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ABSTRACT The vision of the community around geothermal power plants and the development of the power plants should be based on sustainable development principles, without jeopardizing the quality of life and justice for communities surrounding the power plant. This research aims to: (i) identify issues that arise as an result of the development of geothermal power plants in rural Tompaso, and (ii) find solutions to the issues to minimize the conflicts that arises from further geothermal power plant development in rural Tompaso and its surroundings. This study is based on the competitive intelligence research method. The results show that the development of geothermal power plants in Tompaso has a negative impact on the natural and social environment. The technical solutions offered include: (i) bioremediation by cultivating plants that absorb arsenic; (ii) biosulfurization and desulfurization for reducing air pollution, especially sulfur; (iii) floods and extreme drought managed by improving infrastructure and reforestation; (iv) social conflicts (land acquisition, working days, labor recruitment and settlement security) are solved by intensifying program dissemination to the community and involving local communities in decision making. The recommended policy provides incentives to the local community through strategic programs for the development of human and natural resources.

KEYWORDS Competitive intelligence, environmental issues, geothermal power plant, rural Tompaso

1. INTRODUCTION

Indonesia's vision in 2045 is to become the fifth strongest country in the world economically with a GDP of US $7.3 trillion and a per capita income of US $25,000. This can be realized by investment and trade: in industry, tourism, the marine environment, services, supported by reliable infrastructure and strong food, energy and water security. Indonesia plans to launch a new renewable energy mix in 2050 making up 31% of the total national energy (Kementerian PPN/Bappenas, 2018). One renewable energy source that is environmentally friendly and supports sustainable development is geothermal energy.

Indonesian Law No. 30 (2007), concerning energy, states that the National Energy Policy should be prepared based on the principles of fairness, sustainability and environmental insight to support the creation of energy

independence and national energy security. This policy confirms that energy diversification is a necessity to meet national energy needs.

In the industrial era 4.0, the development of electric energy generation is a necessity to meet the energy needs of Sulawesi Island, Eastern Indonesia. One of the available sources of electrical energy is geothermal power plants (GPPs). GPPs are power plants that uses geothermal energy as an energy source.

The objective of the development of GPPs is the availability of geothermal energy to meet regional and national needs. It can be achieved by prioritizing the sustainable development principles without jeopardizing the quality of life and justice of the communities surrounding the plant.

Geothermal energy resources produce renewable energy that is clean and environmentally friendly. This energy is available in abundant quantities and can be exploited with many technologies (Zhang et al., 2019). The development of GPPs is one of the important energy sources that produce green energy that is free of carbon dioxide emissions in the world (Hossain, 2016), including in Indonesia.

The development of geothermal power plants is aimed at meeting national energy needs in the era of industry 4.0 (Salimova et al., 2019) and in the era of society 5.0 (Fukuyama, 2018). The availability of this energy in the framework of supporting national development is necessary so that Indonesia's goal of becoming the fifth strongest country economically in the world can be realized.

The development of GPPs must be carried out by prioritizing the principles of sustainable development without endangering the quality of life and justice for the community around the geothermal power plant. This means that all progress with renewable energy should aim to improve human welfare and the quality of the environment.

However, GPP development initially will have a negative impact on the surrounding community (social environment) and the surrounding natural environment. These negative impacts include the emergence of social conflicts in the community and loss of water resources. The most extreme impacts are that the surrounding communities may lose their homes, workplaces and business land due to the mudflows (Farida, 2013).

The construction of GPPs is usually carried out by the urban community in the rural community. In this connection the urban community will bring technology and information to the rural community, and then the rural community will provide the material and energy back to the urban community. In this connection the urban community will exploit the village community (Rambo, 1983) and efforts and policies are needed to balance the relationship between the two groups so that the negative impacts can be resolved.

Research on the problems posed by the development of GPPs in rural areas and research related to their solutions is still minimal. Natural environment problems related to water pollution by arsenic can be solved by designing special plants that can absorb arsenic in the wastewater reservoir (Mohammed Barznji, 2015) and air pollution by H2S can be solved by desulfurization and bio-desulfurization (Munir et al., 2010). Still research on the impact of the social environment is still lacking. However, comprehensive research related to natural and social environmental impacts and their solutions is needed to provide comprehensive information for stakeholders, including local communities.

The North Sulawesi Lahendong GPP has been operating since 2001 and is currently producing electricity with a total capacity of 120 MW. This has met 60 percent of electrical needs in North Sulawesi province. The Lahendong GPP already has six GPP units, each producing 20 MW, of which the lasts two units, namely units 5 and 6, are in Tompaso (Handoko, 2010). The GPP in Tompaso has acquired around 19 ha of land, nine ha of which are paddy fields. GPP Tompaso has six production wells and two injection wells.

The implementation of the well drilling project and the construction of the GPP in Tompaso had caused problems for some people around the well fields and the GPP construction site. Because of that, many residents refuse the presence of the GPP project for unit 8 that will be set up near water sources.

Based on these facts, the questions that arises are: (i) what are the negative impacts caused by the development of the GPP project on the social environment and natural environment in rural Tompaso, and (ii) what are the solutions to solve the negative impacts caused by the GPP project in rural Tompaso?

Based on these problems, the aims of this study are to identify problems in the

community caused by the development of GPPs in rural Tompaso and to find solutions to these problems to minimize conflicts arising from future GPP development in rural Tompaso and its surroundings.

The aim of this research is to provide input for Pertamina Geothermal Energy (PGE), the government and surrounding communities in geothermal management, which on one hand can meet national energy needs and on the other hand maintain the preservation of the natural environment as well as improve the quality of the social environment.

2. RESEARCH METHOD

This research was conducted from January to June 2019 in Tompaso District, Minahasa Regency, North Sulawesi Province, Indonesia, especially in units 5 and 6 of the local GPP.

This study uses the competitive intelligence (CI) research method as its policy research method (Dou et al., 2019).. This can be used to produce a development strategy for businesses or organizations (Tulungen et al., 2021). CI is a systematic process for collecting and analyzing data and information as well as understanding information in the context of compiling recommendations to answer problems faced by the organization (Dou & Manullang, 2003; Tulungen, 2019). CI is a method of approach and set of tools to help create intelligence (Dou et al., 2019). CI is a circular process (Kahanner, 1997; Vriens, 2004; Garcia-Madurga & Esteban-Navaro, 2020)(Figure 1).

A plan starts with a vision, but in reality problems arise relating to the achievement of the intended vision (Tulungen, 2012). Based on the research problems, an information-gathering plan was developed to solve the problems. The information collected is primary information and secondary information (Dou & Manullang, 2003). Primary information aims at answering the first goal and secondary information aims at answering the second goal. Sources of primary information are informants involved in the PGE project and the people who are influenced directly by the development impact. Information was collected through open-ended interviews with the informants and through direct observation at the project and affected locations. Secondary information is from documents, such as textbooks, reports, scientific journals, and other documents. The collection of secondary information is mostly done through online sources (Tulungen, 2020).

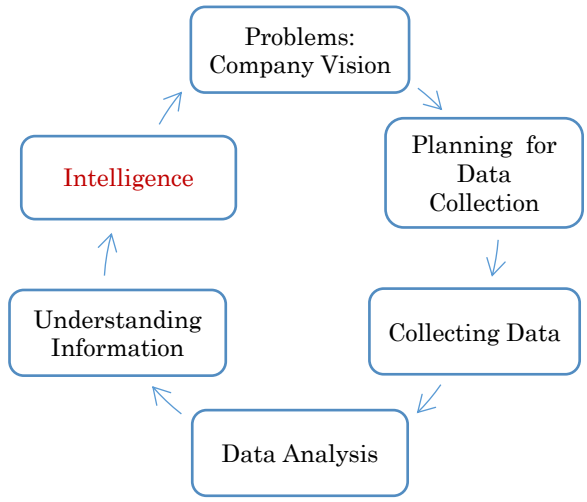

Figure 1 The competitive intelligence process.

Data analysis is done by grouping the data according to themes, namely the social environment or the natural environment. Each can be distinguished into sub-themes until it creates a unified whole and meaning. The results of the data analysis are then understood, through a deep and more comprehensive thought process (Tulungen et al., 2020). Based on this information, understanding can create intelligence as a recommendation for solving negative issues and further considerations for the development of the GPP and the community surrounding the GPP.

3. RESULTS

3.1 The natural environment

3.1.1 Water pollution

Water pollution occurs in two ways, first at the time of well drilling and second at the end of the drilling. During drilling, the drill bit can be released if the drill bit hits a solid material. To remove the drill bit, the well that has been dug is filled with thousands of liters of diesel oil. As a result, the groundwater is polluted with the diesel oil. After the drilling is completed, water or water evaporation coming out of the well is discharged into the reservoir. This water may contain toxic heavy metals such as arsenic. Because the reservoir cannot accommodate this wastewater at certain times, it overflows into the surrounding ground. As a result, surface water or ground water becomes polluted by arsenic.

Surface or ground water that is polluted with arsenic will contaminate agricultural fields, such as rice, with arsenic. The ground water that is used for drinking water by

humans and animals will be contaminated with arsenic as well (Hariyadi et al., 2013).

Based on the research by Hariyadi, the quality of waste water from the Lahendong GPP is poor, consisting of high arsenic concentrations of 1.2 mg/l (at point 1) and 1.26 mg/l (at point 2)(Hariyadi et al., 2012). This amount exceeds the limit that can be tolerated, which is 0.05 mg/l for arsenic (Presiden Republik Indonesia, 2001). Exposure to arsenic can trigger liver, kidney and skin cancer and also heart disease. Consuming arsenic-contaminated water can cause miscarriages, low birth weight babies and poor cognitive development in children (Rahman et al., 2009; Tofail et al., 2009).

Water pollution by arsenic can be overcome by improving waste water storage tanks and treating the wastewater (Mohammed Barznji, 2015). Planting the surrounding area with Monochoria vaginalis, Salvinia molesta and Colocasia esculenta will help reduce the arsenic concentration due to their ability to absorb arsenic in wastewater from GPPs. The highest arsenic absorption occurred in the roots of Monochoria vaginalis (22,289 mg/kg), followed by the root of Salvinia molesta (19,2335 mg/kg)(Hariyadi et al., 2013).

3.1.2 Air pollution

Air pollution is caused by increasing sulfur content (H2S) in the air. Air pollution occurs both around the well or GPP as well as in locations far from wells in Tompaso district. The level of pollution in the area around the wells is higher than the area far from the wells. This air pollution can be easily detected, for example by noting corrosion on zinc roofs faster than usual. This air pollution can also be seen from affected plants around the well, such as tomato plants that fail to bear fruit. In addition, rice production per ha is lower compared to before the drilling of wells by PGE. For example, if farmers were able to harvest 15-20 bushels per 355m2 (waleleng), now they can only harvest 10 bushels per 355m2 (waleleng).

The increase in sulfur content in the air will cause the release of greenhouse gases from below the earth's surface. With a GPP, these gases will reach the surface of the earth and therefor pollute the surrounding air. The air around the GPP was polluted by hydrogen sulfide (H2S) (Layton et al., 1981).

Reducing the sulfur levels from the well into the air can be done by desulfurization. The higher the concentration of Na2CO3 solution, the more NaHS is absorbed, which at a concentration of 11% can reduce H2S gas by 87.86%. In other words, if the concentration of H2S gas emissions from GPP activities ranges from 4800-6600 ppm, then with the absorption process the H2S gas emitted into the ambient air decreases to 582-801 ppm. With the process of bio-desulphurization (Rhodococcus sp.) the formed sulfur crystals were an average of 52.01% on a field scale and an average of 71.28% on a laboratory scale (Munir et al., 2010). Decreasing the quantity of production due to sulfur exposure needs technological innovation to obtain plants that are resistant to high-producing sulfur.

3.1.3 Flood and drought

Changes in land use from paddy fields to other crops and other uses have caused the water reservoir area to become narrow. As a result, if there is high intensity of rain it will cause flooding in the fields around the drilling that can impact the rice production.

Changes in land use from forest land to barren land have caused a reduction in water resources around the site. Tree clearing due to land clearing for the GPP project and drilling have caused the loss of several of the springs around the project. Water sources that irrigate rice fields in several villages in the Tompaso sub-district are deminishing. Areas in the downstream part of the GPP project are very vulnerable to drought and the loss of water has resulted in yearly losses of harvest.

Floods and droughts can be overcome by improving infrastructure, such as the normalization of the Panasen River, and improving vegetation on the headwaters by building community forests or reforestation. This includes the requirement for PGE Lahendong to expand the area cleared for drilling wells from five hectares to ten hectares, of which five additional hectares are designated as village forests.

3.1.4 Conversion of paddy fields to drilling fields

The geothermal development project in Tompaso has closed around nine ha of rice fields. Of this, five hectares was for drilling wells and four hectares was for water pipelines from production wells to injection wells. This is contrary to the government policy regarding the acquisition of paddy fields. Rice fields that are converted into drilling sites should be substituted with the same amount of land, but in reality there is no substitution of rice fields.

In the future it is necessary to consider rice fields as a final consideration in determining the location of well drilling. Besides that, every productive land acquisition must be replaced by other land (Presiden Republik Indonesia, 2011). The decision to locate the project on the paddy fields should be the last alternative, and an effort should be made to locate the project far from human settlement.

3.2 Social environment

3.2.1 Land acquisition conflict

Public concern first arises when land acquisition occurs. The concern is due to the lack of effort from PGE to let people know the location of the project and the land acquisition. Land was acquired before people were aware of where it would be and that the acquisition would occur. In addition, conflicts happened between members of the families who need to sell the land to the project. This is due to the fact that there are family members who have received the compensation of the family-owned land without the knowledge of other family members.

To prevent the conflict during land acquisition, early socialization is needed in order for the local people to correctly understand the project planning and implementation. Furthermore, the surrounding community should be involved in the decision making related to land acquisition and the fixed prices of the land.

3.2.2 Worker recruitment conflict

Worker recruitment is carried out by a contracting company assisted by a working group. The working group consists of village heads (HukumTua) surrounding the well or the GPP. Worker recruitment for skilled labor was carried out directly by the contractor and for unskilled labor, such as security workers and day laborers, recruitment was carried out by the HukumTua as a member of the working group in their respective villages. Even though the village heads were involved, recruitment conflict always occurred. There are two kinds of conflicts occurring, namely between the village heads and the people who want to work and secondly between the contractor and PGE Lahendong and the people around the project. The village heads used their authority in recommending the workers who are only close to them. The contractor recruits people that they think can help protect their interests during the project. As a result, people who were not recruited revolted against the village heads and community leaders revolt against the contractor and PGE Lahendong. This is due to this fact that there were jealousies from the people and that only certain people were accepted. Namely, people who were close to the working group and people related to the contractor and PGE Lahendong worked for the project. This conflict had encouraged people who were not included to demonstrate and rebel against the decision. During the GPP development projects there have been more than ten demonstrations carried out by the local community with various demands, such as asking for PGE Lahendong to socialize the project, requesting transparency about employment opportunities, and refusing workers from outside Tompaso to work in the projects. In addition to that, the local workforce can only meet the needs of low and specialized skilled workers, who do not require skills.

Related to the conflict of the employee recruitment, the project needs to inform the community about the needs of the workforce, including the specifications of the needed workforce, involvement of community and religious leaders in the determination of workers, and should pay attention to community representation in the project.

3.2.3 Working days and hours of operation

In the process of the GPP project development in Tompaso, the working days are Monday through Saturday. Developers do not recognize holidays, especially Sundays. The culture of the local community forbids people to work on Sundays, especially during worship hours. Having a working day on Sunday led to protests from the local community. In addition, the noise and vibration caused from drilling wells are very disturbing during worship activities in the church.

Conflict about days and hours of operation can be solved by communication between community leaders, religious leaders and the developer. For example, there should be recess on Sundays especially during church services.

3.2.4 Settlement security

The existence of the GPP project has resulted in two kinds of fears among the village community. Firstly, local people worried about security and the entry of numerous workers from outside the community from different cultural backgrounds. Secondly, the existence of the GPP project could bring misfortune to the community, such as mudslides or the

decline in land area. This is influenced by the recent Lapindo mud disaster in East Java that drowned several villages surrounding the Lapindo Geothermal Plant (Farida, 2013). Also of concern are the results of research in units 1 and 2 in the Lahendong GPP exploitation area, which had reduced the land surface level by three to four cm (Kurniawan & Anjasmara, 2016).

The concern due to the incoming workers from outside of the area who live together within the village community can be reduced when there is a good interaction within the local community. Public concern about the fears of Lapindo's effect to the community can be overcome by public awareness that the Lapindo mudflow incident was not caused by drilling but rather due to the natural disasters that happened in East Java.

4. DISCUSSION

The development of a GPP is intended to meet national energy needs by prioritizing the principles of sustainable and equitable development. To achieve this goal, we need to pay attention to issues that are developing in the village surrounding the GPP project and also learn from the many experiences that have occurred in other regions and countries.

To solve these problems, the CI approach can provide solutions related to strategic programs and operational programs. The strategic program is under the authority of PGE, as the person in charge of GPPs throughout Indonesia, while the operational program is a program that is mutually agreed with the local community and the local government.

Local people are those who produce geothermal energy or energy producers and outsiders are energy users. In relations between communities (environmental systems), in a state of nature, the more stable systems (cities, elite groups) will exploit less stable systems (e.g., villages, marginalized groups). Energy and matter will flow from villages to cities (Rambo, 1983). Based on this fact, it is necessary for certain parties to intervene to create a balance between rural and urban areas, between the social environment and the natural environment, and between marginal groups and elites by providing incentives for villagers through national and local policies so that the principles of sustainable development and justice can be realized.

National policies will be realized in the form of national strategic programs and local policies. This will be in the form of local strategic program policies (Dou et al., 2020). Strategic programs at the national level are programs built to maintain and improve the quality of the social and natural environment around GPPs and geothermal wells. Based on the results of this study, the national strategic programs that can be offered are making forests around GPPs and geothermal wells, making wider reservoirs so that arsenic does not spread, reducing arsenic by planting plants that absorb arsenic, and paddy fields are the last option for location for the GPP and geothermal wells projects, GPPs and geothermal wells are built far from settlements and improve the quality of community resources around GPPs through education.

The strategic program at the local level aims to improve the quality of human resources in the surrounding community. Improving the quality of education can be done through education and training assistance. Education is formal education, from kindergarten to higher education, while training is according to the needs of the local community.

Since the Covid-19 pandemic in Indonesia, the teaching and learning process from elementary schools to universities has been carried out by distance learning (online) since March 2020. The main problems faced by rural communities, including in the Tompaso countryside around the GPP, in distance learning are the weak internet network, the absence of smartphone or computer devices, and funds to purchase data packages for students (Amalia & Sa'adah, 2020). Based on this fact, the strategic programs at local level must provide an internet network, smart phones, and data quota assistance for students around the GPP.

The absence or weakness of the current internet network must be anticipated by building satellite internet. Satellite internet is one type of internet independent of a cable network which directly uses satellite as its transmission medium. Satellite internet procurement is financed by PGE through corporate social responsibility funds. With this satellite internet, the problem of internet access or internet network and data quota or data credit costs in distance learning can be resolved. Some of the available providers include: Karunia Sinergy, Viasat, Hughes-Net, and Kacific. These providers provide satellite internet and telecommunications services to

customers in remote and rural areas. It can serve 100 networks with a distance of 1 km for 24 hours/day with an internet package cost of around Rp. 2.2 million/month. Through this program, the community, especially students, can participate in education through distance learning online.

The role of the government, PGE, and the surrounding community are very important in maintaining a balance between the social environment (social system) and the natural environment (ecosystem), as well as the balance between villages and cities. Energy will flow from the village to the city, so to balance the two ecosystems, materials and information from the city must be conveyed to the village. For this reason, a collaboration platform between stakeholders is needed in order to support and accelerate the flow of information and materials from cities to villages. The platform is in the form of an information system (Elitan, 2020) that allows all stakeholders to sit together to plan, implement and supervise programs to improve the quality of the natural and social environment around the GPP.

Tompaso GPP as an energy generator must be supported by all stakeholders. The existence of the GPP must be able to improve the quality of the natural environment (e.g., water, air, soil, sunlight, plants, and animals) and the quality of the social environment (e.g., education, health, economics, culture, law), particularly the local environment in which the project or business is located.

GPPs are part of a strategic renewable energy industry, and need to be supported by cooperation between the energy source community and energy users, the government, PGE, and universities to create innovation (intelligence) in order to develop them (Pique et al., 2018). With the cooperation of these stakeholders, GPP units 5 and 6 will be able to continue and the development of other GPP units can be carried out with more competitiveness and better quality by prioritizing the principles of sustainable development.

The CI approach and method is used by companies, both national or multinational (Prinsloo, 2017), and including small, medium, and large companies to be able to win the competition with similar companies (Hassani & Masconi, 2021; Nte et al., 2020), but also by the government and local governments to advance their regions (Ezenwa, 2018). CI is also used by organizations and communities to achieve their vision and goals. In this regard, this CI can be used to evaluate the implementation of GPP development and post-GPP development. Based on findings in this research, we can be concluded that the development of a GPP in rural Tompaso, especially unit 5 and unit 6 in rural Tompaso, is not in accordance with the goals and vision of PGE and the local community around the GPP project.

The vision for the community around GPPs should be based on sustainable development principles, without jeopardizing quality of life and justice. This means that PGE must operate efficiently in its development, not harm the community around the project, and not damage the social and natural environment. Or in other words, the development of the GPP must prioritize the principles of economy, benefit, justice, and sustainability. Thus CI can be used for the construction and development of projects for the public interest with a new vision (Dou et al., 2020), that is not only based on economic aspects but also based on social and natural aspects.

With the internet network, both through base transceiver station and satellite internet in the rural Tompaso, it will make it easier for the community surrounding the GPP project to build an information system or smart village (Andari & Ella, 2019). This smart village will serve the community in relation to government administration as well as the information needs of the community and other stakeholders (Syaodih, 2018). The development of this smart village can initially be realized through the cooperation of the village government, universities, and PGE (Imre, 2015).

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusion

Problems with GPP development include: (i) Natural environment: water pollution by arsenic, air pollution by sulfur, floods and drought, conversion of paddy fields to dry fields, (ii) Social environment: conflicts of land acquisition, recruitment of workers, working days and hours of operation and security of local resident. Some solutions to the natural environmental problems are (i) water pollution, such as exposure to arsenic in water can be overcome by increasing wastewater collection basins and wastewater treatment, (ii) air pollution and reduced crop production by sulfur can be overcome by desulfurization,

and (iii) floods and drought can be overcome by improving infrastructure and reforestation. Solutions to social environmental problems such as (i) land acquisition, (ii) working days and hours, (iii) recruitment of workers can be overcome by a program of socialization with the community and involving local communities in decision making, and (iv) security of settlements can be solved by the development of GPP projects far from settlements.

5.2 Recommendation

Recommendations that can be put forward are: (i) local communities should be included in decision making for location determination and recruitment of workers and should obtain benefits or incentives from energy produced through strategic programs from PGE, central government, and local governments (ii) cooperation between government/ PGE, universities and local communities should be carried out to find innovations, including plants that are resistant to sulfur, and (iii) the procurement of satellite internet to provide free networks for students in villages around the power plant to support online learning, and at the same time support should be in place for the procurement of smart villages.

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