicated that characteristics of ICT infrastructure services in Bhinor Village tended to BTS services as well as Radio and Telephone. Paiton Steam Power Plant contributes positively to the social and economic activities of the residents in Bhinor Village. In environmental aspects, it produces pollution and changes in the coastline due to abrasion. This is in accordance with the results of the IDM calculation, in which Bhinor Village has a high value on the Economic and Social Security Index. It has a low value on the Environmental Resilience Index. Villagers can use ICT availability to deal with environmental issues and improve Environmental Resilience.

Keywords: village development index, ICT, village, Paiton Steam Power Plant

1. Introduction

1.1 Background

Opportunities to create prosperity, justice, and regulate the village in their own way have been provided by the government with the existence of the Village Law [1]. The Law No. 6 issued in 2014 concerning Villages has developed a new paradigm and concept of village management policies. The village will be treated differently than before. The position of the village is no longer subnational, but is located in the regency/city area [2]. In the 2015-2019 National Mid Term Planning (Rencana Jangka Menengah Nasional or RPJMN), one of the targets of village development is to reduce the number of disadvantages village to 5,000 villages and to increase the number of independent villages in at least 2,000 villages in 2019 [3].

Indeks Desa Membangun (IDM) or Developing Villages Index was developed to strengthen efforts to achieve the development goals of the Village and Rural Areas. The development goals require locus (Village) clarity and development status. The IDM not only can provide benefits to investigate the development status of each village that is closely related to its characteristics, but also can provide development as an instrument of target in achieving RPJMN 2015-2019 and the coordination in village development [4]. IDM calculations at 73,709 villages are based on the 2014 village potential data (data potensi desa or PODES) with an average number of 0.566 indicating the following data [4]:

[Further content would follow here, including the rest of the paper's introduction, methodology, results, and conclusion.]
- Very Disadvantaged Villages: 13,453 Villages or 18.25%
- Disadvantaged Villages: 33,592 villages or 45.57%
- Developing Villages: 22,882 villages or 31.04%
- Developed Village: 3,608 villages or 4.89%
- Independent Village: 174 villages or 0.24%

The District that has the IDM lower than the average IDM Province Index is Probolinggo Regency with a value of 0.6303 (Ministry of Village, Development of Disadvantaged Regions and Transmigration, 2015). It is advised that some villages in Probolinggo District should be improved and developed in order to form independent villages.

One of the factors that influence Village Development based on the IDM is access to information and communication technology. Rural telecommunications development has a high and significant benefit to rural development. Besides, socio-economic provides significant advantages in social psychological and socio-cultural aspects [5].

The real conditions in Probolinggo Regency indicate a number of regions where there is no signal of telecommunication. However, about 80% of rural communities have used media both Information and communication technology in the form of wired and wireless [6]. The gap occurs between the northern and southern regions of Probolinggo Regency, where the northern region has a high level of teledensity, in contrast to the southern region. One of the regions with the highest level of tele-density is in the Paiton District area.

Being a region with a high level of teledensity, Paiton District becomes one of the strategic areas situated in the Probolinggo District Spatial Plan [6]. Paiton District serves as the North Coast Strategic Area with the Paiton Steam Power Plant as the Power Plant Centre for Java and Bali. Paiton District is located in the coastal area and traversed by the North Coast of Java. The coastal area of Paiton District is one of the coastal waters with quite high frequencies of people activities. Community activities ranging from aquaculture and fisheries, industries, and power plants where they are located at coastal area of Paiton.

The activities of the Paiton Steam Power Plant have affected the socio-economic conditions at Bhinor village as the location of the power plant due to industrial activities of Paiton Steam power Plant [7]. According to some of these issues, the IDM of Bhinor Village will be investigated. The study is carried out related to the characteristics of the implementation of ICT infrastructure in Bhinor Village and its relationship to the strategic issues of the Region at Paiton Steam Power Plant area.

1.2 Literature review
A. Developing Villages Index.

IDM classifies villages in five (5) statuses as follows [4]: (i) Very Disadvantaged Villages; (ii) Disadvantaged villages; (iii) Developing Villages; (iv) Developed Village; and (v) Independent Villages. The Village Classification is applied to reveal the diversity of characters in each village in a range of scores from 0.27 to 0.92 of the IDM. The classification in the 5 Village statuses is also to sharpen the determination of the status of village development and at the same time to recommend the necessary policy interventions. The status of Disadvantaged Villages explained in two statuses of Disadvantaged Villages and Very Disadvantaged Villages where the situation and condition of each village requires different policy approaches and interventions. Dealing with Very Disadvantaged Villages, the researchers will divide the level of affirmation of their policies compared to Disadvantaged Villages.

Developing Village is commonly related to the situation and conditions in the status of Disadvantaged Villages. Meanwhile, Very Disadvantaged Villages can be explained by vulnerability factors. If there is a pressure of vulnerability factors such as the occurrence of economic shocks, natural disasters, or social conflicts, it will affect the status of a developing village to drop down to a disadvantaged village. If a natural disaster factor is handled without rapid and appropriate responses, or the occurrence of a social conflict continues to occur, it is very risky that the status falls from Disadvantaged Village to a Very Disadvantaged Village.
In addition, the ability of the Developing Village to manage power, especially related to potencies, information value, innovation / initiative, and entrepreneurship will support the progress of the Developing Village to a Developed Village. The classification of village status based on the IDM is also directed at strengthening efforts to facilitate the promotion of the Village to achieve Independent Village status.

Figure 1. Three dimension of IDM [4]

IDM is a composite of social, economic and ecological resilience. The IDM is categorized according to 3 (three) dimensions and is further developed in 22 variables and 52 indicators.

B. ICT Infrastructure

ITU [8] develop ICT development index that represent how ICT is being used and its development. It consist of 3 main aspect, ICT readiness (i.e. infrastructure access); ICT use (i.e. intensity); and ICT capability (i.e. skill). ICT readiness holds important role because it allow ICT user utilize the technology. ICT is generally understood by the public as matters relating to computers and the internet. However, some people consider it as a very narrow view because traditional electronic equipment such as television, radio, telephone, and newspapers also carry information. ICTs are generally grouped based on the duration of the ICT used. The categorization is divided as follows [9]:

1. New ICTs: Computers, satellites, wireless communications (including mobile phones), internet, e-mail, and multimedia which are included in the category of new technology. The concept behind this new technology is a digital device.
2. Old ICT: Radio, television, telegraph, telephone. In general, these electronic gadgets are required to use analogue transmission techniques.
3. Very old ICTs: Newspapers, books and libraries. These media have been the most popular communication tool for years.

C. Relationship between ICT Infrastructure and Village Development

Information and Communication Technology provides benefits to ICT users in socio-economic, social psychology, and socio-cultural aspects [5]. The benefits of socio-economic are several indicators which has been showed as the benefits of Information and Communication Technology in rural communities. In the socio-economic aspects, Information and Communication Technology delivers benefits in the welfare aspects for the village community. For community leaders, Information and Communication Technology is very important in dealing with problems / affairs that occur in community institutions. In addition, the social-psychological aspects, Information and Communication Technology can increase prestige (pride) for the region. The increasingly close relationship between family and neighbours can be beneficial for Information and Communication Technology.
In the socio-cultural aspects, activities supported by Information and Communication Technology can accommodate the information distribution. By the existence of Information Technology and Communication, population mobility to access the region is easier to sustain the wellbeing of countryside community. According to research conducted by [5], it indicated that ICT affects 3 aspects such as social, economic and cultural aspect, including the IDM.

D. Steam Power Plant

Steam power plant is a power plant that employs steam power as the main driver of the turbine to produce electricity. Steam power plants runs in the form of hot water which is higher in temperature than the water temperature before being used for cooling down. The amount of cooling water needed depends on the maximum capacity of the units at the steam power plant. In general, cooling water at full load for each cooler with a relatively high temperature requires a lot of volume, and is continuously discharged into local waters. The cooling water receiver will gradually be affected by rising temperatures due to the discharge of cooling water [10]. Any prominent business in the rural area will affect to socio-economic of the local community as well as land use.

2. Methods

This study employed the calculation of the IDM and literature study which covers data collection from related agencies as well as reviews theories from the existing journals to obtain descriptive analysis. Calculation of the IDM is prepared by ensuring the availability of data sourced from the Village Potency, published by the Central Bureau of Statistics. IDM is a composite index that is built from social, economic and cultural dimensions. The three dimensions consist of variables, and each variable is revealed to be an operational indicator. The procedure for obtaining the IDM is as follows[4]:

1. Each indicator has a score of 0.5; the higher the score reflects the higher level of significance.
2. Each indicator score is grouped into variables, resulting in a variable score. The total variable score is then formulated into a following index:

\[
\text{Variable Index} = \frac{\sum \text{Indicator } X}{\text{Maximum Score (X)}}
\]

\[(1)\]

3. The index of each variable becomes a Composite Index called the Village Build Index (IDM).

\[
\text{IDM} = \frac{1}{3} (\text{IKS} + \text{IKE} + \text{IKL})
\]

IDM: Developing Villages Index
IKS: Social Security Index
IKE: Economic Resilience Index
IKL: Environmental Resilience Index (Ecology)

4. The status of each village classification is carried out by calculating the range obtained from the maximum and minimum values. The range value obtained is the limitation of the status of each village, so that five village status classifications are established.

The study investigated the IDM in the strategic area of North Coastal affected by the existence of the Paiton Steam Power Plant to assess its impacts and potencies and the existing problems related to the IDM. In addition, it will also be discussed descriptively about Information and Communication Technology related to the number of telephone connections, the number of households with Internet access, the number of BTS, the number of households equipped with radio and the number of households equipped with TV; the relation to the IDM will be discussed as well.

3. Results and Discussions

3.1 General view of study location

Bhinor village is the largest village in the Paiton District. With a total population of 2,445 people who inhabit 13.97 ha. Most of the population is less than 40 years old. Many villagers work in the agricultural sector as farmers and farm labourers (444 people). The population working for the company is very small although its location is near to Paiton Steam Power Plant. They actually are
benefited by selling and offering services to Paiton Steam Power Plant’s workers. The village land is mostly managed for settlements and agriculture. Agricultural land dominates up to 90%. The location of the village is in the northern coastal region of the island of Java, but the village of Bhinor has no fish ponds. Bhinor village community has gained access to community services and infrastructure, including telecommunication. This is indicated by the high social and economic dimensions of the IDM. The following are the results of IDM calculations for Paiton District. Telecommunication infrastructure in the village of Bhinor is very complete. This village is passed through the main fibre optic line. There are at least 3 BTS including special BTS at the Paiton Steam Power Plant. It is quite reasonable that tele-density at Bhinor village is in very good state.

3.2 IDM of Bhinor and Paiton District

Figure 2. Social, economy, and environmental index of Paiton District

Figure 2 indicated that the average Social Security Index at Paiton District is 0.61. There are 13 villages that have a Social Security Index below the average (i.e. 0.61). The lowest Social Security Index is Plampang and Petunjungan because there are no health and education facilities in these two villages. The highest Social Security Index in Paiton District is in Sukodadi Village because there are junior and senior high school education facilities, health facilities are in the form of local health care centre and post office facilities.

According to Economic Resilience Index, Paiton District has an average Economic Resilience Index of 0.63 which is included in the developing category. There are 11 villages that have a Social Security Index below the average. The lowest Social Security Index is Plampang because there are no economic facilities in this villages. The highest Social Security Index in Paiton District is Karanganyar Village because there are economic facilities in the form of markets, shops and bank offices.

Paiton District has an average Environmental Resilience Index of 0.67 which is included in the developing category. There are 11 villages that have a Social Security Index below the average. The lowest Social Security Index is in Bhinor and Sumberejo villages because the two villages are areas where Paiton Steam Power Plant is located. The highest Environmental Resilience Index can be found in other villages except Randu Tatah, Bhinor, Sumberejo, and Jabung Sisir. These conditions can be seen in the following picture:

According to the research that has been done, it was found that total IDM Value at Bhinor village is 0.58 with a Social Security Index is 0.64, an Economic Resilience Index is 0.77 and an Environmental Resilience Index is 0.33. Based on these values, it can be concluded that Bhinor Village has a good development in the economic and environmental sectors. This is related to its location on the northern coast line with facilities and infrastructure to support existing social activities. However, the environmental aspect has a low value due to the large amount of pollution in the area, especially from the activities of the Paiton Steam Power Plant.
3.3 The Characteristics of ICT Infrastructure Services in Bhinor Village

**Fixed line service**

According to the results of the survey, it was found that the Telephone Network Service Level in Paiton District was 1%, indicating that telephone was very rarely used. The telephone network service in Paiton District is only in urban areas, such as at Sukodadi, Sumberanyar, Karanganyar and Paiton Villages. Bhinor village is a village outside Paiton, with no telephone connection. Although it is not as an urban area, Bhinor Village is an industrial area so that industrial development should require infrastructure development to support the existing activities [11], one of which is telephone network as a supporter in industrial activities.

**Internet and BTS services**

Similar to telephone networks, the distribution of internet networks is dominated by Paiton District urban areas. The level of internet service in Paiton District is 2.7% with the highest level of Internet service in Paiton Village. The internet today does not act as a solution to overcome geographical boundaries as predicted by many experts. Instead the Internet is currently only a supporter of activities and business in urban areas [12]. This is applied at Paiton District with the internet network employed as a supporter of activities, especially education and business activities in urban centre areas. In addition, businesses in the form of internet cafes are also located in these urban areas. Although Bhinor Village currently has no internet network, the level of tele-density is relatively high with the presence of BTS. The existence of BTS should be utilized, especially related to access of information through mobile phones.

**Television and Radio Services**

ICT Infrastructure Services in the form of television in Paiton District are 35% in a fair distribution. Unlike telephone, internet and BTS services, almost every home has a television. In addition, television in rural areas plays as substitution for other ICT services that do not reach rural areas in Paiton District. Television is recognized as the most important media for communication of rural populations in developing countries [13]. This applies to Paiton District for rural areas that have not been served. Other ICT infrastructure has been covered by television services. The level of radio service in Paiton District is 5% with a fair distribution in each village.

Similar to television, radio utilizes as a substitution to obtain information that cannot be accessed by using the internet. Radio is currently still considered important for the information necessity in rural communities. The existence of radio has made tremendous progress in the socio-cultural life [14]. Television service that can be reached by Bhinor Village is only 1.81% while radio is 0.03%, indicating a very low ICT infrastructure services that can be accessed by people at Bhinor Village.

3.4. Impact of PLTU on Social Economy

The construction of the Steam Power Plant (PLTU) in 1983 in Paiton District became a power plant centre which was established by the government with the assistance of foreign capital or private companies. It was aimed to fulfil electricity necessity in Java and Bali as the beginning of a change in balance in a system (community) at Bhinor village. Since the 1980s the government has turned the function of settlements into industrial estates by paying compensation causing many residents to leave work as farmers and to become labours at the Paiton Steam Power Plant (PLTU).

**Job Opportunity Aspects**

In the aspect of employment opportunities, the changing of working types of Paiton Steam Power Plant has been quite significant. When the Paiton Steam Power Plant was established, several new job opportunities for the service business began to develop, as seen from the trading business provided for the workers. Almost along the main road, there are stalls providing the workers necessity. With the ease of transportation routes to the village, it was beneficial for some residents who offer services such as motorbike or taxi drivers to empower motorized vehicles to get income. The broaden variety of occupations at the Bhinor villagers after Paiton Steam Power Plant established, it turned out to be very instrumental in changing socio-economic conditions. The majority of Bhinor village people has multiple jobs improving the income of each individual along with enhancing the quality of life.
Aspects of Social Interaction

Changes in social interaction were also very visible at Bhinor village community. According to the results of the study, it was found that there were changes in the socio-economic aspects of the Bhinor Village community related to the construction of the Paiton Steam Power Plant. Many Bhinor villagers at that time preferred working as PLTU employees, employment opportunities were increasing, thus affecting the level of income of the community. The latest changes in social interactions affect the concessions in physical and economic dimension, as well as the social community. The survey results revealed that the Paiton Steam Power Plant had a positive impact on the social and economic activities of the villagers of Bhinor, starting from increasing income to creating new employment opportunities.

3.5 Significances of Paiton Steam Power Plant on the Environment

According to research conducted by Saptarini [15], it was investigated that coastline changed from 1993-1996 and from 1996-2009. The shoreline had been changed in the coastal area of Paiton District in 1993-1996 predominantly caused by a coastal abrasion process for 56.1 ha area. The abrasion caused environmental changing in rice fields (658,158 ha), forests (193,744 ha) and industries (15.125 ha). The coastline change in 1996 - 2009 was related to the coastal abrasion process which caused a change in land area of 12.4927 ha. The abrasion causes limitation of land potency to be used. The type of land affected by abrasion consists of farm, industry and ponds, each of which is as wide as 870,903 ha, 73,667 ha and 85,9307 Ha. In the period of 1996-2009, there was an addition in the coastline length for 1,193,489 m. The changing of land area due to the accretion process from 1993 to 1996 was 38.5345 ha. Besides, the changing of land area due to accretion from 1996 to 2009 was 11,863 ha. In addition, other environmental impacts that occurred around the Paiton Steam Power Plant were related to the sustainability of biodiversity, especially marine biota around the PLTU area. In 2009-2010 indications of cases of coral bleaching in coastal locations in East Java were found around the Paiton Steam Power Plant [16]. From the previous study it was investigated that the problem with the Paiton PLTU was related to environmental aspects, especially in terms of pollution and shoreline changes due to abrasion. This is directly proportional to the calculation results of the Environmental Resilience Index in Bhinor village which has the lowest yield.

4. The Role of ICT Infrastructure in overcoming the problems of village development

From the results of research and calculations that have been carried out, Bhinor Village is included in the category of underdeveloped villages with the IDM value of 0.58. There are problems in the environmental aspects due to the large amount of pollution in the area mainly from the activities of Paiton Steam Power Plant. The existence of the Paiton Steam Power Plant and its waste disposal are inescapable as one of the consequences of industrial development. In order to minimize the negative impact, community response and education to the community are vital in addressing these problems so that the presence of waste disposal does not interfere the community activities.

In addition, information technology has been greatly affected by economic, educational, environmental, consumer behavior related to the environment, and personal life. With the existence of information and communication technology, people have experienced opportunities to share knowledge, thoughts, and to access valid information easily and quickly [17]. In Bhinor Village, the ICT infrastructure available consists of BTS, Radio and Television. BTS plays an important role in the spreading information through mobile media, which is more accessible and available while television and radio can provide information in audio-visual forms related to knowledge in managing waste disposal problems. Since rural areas in Indonesia are facing digital divide challenges [18], the usage of internet for obtaining information to manage waste is doubtable.

4. Conclusions

The results of the study indicated that the Paiton Steam Power Plant had positive significances on the social and economic activities, starting from increasing income to creating new employment opportunities. The problem arose from Paiton Steam Power Plant is related to environmental aspects,
especially in terms of pollution and shoreline changes due to abrasion. This is directly proportional to the calculation results of the Environmental Resilience Index in Bhinor village which has the lowest yield. This is in accordance with the results of the IDM calculation, where Bhinor Village has high values on the Economic Resilience index and the Social Security Index, with a low value on the Environmental Resilience Index. The availability of Information and Communication Technology, should be utilized in tackling the existing environmental problems through environmental education so that information can be disseminated to the village community.

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