GEO-TOURISM AND RENEWABLE ENERGY POTENTIAL STUDY OF THE ANCIENT LAKE SANO NGGOANG IN FLORES, EAST NUSA TENGGARA

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Abstract

Geo-tourism is a part of special interest tourism that explores the geological potential to gain a travel experience, and less of people enjoy this activity. Indonesia has a lot of geo-tourism potential such as Toba (North Sumatra), Ciletuh (West Java), Batur (Bali), Rinjani (Lombok), and others. One of the most rising tourist destinations in Flores Island, NTT which is currently famous for Komodo National Park. Not far from the area, there is geo-tourism potential in the West Manggarai area known as the ancient lake Sano Nggoang. This area has the potential for the deepest ancient lake in Indonesia with a forest area with endemic flora and fauna, and hot springs, including the potential for renewable energy in the form of geothermal. The people of the Sano Nggoang village area have developed tourism in recent years by conducting village, lake, and forest tours; homestays; local culture; and local community's farming and gardening habits. This potential can be further developed by creating a village tourism study including attractions, amenities, accessibility, and ancillary combined with community-based tourism. Other potentials such as geothermal, and solar energy can be developed equitably for the welfare of the local community. This research was created using the literature review method and direct observation experience in the field. The study and development of the Sano Nggoang tourist village can be more focused on the concept of geo-tourism, as input for policymakers, and produce the concept of responsible sustainable tourism.

Keywords: geo-tourism, renewable energy, Sano Nggoang

A. INTRODUCTION

Tourism is a complex chain that involves various sectors. The transportation sector has a significant influence on the development of tourism for example, someone traveling from one place to another will use transportation in the form of planes, land vehicles, sea vehicles, and others. The hotel and restaurant sector are also supported as a place to stay, eat and drink for tourists. The banking sector, hospitals, travel agents, and many more sectors support tourism worldwide for the management and sustainability of the business. Recently, the tourism trend has shifted towards an environmentally friendly direction, often referred to as eco-tourism and responsible traveler. The traveling experience is not only about enjoying tourist destinations but also about how sustainable tourism contributes to the environment. Tourism is also not just about traveling to a place, but how to get an experience from that place that is remembered and valuable so that when leaving it can re-tell it to others with an extraordinary travel experience.

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Indonesia as one of the countries has many famous tourist destinations has great potential to bring in foreign tourists and earn foreign exchange from the tourism sector. Some examples of tourist destinations in Indonesia are Toba (North Sumatra), Ciletuh (West Java), Batur (Bali), Rinjani (Lombok), Komodo (East Nusa Tenggara), and many others. Visitors to these destinations are also increasing from year to year. The number can be seen that the graph of visits in the last 5 years is quite fluctuating due to Covid-19 which caused paralysis of the tourism sector and the number of visits. However, starting in 2022, foreign tourist visits began to rise and are predicted to continue to provide a positive trend in the future.

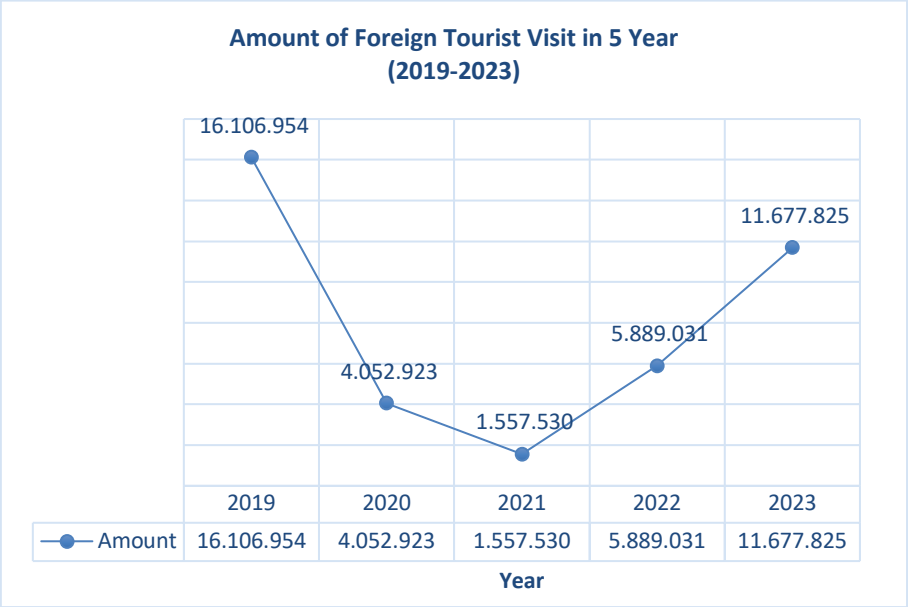

Figure 1. Amount of Foreign Tourist Visit in 5 Year (2019-2023)
Source: Badan Pusat Statistik, 2024

With those increase in visits, it is expected that improvements to various destinations will also continue to grow including in the geo-tourism tourism subsector. Geo-tourism is a branch of tourism that emphasizes the geological environment sector. This tourism focuses on geo-site visits and biodiversity conservation. This is achieved through visits to geological features, tours and geo-trail viewpoints, guided tours, geo-activities, and the protection of site visitor centers. Geo-tourism can consist of independent travelers and group tourists, and they can visit natural areas or urban/developed areas wherever there is geological interest (Dowling, 2013). Geo-tourism is often categorized as special interest tourism which is only visited by people who are interested in such tourism such as researchers, school children, or individuals who are interested in geology and aim for educational tours to add experience and seek pleasure as the purpose of traveling. For this reason, the number of visitors is usually small and deliberately limited to preserve the sites and the environment they visit.

This type of tourism is often known as niche-marketing tourism which is different from the mass-market type. Niche marketing is characterized by a focus on a small market, specialized product, loyal customers, small group, centrifugal, flexible, weak competition, and bottom-up approach (Sert, 2017). In addition, several classifications of special tourism types can be classified based on nature, culture, education, and hobbies. While geo-tourism can be included in some of these types such as mountain, nature, highland, adventure, cave, silk- road, and cave tourism which allows a touch of geology and biodiversity.

There are several classifications of special interest in tourism related to the geo-tourism sector such as mountain, nature, cultural heritage, silk road, adventure, and cave tourism which is related because of the activity and attraction using geo-sites.

Table 1. Classification of Special Interest Tourism Types

Based on Nature	Based on Culture	Based on Education	Based on Hobbies
Botanical Tourism	Dark Tourism	Educational Tourism	Shopping Tourism
Farm Tourism	Ethnic Tourism	Youth Tourism	Hunting Tourism
Mountain Tourism	Festival Tourism	Congress Tourism	Golf Tourism
Nature Tourism	**Silk Road Tourism**		Gambling Tourism
Air Sports Tourism	Faith Tourism		**Adventure Tourism**
Winter Tourism	Cultural Tourism		**Cave Tourism**
Village Tourism	Third-Age Tourism		Rafting Tourism
Bird Watching	**Cultural Heritage Tourism**		Wine Tourism
Water Sports Tourism			Yacht Tourism
Agricultural Tourism			
Highland Tourism			

Source: Sert, 2017

Indonesia needs to support the development and many policies of geo-tourism have also emerged. Based on the Ministerial Regulation of Tourism and Creative Economy no. 2 year of 2020 concerning Technical Guidelines for Geoparks as Tourism Destinations, it discusses that geoparks as tourism destinations are not only intended to encourage efforts to conserve geological diversity, biodiversity, and cultural diversity but also to encourage community and regional economic growth through community empowerment efforts. There are three important pillars discussed, are conservation, education, and sustainable community economic development. In addition, Minister of Energy and Mineral Resources Regulation no. 1 of 2020 concerning Guidelines for the Determination of Geological Heritage(geo-heritage) aims to preserve the value of geological heritage (geo-heritage) as an object of research, earth education, and geo-tourism, and can even be used as a basis for geopark development.

Ancient Lake Sano Nggoang is one of the deepest ancient lakes in Indonesia and is currently one of the geo-tourism destinations and also a geothermal renewable energy development plan planned by the government. Regarding geo-tourism, tourism development in Nunang Village, which is located on the edge of Sano Nggoang Lake, has been carried out by developing homestays, village tours, birdwatching, forest trekking, hot springs, caci dance although it has not brought many tourists to this area because of special interest tourism types. Meanwhile, geothermal development was rejected by the community in 2022 because it damaged the environment. The purpose of this paper is to provide a comprehensive overview of tourism, community, and renewable energy. The problems between these sectors will be discussed comprehensively to produce a study on the potential development of renewable energy-based geo-tourism in the Lake Sano Nggoang area, West Manggarai, East Nusa Tenggara.

B. RESEARCH METHOD

This research was conducted in Nunang Village, Sano Nggoang Tourism Village, using a qualitative-based approach that focuses research on in-depth observations at the site location. Researchers used informants from the head of the tourism awareness group (Pokdarwis), the manager of the Sano Nggoang tourist village homestay, the surrounding community, and direct observation in the field. From the informants, researchers explored tourism activities that have been carried out so far as attractions, activities, homestay management, birdwatching, tourist visits, energy-related planning, and various other qualitative data. Researchers also directly observed data, facts, and problems in the field.

As for data collection and analysis techniques using several qualitative techniques below, such as:

- Interviews, which directly conduct in-depth interviews with sources related to the field of geo-tourism and renewable energy. In terms of geo-tourism and eco-tourism, interviews were conducted with several important informants to obtain accurate data.
- Observations were conducted in the Nunang village area of Wae Sano Village, which is administratively part of the Sano Nggoang sub-district. In addition, observations were also made of several tourist attractions around the area that are related to the Sano Nggoang sub-district area. Observations were made by looking directly and also recording/taking video photos related to tourism potential and renewable energy.
- Document study, this study was conducted by searching for various literature related to tourism potential and renewable energy in the area. The literature used mostly comes from articles written by various government, private sector data literature, mass media, and non-profit organizations that develop the area. Tourism data is mostly sourced directly from observations, interviews, and observations. Renewable energy data is mostly obtained from several literature such as third-party studies for geothermal exploration in the Sano Nggoang area.

C. FINDINGS AND DISCUSSION

Sano Nggoang Lake is a 512-hectare sulfur crater lake located at an altitude of 757 m above sea level. The formation process is due to the eruption of Mount Sano Nggoang with various types of old volcanic rocks around it. Its depth only ranges from 40-90 m with a maximum depth in the centre of the lake which is 500 m deep, making it one of the deepest crater lakes in the world. The lake has a diameter of 2.5 km at the center of Mount Waesano, which is located in the southwest of Flores Island. A bathymetric survey found that the lake's water pH (potential of hydrogen) is less than 3 with a strong sulphuric smell. This condition is not suitable for bathing, drinking, and consumption in the surrounding community (Rosary, 2022).

Location, Accessibility, and Landscape

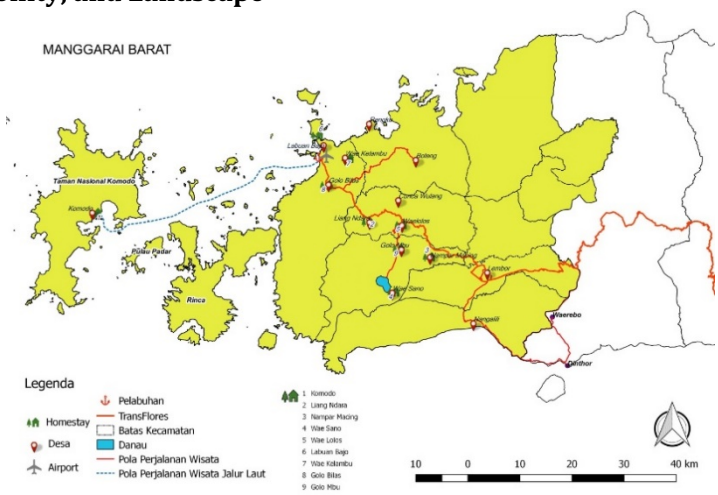

Figure 2. Accessibility Map to Sano Nggoang Lake
Source: Indecon, 2018

Sano Nggoang Lake is located in Sano Nggoang District, West Manggarai Regency, East Nusa Tenggara Province. Administratively, the lake area is in the area of Wae Sano Village, Sano Nggoang, and Nuncung Island. To reach this location, visitors can come from the capital of West Manggarai Regency, Labuan Bajo. This location is also very famous for its tourism with the destination of Komodo Island. The journey from Labuan Bajo to Wae Sano Village will take about 3-4 hours using a four-wheeled vehicle. The road conditions are winding along the Trans-Flores with good conditions, and when entering the village area, the road conditions are relatively poor.

The average air temperature in the West Manggarai region including San Nggoang is 27.7^0 C with a humidity of around 78% throughout the year. Rainfall and sunshine are present throughout the year as the area is located in a tropical climate (BPS, 2023). The Wai Sano forest and mountain area is also adjacent to the Mbeliling forest and mountain area in West Manggarai. This area has a lot of typical flora and fauna and also a variety of biodiversity. Wai Sano volcano has an elliptical caldera with a center line measuring 2.5 x 3.5 km, called Lake Sano Nggoang, which has a high content of solfatara (sulfur). The peaks of Poco Sesok and Poco Dedeng are near the center of the eroded mass. The area has been the target of geothermal investigations, and two solfataras are located on the southeast shore of the lake. No eruptions have been reported or dated in its history, but the area is mapped as Holocene in age. (Smithsonian Institution, 2024)

Potential Geo-tourism Attaction

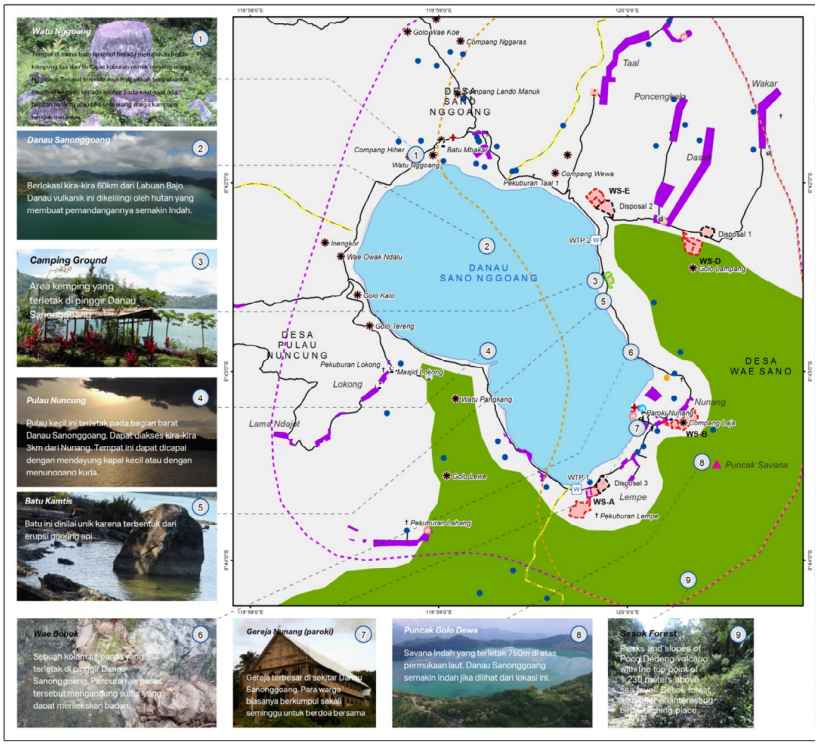

Figure 3. Potential Tourism Attraction List
Source: Waesano ESIA, 2019

Sano Nggoang has the potential the main tourist attraction in the form of a volcanic lake that contains a lot of sulfur. In addition, the tourism potential is also very large with a significant number of tourist visits, especially foreign tourists. This is because special interest tourism has a segmented target audience so the number of visits is also adjusted accordingly. Some of the potential tourist attractions at Lake Sano Nggoang are as follows:

1. Horse riding around the lake

   Lake Sano Nggoang has an area of about 512 hectares, which can be reached by riding around the lake on a path along the lakeside forest. Visitors do not need to walk because horses have been provided by the local tour manager who is also the owner of the only roadside stall when entering Nunang Village. Visitors will also get a view of the lakeside and local community activities in the village. The journey takes 3-4 hours at a normal speed covering a distance of about 14 km around the lake.

2. Birdwatching

Sano Nggoang is also one of the best birdwatching spots in West Manggarai. Various types of endemic Flores birds have habitats in this area, namely the Flores Hawk-eagle, Wallace's Scops-owl, Russet-capped Tesia, and Brown-capped Fantail). This location is around the villages of Nunang, Lempe, Ta'al, Golo Lampang. This is a forested area with clear streams and springs. For this reason, some endemic meat-eating birds can find food around the river and forest. (Burung Indonesia, 2017)

3. Village and Forest Tour

Besides seeing endemic birds and horse riding, other activities include forest exploration and village exploration in Sano Nggoang. For the jungle trek, visitors climb Waisano mountain (903 m) and discover Flores'endemic biodiversity. Visitors will pass several peaks such as Poco Dedeng to be able to trek to the top of the mountain by passing through Sesok Forest the source of biodiversity in this region. The Golo Dewa savanna peak also presents the beautiful Sano Nggoang Lake from the top of the hill. In addition, another potential is a village tour that can be enjoyed by visitors by seeing various local plantation commodity such as candlenuts, coffee, cloves, avocados, and many others. This potential can be packaged in a tour as an alternative tourist attraction in the Sano Nggoang area.

4. Hotsprings

The bathhouse is located on the edge of a lake with a high sulfur content. There are several springs whose temperature is so hot that they are often used to boil food (eggs, sweet potatoes, cassava) by visitors who come to the location. This can be an interesting activity if it is well-packaged and supported by adequate infrastructure.

5. Homestay

Homestay potential already exists in this area, as seen with some residents who have started renting out their rooms to visiting tourists. The concept of homestay here is to live together with the community, follow the way of life, and interact a lot with the community as the host. So that later an atmosphere of intimacy and exchange of experiences from tourists and villagers will be created. There are about 10 houses that have committed and are ready to become homestays to promote community-based local tourism. These attractions support the geo-tourism potential of the Sano Nggoang area with sites such as volcanic rocks, sulfur lakes, biodiversity, birdwatching, and other interesting geo-sites.

Potential Renewable Energy

In terms of renewable energy, Sano Nggoang has an abundance of potential, such as geothermal, which is still being polarised between the government, developers, and local communities. In addition, there is also the potential for solar energy, which is currently used in individual households to light up some lamps at night.

1. Geothermal

Geothermal energy is an alternative energy source that is often referred to as renewable energy. The character of renewable energy is more environmentally friendly, producing relatively fewer greenhouse gas emissions than fossil energy. For this reason, renewable energy has recently become one of the energy sources developed by many countries in the world, one of which is geothermal. Energy from geothermal is also very stable in contrast to other

renewable energies (water, solar, tidal, etc) that have peak times. The energy produced from geothermal does not change so that it can fulfill a stable electricity supply. The study for this project has been carried out since 2016 to prepare an EIA conducted by PT SMI. In the planning, 4 well pads will be drilled, each conducted in 2 stages to produce 45 MW of electricity. The stages are exploration and exploitation. In the exploration stage, studies and various tests are still being carried out to ensure the feasibility of geothermal heat contained therein. While the exploitation stage is already included in the construction, operation, and operational stages. This study plan also explains the various impacts of biodiversity on forests and endemic animals, especially local Flores birds. In addition, it also explains the various impacts of exploration and exploitation that cause various environmental damage and diseases in humans. The environmental damage that may occur such as small earthquakes, noise, dust, residual material, pollution, and shrinking groundwater is presented as not having a significant impact on the entire ecosystem of community life. In addition, the well pad drilling location is also located in an area close to residential areas, plantations, and community agriculture so that it will not disturb protected forests or endemic animals. The study also found that most people (89%) agreed with the geothermal project. This is due to the need to improve community welfare, the local economy, and household welfare. It is also to fulfill the electricity needs of the community in a more environmentally friendly way. (Waesano ESIA, 2019)

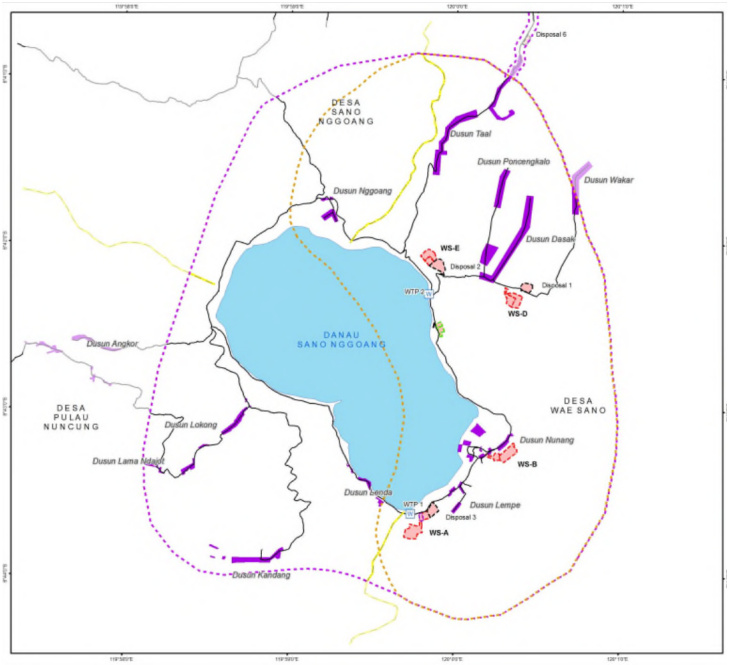

Figure 3. Potential Geothermal Wellpad
Source: Waesano ESIA, 2019

However, from all these environmental impact assessment studies, in 2022 the World Bank as the largest funder of the geothermal project in Sano Nggoang came to visit and was rejected by the local community. The villagers vehemently rejected the geothermal project and the World Bank did not proceed with the project due to the lack of negotiation and consensus in the project implementation plan. The reason is that the geothermal will damage their source of life, with the reduction or destruction of their farm and plantation crops such as candlenuts, cassava, sweet potato, bananas, and others (Jempau, 2022). In 2023 the government again planned to continue the geothermal project because it was one of the national strategic projects of the Geothermal Energy Upstream Development Project (GEUDP). The government through the Ministry of Energy and Mineral Resources also issued Minister of Energy and Mineral Resources Decree

no.2268 K/30/MEM/2017 which also designated Flores Island as a geothermal island. The funding will be covered by the government and involves PT Geo Dipa Energi as the developer. (Floresa Team, 2023)

2. Solar Energy

The potential for renewable energy in the Sano Nggoang area is not only geothermal but also solar energy. Until 2018 the Nunang village area and its surroundings were still not connected by electricity from National Electric Company (PLN). The plan is that this geothermal energy will become a source of electrical energy for residents. Even so, the community already has a lighting system using solar energy initiated by the government and several non-governmental organizations. The system uses rooftop solar power plants, and solar battery flashlights that are used only at night. The potential for solar energy in this village is quite good because the sun shines throughout the year and is quite strong at peak hours for about 4 hours. This is enough to light 1-3 lamps at night. As for cooking, most people use firewood as heat energy. Some families use kerosene but it is very rare. The use of firewood is inseparable from the location which is located in a rural area with many forests and dense trees so people often go to the forest to look for dry firewood for daily cooking.

Community Based-Management System

Both geo-tourism and renewable energy should be brought together for a comprehensive concept. Community-based management is certainly one good way to be able to develop both of these things. So far, Sano Nggoang geo-tourism has implemented community-based tourism that is managed by local communities ranging from tour guides, operators, homestays, food, drinks, and various other types of tourism services. Nunang Village has a tourism management group that aims to process the geo-tourism potential of the Sano Nggoang area into an activity that improves the economy of the local community, of course, while remaining environmentally friendly. In addition, the formation of the social capital of tourism awareness group (Pokdarwis) of Wae Lolos Tourism Village has also had an impact on the community in Nunang village and its surroundings which are closer to Sano Nggoang Lake. Several tourism managers have received training in tour operators, marketing, learning English, homestay training, and various other types of sustainable tourism management. As for renewable energy, there is still very little management in the community. The use of solar panels in households has been used but not optimized. This is due to difficulties in accessing or acquiring the technology and also the relatively expensive price of installing solar panels for community members and there are still many who use traditional lamps. Geothermal development is also one of the things that can be an alternative for the community, but here two sides of the blade provide more feasible energy access to the community, low carbon emissions, especially CO_2, but it is feared that it will hurt the surrounding environment with damage to forests, water, and biodiversity ecosystems in Sano Nggoang. It is also feared that the absorption of labor from outside the village will later implement this geothermal project so that local people do not get a portion of economic improvement. This is why the community cannot yet trust that geothermal renewable energy development will have a positive impact on the community. Geothermal development is indeed developed on an industrial scale, unlike solar photovoltaic which can be developed on a small scale and developed by the community. A community-based management system should be put forward to be able to have a positive impact on local communities, including the acceptance and affordable energy in the community.

D. CONCLUSION

In its development, the various potentials of Sano Nggoang Village are very abundant in the geo-tourism sector and also renewable energy. The existence of this potential is certainly expected to develop the potential of the village and the community to increase the economic value of Sano

Nggoang village even though there are still many things to do. The conclusions of the research conducted are as follows:

- The huge potential of tourist attractions such as birdwatching, forest and village exploration, as well as homestays needs to be developed further. This potential is already very good, still maintained its authenticity, carried out with small-scale tourism management so that it is expected to benefit the environment and not cause much damage.

- The potential for renewable energy such as geothermal and solar energy is also very large in this area so it needs to be managed properly so as not to cause problems for the community and the surrounding environment.

- Community-based approach and management is very important for the approach in the village. These areas and territories belong to the community so it is important to consider a community-based approach that impacts can be minimized.

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