Utilisation of Geothermal Energy that Impacts the Right to Clean Water

Adam Muhammad Yanis
Universitas Indonesia, Indonesia
adamyns@gmail.com

Erina Pane
Universitas Islam Negeri Raden Intan Lampung, Indonesia
inapane@gmail.com

Abstract

Geothermal utilisation policy based on the consideration highlights that geothermal resources are natural resources which are low cost and environmentally friendly. In some countries, including in Indonesia, waste from geothermal utilisation causes pollution of water sources in geothermal working areas. A normative juridical method was employed in this study, which data was processed based on the research of secondary data. The study results indicated that (1) geothermal management in the protected forest area of Mount Slamet, Central Java in Indonesia, resulted in contamination of clean water sources that were commonly used by the community for their daily needs. The liquid that came out of the process of geothermal exploitation had an impact on water governance in protected forest areas. In some countries pollution of water sources caused a long-term threat to human health and environmental sustainability, (2) the danger of sustainability of water resources in protected forest areas, it was caused by the policies undertaken did not pay attention to the principle of prudence. Therefore, it is necessary to reformulate policies in the utilisation of geothermal resources.

Keywords: *Clean Water, Geothermal Energy, Policies, Rights.*

How to Cite: Adam Muhammad Yanis, Erina Pane, “Utilization of Geothermal Energy that Impacts the Right to Clean Water”, *Fiat Justisia*, 13 (3), (2019).

DOI:10.25041/fiatjustisia.v13no3.1614

A. Introduction

The global energy crisis and scarcity of mineral fuels cause the need for alternative energy. Alternative energy is a renewable energy resource that has different characteristics from natural resources in general. Ladislaus Ryach¹ said that “Renewable is a characteristic of the support: the energy is removed from the source is similar to those required for energy removal. One alternative energy is geothermal energy”. The heat of the earth is claimed to be energy low cost and environmentally friendly alternative. Also, geothermal energy can be used directly and indirectly. Use directly for non-electric purposes such as hot springs. Indirect utilisation by carrying out the process of converting from heat energy and fluid into electrical energy. The method of geothermal utilisation to meet the needs of electricity infrastructure for the acceleration of strategic projects.

However, the use of geothermal energy in several countries, such as in China,² Turkey,³ Greece,⁴ including in Indonesia,⁵ raises problems. The renewable resource project that is claimed to be clean energy creates a condition of turbid water governance. In Indonesia, the Baturraden Geothermal Power Plant (PLTPB) caused the condition of the Prukut river water to be mixed with mud in ponds belonging to the residents of Karangtengah Village. Villagers have become difficult sources of clean water because Prukut River is a source of water for everyday life. The occurrence of itching disrupts public health due to using the Prukut River water.⁶

Therefore, this study attempted (1) to examine the impact of geothermal energy utilisation policies on water management that is a source of water for communities around geothermal working areas and (2) to reformulate of state policies in geothermal utilization, taking into account the precautionary principle. The state is obliged to maintain ecosystems in geothermal working

¹ Ladislaus Rybach, *Geothermal Sustainability*, Klamath Falls: Oregon Institute of Technology's Geo-Heat Center, (2007), p. 2.

² Qinghai Guo, Yanxin Wang, Wei Liu, B, As, and F contamination of river water due to wastewater discharge of the Yangbajing geothermal power plant, Tibet, China, Tibet: Springer-Verlag, (2008).

³ Department of Regional State Hydraulic Works XXI, *Laboratory Records on Boron Concentrations in Streams and Groundwater in Great Menderes Basin*, Aydın, (2001).

⁴ E. Dotsika, D. Poutoukis, J.L. Michelot, W. Kloppmann, *Stable Isotope and Chloride, Boron Study for Tracing Sources of Boron Contamination In Groundwater: Boron Contents in Fresh and Thermal Water in Different Areas in Greece*, Athens: Springer, (2006).

⁵ BBC Indonesia, When Clean Energy Projects Actually Bring Turbid Water to Banyumas, <http://www.bbc.com/indonesia/majalah-41661762>, accessed on April 28, 2018 at 23.08 WIB.

⁶ Satelit Post Masyarakat di Kecamatan Cilongok Ingin Mata Air Kembali Jernih (*Society in Cilongok Subdistrict Want Mata Air Back Clear*), <https://satelitpost.com/beritautama/masyarakat-di-kecamatan-cilongok-ingin-mata-air-kembali-jernih>, accessed on April 28, 2018 at 11.41 WIB.

areas. The maintenance of a good ecosystem will increase the carrying capacity of the environment.⁷

B. Research Methods

This study adopted a normative approach. It examined legal norms (statutory regulations). Library materials were used as secondary data. This research was descriptive-analytical, which described data obtained based on facts. The collected data were analysed using qualitative juridical methods. To achieve clarity on the issues discussed. Then a logical interpretation was carried out through investigating the law itself by exploring a relationship between the law and other laws as long as the law still had its relevance.

C. Discussion

1. Impact of Geothermal Utilization on Water Management Which was a Source of Water for the Community

Indonesia has the potential of geothermal energy which consists of 40% of the world's geothermal reserves, but its utilisation is still very low at 3.1%⁸. One of them is in the southern slope of Mount Slamet, Central Java. The hill of Mount Slamet has eight geothermal manifestations consisting of four points on the northern slope, two points on the northwest, and two points on the south (Baturraden) which have the closest distance 7km from the centre of the eruption.⁹

Based on the assessment and processing of data from the preliminary survey, the Director-General of Mineral, Coal and Geothermal submitted a letter from the Ministry of Energy and Mineral Resources regarding the proposed determination of geothermal mining work areas in the Central Java¹⁰ Baturaden area. Furthermore, the Ministry of Energy and Mineral Resources issued a Minister of Energy and Mineral Resources Decree regarding the determination of geothermal mining working areas in the Baturaden area, Banyumas Regency, Tegal Regency, Brebes Regency, Purbalingga Regency

⁷ Rachmadi Usman, *Pokok-Pokok Hukum Lingkungan Nasional (Principal of National Environmental Law)*, Jakarta: Akademika Pressindo, (1993), p. 7.

⁸ Daniel Rohi, *Alternatif Pembangkit Tenaga Listrik yang Ramah Lingkungan di Indonesia (Alternative Environmentally Friendly Power Generation in Indonesia)*, Surabaya: EECCIS, (2008), p. 2.

⁹ Asmoro Widagdo, Adi Candra, Sachrul Iswahyudi, dan Chalid Idham Abdullah, *Pengaruh Struktur Geologi Gunung Slamet Muda dan Tua Terhadap Pola Sebaran Panas Bumi (Effect of Geological Structure of Young and Old Mount Slamet on Geothermal Distribution Patterns)*, Bandung: IRWNS Politeknik Bandung, (2013), p. 206.

¹⁰ Surat Nomor 477/30/DJB/2010 tanggal 11 Februari 2010 perihal Usulan Penetapan Wilayah Kerja Pertambangan Panas Bumi di Daerah (*concerning Proposal for Determining Geothermal Mining Working Areas*) Baturraden, Provinsi Jawa Tengah.

and Pemalang Regency, Central Java Province¹¹. Even though Baturraden located on Mount Slamet is a protected forest area.¹²

Protected forest areas have a primary function as protection of life support systems to regulate water systems, prevent flooding, control erosion, prevent seawater intrusion, and maintain soil fertility. Baturraden is a protected forest area is useful for maintaining the management of Prukut River water in Karangtengah Village, Cilongok District, Banyumas Regency, Central Java Province. The exploration phase of the Baturraden PLTB project on Mount Slamet has caused the turbidity of the Prukut River.

On October 10, 2012, an auction of geothermal working areas was held by PT Sejahtera Alam Energy won the auction to carry out the PLTB project in Baturraden, Central JavaProvince¹³. In 2014 a power purchase agreement was carried out with a total investment of 900 million USD.¹⁴ Furthermore, PT Sejahtera Alam Energy has IPB¹⁵ geothermal permit PT Sejahtera Alam Energy Geothermal Mining in the Baturraden working area, Banyumas Regency, Tegal Regency, Brebes Regency, Purbalingga Regency and Pemalang Regency, Central Java Province.

The research conducted by the Banyumas Study Circle stated that this was due to the flow of material, especially land in the Baturraden PLTPB project, into the river. The cloudiness of the Prukut River is felt by the residents of Karangtengah, Sambirata, Panembangan, Kalisari, Pernasidi, Cikidang and Karanglo. The seven villages are villages that are on the southern slope of Mount Slamet which depend on clean water needs for the springs that flow through the PrukutRiver.¹⁶

One of the chemical elements in question and can be harmful to human health and naturally contained in geothermal working areas is boron. David Keith Todd said that boron is an element that is needed in the development of

¹¹ No. 1557 K/30/MEM/2010 tentang Penetapan Wilayah Kerja Pertambangan Panas Bumi di Daerah Baturraden, Kabupaten Banyumas, Kabupaten Tegal, Kabupaten Brebes, Kabupaten Purbalingga dan Kabupaten Pemalang, Provinsi Jawa Tengah (*concerning Determination of Geothermal Mining Working Areas in Baturraden Area, Banyumas Regency, Tegal Regency, Brebes Regency, Purbalingga Regency and Pemalang Regency, Central Java Province*).

¹² SK.3681/Menhut-VII/KUH/2014, May 8 of 2014.

¹³ Keputusan Menteri ESDM Nomor 6106 K/30/MEM/2015 Tentang Perpanjangan Jangka Waktu Eksplorasi PT Sejahtera Alam Energy (*Concerning Exploration Term Extension of PT Sejahtera Alam Energy*).

¹⁴ Alexander Richter, *PT SAE wins tender for Mt Slamet project in CentralJava*<http://www.thinkgeoenergy.com/pt-sae-wins-tender-for-mt-slamet-project-in-central-java/>, accessed on May30 at 17.37 WIB.

¹⁵ Sejahtera Alam Energy, *Geothermal Energy Project Info*, <http://www.saegeothermal.co.id/project-info>, accessed on April 26, 2018 at 00.23WIB.

¹⁶ Keputusan Menteri ESDM Nomor 4577 K/30/MEM/2015 on November 16, 2015 (*regarding geothermal permits of PT Sejahtera Alam Energy Geothermal Mining in the Baturraden Working Area, Banyumas Regency, Tegal Regency, Brebes Regency, Purbalingga Regency and Pemalang Regency, Province Central Java*).

plants if in small amounts, whereas if in large quantities, the element can be toxic.¹⁷ The immune function contained in the human body can be damaged if the human body consumes excessive boron content as drinking water for a long time.¹⁸

In geothermal drilling, (taking steam from reservoirs to fluid flows to power plants)¹⁹ steam and/or liquids are taken from vulnerable reservoirs are mixed with hazardous chemical elements. Even though the drilling process has been using sludge and addictive materials that are safe and environmentally friendly. As a government-issued policy regarding the management of drill mud and drill cuttings in geothermal drilling.²⁰

This problem is caused when the power plant operates, almost all hot springs, boiling springs and warm springs which are sources of underground water around geothermal areas are sucked into the surface of the ground through steam extraction activities in the process of geothermal exploitation.²¹

Even though the water vapour is channelled back to the disposal of geothermal wastewater or reused to heat the reservoir area in geothermal areas, then there is a mixture of water with chemical elements in geothermal areas. Some of them are dangerous chemical elements when mixed with the medium of water consumed by humans.

The same problem is experienced by Tibet, which is a region that has many geothermal areas and natural hot springs. Geothermal areas in Yangbajing are in the Northeast of Lhasa City, China. Inside the area, there is a reservoir with temperatures reaching 329.80C.²² Based on research conducted by Zhao P, Jin J, Zhang H, Duo J, and Liang T, geothermal liquids from the geothermal exploitation process carried out by the Yangbajing Geothermal Power Plant in Tibet contain several dangerous chemical elements with very high concentrations of boron, arsenic, and fluorine.²³

¹⁷ BBC Indonesia, *Ketika Proyek Energi Bersih Justru Memunculkan Air Keruh di Banyumas*, (When Clean Energy Projects Actually Bring Turbid Water in Banyumas), <http://www.bbc.com/indonesia/majalah-41661762>, accessed on April 28, 2018 at 23.08 WIB.

¹⁸ David Keith Todd, Larry W. Mays, *Groundwater Hydrology, Third Edition*, New York: Wiley, (2004), p. 176.

¹⁹ F Jay. Murray, "A Human Health Risk Assessment of Boron (Boric Acid and Borax) in Drinking Water", *Regulatory Toxicology and Pharmacology*, 22 (3), (1995), p. 23.

²⁰ D. Chandrasekharam, J. Bundschuh, *Geothermal Energy Resources for Developing Countries*, Boca Raton, Florida : CRC Press, (2002), pp. 65-66.

²¹ Pasal 3 ayat (1) *Regulation of the Minister of Energy and Mineral Resources of the Republic of Indonesia Number 21 of 2017 concerning Management of Drilling Mud Waste and Drill Powder at Geothermal Drilling*.

²² Qinghai Guo, Yanxin Wang, Wei Liu, As, and *Contamination of River Water Due To Wastewater Discharge of the Yangbajing Geothermal Power Plant, Tibet, China*, Tibet: Springer-Verlag, (2008), p. 2.

²³ Duo J, *The Basic Characteristics of the Yangbajing Geothermal field—A Typical High Temperature Geothermal System*, Tibet: Engineering Science, (2003), p. 44.

The results of research conducted by Qinghai Guo, Yanxin Wang, and Wei Liu on the Zangbo River showed that there was water contamination originating from water management in the Yangbajing geothermal working area containing chemical elements boron, arsenic and fluorine with relatively high concentrations of the womb element of Boron 3.82 mg/L, Arsenic 0.27/L, and Fluorine 1.85 mg/L.²⁴ The concentration of Boron, Arsenic, and Fluorine content recommended by the World Health Organization is Boron 0.3 mg/L, Arsenic 0.01 mg/L, and Fluorine 1.5 mg/L to be used for drinking needs.²⁵

Geothermal wastewater flowing into the Zangbo River has changed the quality of river water. River water samples collected in the lower reaches of wastewater disposal have higher concentrations of boron, arsenic and fluorine than those collected upstream. Although the Zangbo River has resilient power due to the sedimentation process, governance in the river waters has caused harmful effects on human health.²⁶ Based on a statistical survey conducted by the Hydrological and Water Resources Survey Bureau in Tibet in 2003, 80% of workers at the Yangbajing Geothermal Power Plant experienced baldness, and 30% of workers suffered porous teeth at the age of 30. Meanwhile 60% of the villagers who lived in the Yangda Village of Duilongdeqing Country near the geothermal field had suffered baldness and porous teeth at the age of 30 due to consuming water from the river.²⁷

These environmental problems also occur in geothermal working areas in Tibet, China (Yangbajing Geothermal Power Plant) and Turkey.²⁸ Boron pollution in the waters of the Great Menderes Basin is caused by the use of water originating from groundwater and mixed with industrial geothermal waste Kizildere Geothermal Power Plant. Based on the results of the study, the boron content contained in water management is in hazardous levels or is very dangerous to tolerate or to be consumed by the human body.²⁹

Furthermore, similar research was found in northern Greece due to geothermal mining activities from geothermal areas in Central Macedonia, Northern Greece. The results of the study state that water samples, boron concentrations that exist exceed the WHO-defined safe limit (0.3mg/L) and in

²⁴ Zhao P, Jin J, Zhang H, Duo J, Liang T, *Chemical Composition of Thermal Water in the Yangbajing Geothermal Field*, Tibet: Science Geology, (1998), p. 62

²⁵ Qinghai Guo, Yanxin Wang, Wei Liu, *Op.Cit.*, p.1.

²⁶ E. Dotsika, D. Poutoukis, J.L. Michelot, W. Kloppmann, *Stable Isotope And Chloride, Boron Study For Tracing Sources Of Boron Contamination In Groundwater: Boron Contents In Fresh And Thermal Water In Different Areas In Greece*, Athens: Springer, (2006), p. 19.

²⁷ *Ibid.*

²⁸ Li H, He X, Hu X, Duo J, *Environmental issues of geothermal development in Yangbajing, Tibet and the countermeasures*. Hubei: Wuhan University Journal Natural Science, (2003), p. 965.

²⁹ *Research of Laboratory Records on Boron Concentrations in Streams and Groundwater in Great Menderes Basin* yang dilakukan oleh Department of Regional State Hydraulic Works XXI di Aydin.

some areas with high geothermal activity, the boron content exceeds 1mg/L which far exceeds the appropriate water consumption limit in The European Union.³⁰ Environmental protection arrangements in the sense of ecological preservation, but also related to the regulation of the use or use of natural resources.³¹

2. Reformulation of Policies to Prevent the Impact of the Sustainability of Water Resources by Paying Attention to the Principle of Prudence

Environmental law regulates the behaviour of legal subjects in the use and protection of natural resources and the environment- human protection from negative impacts arising from the use of natural resources. Thus, environmental law is not always related to. In the scope of geothermal utilisation for electricity, environmental law plays a role so that engineering is carried out by the principles of environmental protection and management. Policies that protect human health from possible impacts.

Pamela Hill said that environmental protection or environmental protection is defined as “*reducing pollution, making sustainable choices, seeking holistic solutions, and distributing the burdens and benefits of industrialisation among all populations, considering their current situations, their contribution to the harms being addressed, and the resources available to them*”.³² Based on this understanding, environmental protection is a series of efforts aimed at creating protection for humans not only for the environment itself. It is because in the management of the situation if it is carried out massively with uncontrolled pollution it impacts on the availability of the resources themselves and impacts on the survival of the surrounding human population.

Improvements in geothermal management policies must begin with the precautionary principle. This principle originates from the basic concept, that every policy maker must act based on thought, consideration and scientific study of the possible impacts of the policy, to protect the environment from the dangers of pollution and/or damage.³³

Based on Principle 15 of the Rio Declaration on Environment and Development (1992) it is stated that “To protect the environment, the precautionary approach shall be widely applied by States according to their capabilities”. This principle explains that uncertainty about the impact of a business and/or activity is due to limited mastery. This principle explains the uncertainty about the impact of a business and/or activity due to limited

³⁰ Department of Regional State Hydraulic Works XXI, *Laboratory Records on Boron Concentrations in Streams and Groundwater in Great Menderes Basin*, Aydın, (2001), p. 34.

³¹ E. Dotsika, D. Poutoukis, J.L. Michelot, W. Kloppmann, *Op.Cit.*, p.31.

³² Davied Farrier, Rosemary Lyster, Linda Pearson, Zada Lipman, *The Environmental Law Handbook*, New South Wales: Legal Centre Publishing, (2000), p. 4 in Takdir Rahmadi, *Indonesia The Environmental Law*, Jakarta: Raja Grafindo Persada, (2015), p. 21.

³³ Pamela Hill, *Environment Protection: What Everyone Need To Know*, Oxford: Oxford University Press, (2017), pp. 2-3.

mastery. Science and technology is not an excuse to delay measures to minimise or avoid threats to pollution and/or environmental damage. The precautionary principle is taken into consideration because the geothermal utilisation policy must answer the question “whether the policy is good for the environment and human health ? Can this policy protect the environment and humans at this time and in the future?”. In the problems of PLTB Baturraden which pollute the Prukut River is learning for policymakers in Indonesia towards geothermal utilisation which is generally carried out in forest areas.

The Indonesian government uses geothermal energy indirectly as a non-mining activity. The policy is legalized in the form of several laws and regulations concerning indirect use of geothermal energy, utilization of geothermal environmental services in several regions.³⁴ The regulation becomes the legitimacy of the use of geothermal energy in forest areas both nature conservation and protected forests. Geothermal energy is expressed as clean energy but does not exclude prevention instruments which are also regulated in the Law on Environmental Protection and Management. Prevention instruments based on the precautionary principle must be used for policymakers in considering the use of protected forests as geothermal processing areas.

Mount Slamet is a protected forest that functions to meet the needs of clean water for the surrounding community. Environmental functions related to the water system must be preserved.³⁵ Regarding the establishment of protected forest as a geothermal working area, there must be a preventive instrument from the impact of changing the water system in the protected forest.

The parties that play a role in forest use must consider that every action taken can be carried out sustainably (both for mining, the utilisation of timber products from the forest directly, or in the context of clearing land for plantations). Each of these actions must be carefully reviewed so as not to produce output in the form of damage to the ability of forests to protect water and soil conservation.³⁶ Moreover, in this case the forest area utilised is the area of Mount Slamet is a protected forest that has the main function to protect

³⁴ Allard E. Dembe, Carolyn Raffensperger, Joel Tickner, “Protecting Public Health and the Environment: Implementing the Precautionary Principle”, *Journal of Public Health Policy*, 22 (2), (2001).p. 23.

³⁵ (1) Republic of Indonesia Government Regulation Number 7 of 2017 concerning Geothermal Energy for Indirect Use, (2) Regulation of the Minister of Environment and Forestry of the Republic of Indonesia Number P.46 / Menlhk/Setjen/Kum.1/5/2016 concerning Utilization of Environmental Services Geothermal in National Park Areas, Forest Parks and Nature Tourism Parks, (3) Republic of Indonesia Government Regulation Number 108 of 2015 concerning Amendments to Government Regulation Number 28 of 2011 concerning Management of Natural Reserve Areas and Nature Conservation Areas.

³⁶ Dadang Epi Sukarsa, “Metode Kajian Lingkungan Hidup Strategis dalam Evaluasi Rencana Tata Ruang Wilayah Provinsi Jawa Barat”, *Bina Hukum Lingkungan*, 1 (2), (2017), p. 9.

the life support system from regulating water management, prevent flooding, control erosion, prevent seawater intrusion, and maintain soil fertility.³⁷

Implementation of the precautionary principle in this problem can be applied in preventive instruments in the form of environmental permits. Preliminary surveys and exploration of an area are determined based on geological, geophysical, and geochemical conditions. It is estimated that there are geothermal resources and estimates of geothermal reserves. Furthermore, through Environmental Impact Analysis (EIA) or *Analisis Dampak Lingkungan* a holistic assessment, forecast and evaluation are carried out on the impact of the planned activities.

The EIA is based on the criteria for the number of people affected, the area and the intensity and duration of the impact. If this procedure is carried out based on a comprehensive scientific study, of course, there are considerations regarding the fatal implications of geothermal utilisation in protected forest areas on the sustainability of water resources and human health. These studies and scientific factors can lead to policies that arise regarding environmental inadequacies so that both environmental permits and IPB cannot be issued. This policy can realise environmental, and human protection from more significant threats.

Implementation of the precautionary principle can be included in the improvement of norms relating to the management of drill mud and drill cuttings in geothermal drilling. Based on the regulations³⁸ concerning sewage mud and drill cuttings, that from geothermal drilling, water and air-based drill mud is not included in the category of hazardous and toxic material waste.

However, based on the regulation³⁹ regarding the management of drill mud and drill cuttings in geothermal drilling, it is regulated regarding the provisions for the management of drill waste, which must be ended by a stockpiling mechanism. It shows that it is not permissible for the misuse of drill mud and drill cuttings to be dumped into the river.

The principle of prevention or the precautionary principle determines when making changes so that there is no degradation in the quality of the environment due to pollution. Furthermore, this principle also discusses the absence of environmental damage. Prevention is carried out on activities and/or businesses that have not been recognized broadly and the extent of the loss and/or injury. Prevention is carried out by taking concrete steps, although no precautionary principle is an important principle and was adopted in

³⁷ Brett M. Bennett, *Plantations and Protected Areas: A Global History of Forest Management*, Cambridge: MIT Press, (2015), p. 51.

³⁸ Herman Hidayat, *Pengelolaan Hutan Lestari: Partisipasi, Kolaborasi dan Konflik*, (Participation, Collaboration and Conflict), Jakarta: Yayasan Pustaka Obor Indonesia, (2015), p. 10.

³⁹ Consideration letter a Republic of Indonesia Minister of Energy and Mineral Resources Regulation Number 21 of 2017 concerning Management of Drilling Mud Waste and Drilling Powders.

various policies after it was outlined in the 1992 Rio Declaration produced at the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro, Brazil 3-14 June 1992. Principle 15 of the Rio 1992 Declaration states that:

“To protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation”.

The precautionary principle shows that caution needs to be exercised by the state in its policymaking. The concept of early returns has indeed been approved and widely applied in various aspects of life. In answering it with the precautionary principle, it was stated that “Science does not always provide the insights needed to protect the environment effectively, and that the effect of my results is undesirable if steps are taken only when science does provide such insights”.

Furthermore, also suggest that “The essence of the concept of caution, the principle of caution, is that once risks have been identified, the lack of scientific evidence of cause and effect should not be used as an excuse not to take action to protect the environment”, in the application of the precautionary principle:

- a. After the risk has been identified. If it has been identified, a loss that may arise.
- b. Where there is a threat of severe or irreversible damage, if there are severe or serious problems, these problems can be cured. Serious and irreversible damage is erratic in size and must be seen on a case by case basis.
- c. Lack of scientific certainty. If needed, it will happen because there is uncertainty or distrust of confidence about the magnitude and breadth of the consideration that will occur.

The purpose of carrying out drilling mud waste is a form of limitation of activities in geothermal activities to prevent the destruction of ecosystems. Thus the existence of legal norms that regulate waste dumping is a form of implementation of the principle of prudence. This hoarding mechanism can also be applied in geothermal utilisation, even though geothermal energy is believed to be clean energy. Geothermal business actors must conduct an assessment of the impacts of geothermal exploitation activities. The evaluation of this impact is not only on the use of geothermal energy in protected forests but also on every geothermal utilisation in other areas to minimise environmental pollution.

The policy of establishing the Baturraden area as a geothermal working area must be conducted in a holistic study as a form of implementing the

precautionary principle. In 1990 the Presidential Decree⁴⁰ stipulated that cultivation activities were prohibited from cultivation, except those that did not interfere with the protected function. It's just that in this case, the protected function is disrupted due to the long-term impact of the use of geothermal energy which is directly in contact with the water medium.

The focus of this problem when it is associated with controlling protected areas should be the focus of policymakers in determining whether an area is feasible which supports the balance between environmental preservation and the needs of the general public for development interests when the threat is far greater than the benefits to be obtained and is a form of utilization which interferes with the protected function.

Corporations or individuals can cause the use of protected forests that affect communities around the forest. Therefore, policymakers must pay attention to the rights of the people affected by forest management. The concept of human rights includes horizontal relations, where corporations are responsible for activities that intersect with people's lives. The existence of companies inevitably has an impact on people's lives which often results in reduced human rights. The interface between corporations and human rights is at least related to the right to a clean and healthy environment, the right to availability and accessibility to natural resources. Because of that, it is time for the obligations and responsibilities for the protection and promotion of human rights also in every individual and corporation. It was also stated in 1998 in "Declaration on the Right and Responsibility of Individuals, Groups, and Organizations of Society to Promote and Protect Universally Recognized Human Rights and Fundamental Freedoms".⁴¹

D. Conclusion

Based on the discussion described, it can be concluded that:

1. Geothermal utilisation policies had an impact on water governance which was a source of water for the community. Indirect use of geothermal energy caused the natural mixture of dangerous compounds to be susceptible. These dangerous compounds polluted water sources around the geothermal working area. The impact of pollution had a long-term threat to human health, so that prevention of impacts is needed.
2. One of the efforts taken was to use the precautionary principle towards the start of the policy. The precautionary principle was implemented through an Environmental Impact Analysis or *Analisis Dampak Lingkungan* instruments and environmental permits and landfill. The use of the precautionary principle was prioritized so that indirect geothermal

⁴⁰ Article 37 (1) Republic of Indonesia President Regulation Number 32 of 1990 concerning Management of Protected Forest Areas

⁴¹ Adopted from Majelis Umum PBB on December 9 of 1998 with Resolution Number 53/144

utilisation activities are carried out in vital areas that sustain water conservation in protected forest areas.

Based on the research that has been carried out there are several suggestions including:

1. As a form of good protection for forest areas that has a main function in maintaining the sustainability of water resources to the health of people who depend on clean water from the water source, then the use of clean geothermal energy for the general public in protected forest areas can only conducted as long as it does not interfere with the function of protected areas.
2. The government is carrying out the determination of geothermal working areas should carry out a thorough consideration and assessment of the impact of the indirect use of geothermal energy in the area on the environment to aspects of human health.

Bibliography

A. Book

- Asmoro Widagdo, Adi Candra, Sachrul Iswahyudi, and Chalid Idham Abdullah. (2013). *Effect of Geological Structure of Young and Old Mount Slamet on Geothermal Distribution Patterns*. Bandung: IRWNS Polytechnic Bandung.
- Bennett, Brett M. (2015). *Plantations and Protected Areas: A Global History of Forest Management*. Cambridge: MIT Press.
- D. Chandrasekharam, J. Bundschuh. (2002). *Geothermal Energy Resources for Developing Countries*. Boca Raton, Florida: CRC Press.
- David Keith Todd, Larry W. (2004). *Groundwater Hydrology*. Third Edition. New York: Wiley.
- Davied Farrier, Rosemary Lyster, Linda Pearson, Zada Lipman. (2000). *The Environmental Law Handbook*. New South Wales: Legal Centre Publishing.
- Duo J. (2003). *The Basic Characteristics of the Geothermal Filtering - A Typical High Temperature Geothermal System*. Tibet: Engineering Science.
- E. Dotsika, D. Poutoukis, J.L. Michelot, W. Kloppmann, Stable Isotope And Chloride. (2006). *Boron Study For Tracing Sources Of Boron Contamination In Groundwater: Boron Contents In Different Water In Different Areas In Greece*. Athens: Springer.
- Hidayat, Herman. (2015). *Pengelolaan Hutan Lestari: Partisipasi, Kolaborasi dan Konflik*. Jakarta: Yayasan Pustaka Obor Indonesia.
- Li H, He X, Hu X, Duo J. (2003). *Environmental Issues of Geothermal Development in Yangbajing, Tibet and the Countermeasures*. Hubei: Wuhan University Journal Natural Science.
- Qinghai Guo, Yanxin Wang, Wei Liu. (2008). *As, and Contamination of River Water Discharge From The Yangbajing Geothermal Power Plant, Tibet, China*. Tibet: Springer-Verlag.
- Rahmadi, Takdir. (2015). *Hukum Lingkungan di Indonesia*. Jakarta: Raja Grafindo Persada.
- Rohi, Daniel. (2008). *Alternative Environmentally Friendly Power Generation in Indonesia*. Surabaya: EECCIS.
- Rybach, Ladislaus. (2007). *Geothermal Sustainability*. Klamath Falls: Oregon Institute of Technology's Geo-Heat Center.
- Soemitro dan Ronny Hanitijo. (1985). *Metodologi Penulisan Hukum dan Jurimetri*. Jakarta: Ghalia Indonesia.
- Usman, Rachmadi. (1993). *Pokok-Pokok Hukum Lingkungan Nasional*, Jakarta: Akademika Pressindo.
- Zhao P, Jin J, Zhang H, Duo J, Liang T. (1998). *Chemical Composition of Thermal Water in the Geothermal Yangbajing Eld*. Tibet: Geology Science.

B. Journal, Research and Article

- Alexander Richter, PT SAE wins tender for Mt Slamet project in Central Java, <http://www.thinkgeoenergy.com/pt-sae-wins-tender-for-mt-slamet-project-in-central-java/>.
- Allard E. Dembe, Carolyn Raffensperger, Joel Tickner, "Protecting Public Health and the Environment: Implementing the Precautionary Principle", *Journal of Public Health Policy*, 22 (2), (2001), <https://doi.org/10.2307/3343463> .
- BBC Indonesia. When a Clean Energy Project Precisely Brings Turbid Water in Banyumas. <http://www.bbc.com/indonesia/majalah-41661762>.
- Dadang Epi Sukarsa, "Metode Kajian Lingkungan Hidup Strategis dalam Evaluasi Rencana Tata Ruang Wilayah Provinsi Jawa Barat", *Bina Hukum Lingkungan*, 1 (2), (2017), <https://doi.org/10.24970/jbhl.v1n2.17>
- F Jay. Murray, "A Human Health Risk Assessment of Boron (Boric Acid and Borax) in Drinking Water", *Regulatory Toxicology and Pharmacology*, 22 (3), (1995), <https://doi.org/10.1006/rtp.1995.0004>.
- Satelit Post, Society in the District of Cilongok Want Mata Air Back Clear, <https://satelitpost.com/beritautama/masyarakat-di-kecamatan-cilongok-ingin-mata-air-kembali-jernih>.
- Sejahtera Alam Energy, Geothermal Energy Project Info, <http://www.saegeothermal.co.id/project-info>.
- XXI's Department of Regional Hydraulic Works, Laboratory Records on Boron Concentrations in Streams and Groundwater in the Great Menderes Basin, Aydın, (2001).

C. Regulations

- The 1945 Constitution of the Republic of Indonesia and amendments.
- ESDM Minister Decree Number 1557 K/30/MEM/2010 Concerning Determination of Geothermal Mining Working Areas in Baturraden Region, Banyumas Regency, Tegal Regency, Brebes Regency, Purbalingga Regency and Pemalang Regency, Central Java Province.
- ESDM Minister Decree Number 4577 K/30/MEM/2015 dated 16 November 2015, Regarding PT Sejahtera Alam Energy Geothermal Permits in Geothermal Mining in the Baturraden Working Area, Banyumas Regency, Tegal Regency, Brebes Regency, Purbalingga Regency and Pemalang Regency, Java Province The middle.
- Law of the Republic of Indonesia Number 21 on 2014 of Geothermal Energy.
- Law of the Republic of Indonesia Number 32 on 2009 of Protection and Management of the Environment.
- Presidential Decree of the Republic of Indonesia Number 32 on 1990 of Management of Protected Forest Areas.

Regulation of the Minister of Environment and Forestry of the Republic of Indonesia Number P.46/Menlh/Setjen/Kum.1/5/2016 concerning Utilization of Geothermal Environmental Services in National Parks, Forest Parks and Nature Parks.

Republic of Indonesia Government Regulation Number 108 on 2015 of Amendments to Government Regulation Number 28 on 2011 of Management of Natural Reserve Areas and Nature Conservation Areas.

Republic of Indonesia Government Regulation Number 7 on 2017 of Geothermal For Indirect Use.

Republic of Indonesia Minister of Energy and Mineral Resources Regulation Number 21 on 2017 of Management of Drilling Mud Waste and Drill Powder at Geothermal Drilling.