

**Document Version**

Final published version

**Licence**

CC BY

**Citation (APA)**

Trisiah, A., & de Vries, G. (2026). Local Perception and Frames of Geothermal Energy: the Relevance of Cultural and Religious Values. *Geothermal Energy*, 14, Article 13. <https://doi.org/10.1186/s40517-026-00381-w>

**Important note**

To cite this publication, please use the final published version (if applicable).  
Please check the document version above.

**Copyright**

In case the licence states "Dutch Copyright Act (Article 25fa)", this publication was made available Green Open Access via the TU Delft Institutional Repository pursuant to Dutch Copyright Act (Article 25fa, the Taverne amendment). This provision does not affect copyright ownership.  
Unless copyright is transferred by contract or statute, it remains with the copyright holder.

**Sharing and reuse**

Other than for strictly personal use, it is not permitted to download, forward or distribute the text or part of it, without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license such as Creative Commons.

**Takedown policy**

Please contact us and provide details if you believe this document breaches copyrights.  
We will remove access to the work immediately and investigate your claim.

RESEARCH

Open Access



# Local Perception and Frames of Geothermal Energy: the Relevance of Cultural and Religious Values

Anita Trisiah<sup>1,2\*</sup> and Gerdien de Vries<sup>1</sup>

\*Correspondence:  
A.Trisiah@tudelft.nl

<sup>1</sup> Technology, Policy, and Management Faculty, Delft University of Technology, Jaffalaan 5, 2628 BX Delft, The Netherlands

<sup>2</sup> Faculty of Dakwah and Communication, UIN Raden Fatah Palembang, Jalan K.H. Zainal Abidin Fikri, K.M. 3,5, Palembang, Indonesia

## Abstract

The potential of geothermal energy is not parallel with the amount of its production due to several factors. Although technical, financial, and regulatory challenges are often cited, this paper highlights the critical role of indigenous perceptions and cultural–religious framing in shaping local responses to geothermal energy initiatives. Drawing on fieldwork conducted in South Sumatera—home to Indonesia’s most promising geothermal reserves—this study explores how local cultural and religious values interrupt people’s perception and reactions to the implementation of geothermal energy. In-depth interviews conducted within participants’ homes provided nuanced insights into the socio-cultural context. Findings reveal that the economic, environmental, and quality-of-life concerns are deeply embedded in the Tunggu Tubang tradition, which prohibits the ancestral land from being traded. This cultural framework influences how local people interpret change, evaluate risks, and determine a meaningful future, including the adoption of new energy resources. We described the local culture and religious values that shape the perceptions and frames surrounding geothermal energy, offering implications for more culturally attuned energy policy and implementation strategies.

**Keywords:** Geothermal energy, Local perceptions, Local frames, Cultural–religious values, Tunggu Tubang

## Introduction

Local perceptions and frames are key factors in determining whether geothermal energy is successfully implemented. They are shaped not only by tangible technical, economic, and environmental considerations but also by deeply rooted cultural and religious narratives that affect how local communities perceive the implementation of energy technology.

Geothermal energy, an emerging and uncertain energy, might face doubt and resistance from the public when the technology goes against locals’ beliefs and culture (Antara 2013; Vargas Payera 2018). In Chile, for example, the development of a geothermal project located on a mountain faced strong opposition from locals who had spiritual beliefs about the mountain. In such contexts, the act of drilling to produce geothermal energy is

© The Author(s) 2026. **Open Access** This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article’s Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article’s Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

not merely a technical operation, but a culturally charged intervention that is difficult for local communities to accept (Vargas-Payera et al. 2020a). A parallel situation occurred in Japan, where local resistance emerged over fears that geothermal exploration could damage hot spring resources, an integral part of regional identity and cultural practice (Erfurt-Cooper 2010; Kubota 2015).

In contrast, locals accept the implementation of geothermal energy when it aligns with their traditions and values (Neilson et al. 2010) and supports their socio-economic well-being (Renoth et al. 2023). For example, when the heat power from the Earth's subsurface decreases local heat costs and raises household welfare (Meirbekova et al. 2024). In countries, such as New Zealand and Iceland, geothermal development has provided local employment opportunities while respecting and preserving indigenous cultural practices (Bargh 2012; Daysh et al. 2020; Jónsson & Rastrick 2017; Neilson et al. 2010; Shortall & Kharrazi 2017). In these contexts, geothermal resources have bolstered tourism by allowing local people to interpret and showcase traditional knowledge tied to geothermal phenomena, such as hot springs, while generating income through roles like tour guiding (Musembi 2010; World Bank et al., (Stähler, et al., 2017) (Stähler, et al., 2017) (Stähler, et al., 2017)). These contributions subsequently led to a success story in geothermal exploration, facilitating the successful integration of energy transition and culture (Neilson et al. 2010; Pavlaković & Turnšek 2019). Thus, the geothermal acceptability of local people living in the vicinity of the project is pivotal for the project owners to succeed. Otherwise, delays or even project cancellations are highly likely to occur (De Vries 2017).

Indonesia, with a potential geothermal resource of 40% of the world's supply, faces similar challenges. In terms of benefits, research has shown that local acceptability increased when the implementation of a geothermal energy project included the recruitment of local employees, which increased locals' socio-economic status (Pambudi et al. 2022). Additionally, the direct application of geothermal energy for coffee drying, utilising geothermal heat vapour on Java Island, has enhanced local productivity, ensuring continuous coffee processing regardless of weather conditions (Azrian et al. 2023; Malik Ibrahim et al. 2022).

However, resistance also happens in Indonesia. Several factors contribute to these reactions, including opposition to exploring geothermal resources in West Sumatera due to environmental and social concerns. They perceived that exploration might reduce soil fertilisation, thereby threatening agricultural productivity, a critical component of local livelihoods (Sastra Hadi & Vidya Putra 2019). In other regions, resistance is primarily caused by the location of energy resources. For example, in Bedugul, Bali, locals argued that exploring geothermal energy might disturb their sacred connection to nature, given the presence of 36 Hindu temples surrounding the geothermal manifestations (Berita Bali 2013). Not only did local people resist this project, but local and regional governments were on the same side, opposing this project from 2005 onwards (Iman et al. 2023; Nurdifa 2025).

Similar opposition to the development of geothermal energy, due to cultural–religious factors, also appeared in South Sumatera Province. The geothermal implementation in this province is slow, despite hosting a 10% potential of Indonesian total resources due to its location on the active volcanic arc along the Great Sumateran Fault that runs

parallel to the southwestern coast of Sumatera (Artyanto et al. 2018; Darma 2016). Literature indicates that the region in South Sumatera with the most potential geothermal resources is exclusive to its traditional culture, *Tunggu Tubang* (Anzari & Sarwono 2019). This culture ensures that ancestral land remains within the family, preventing external ownership (Murdiati et al. 2018). *Tunggu Tubang* is a culture centred on land. Not only is land a symbol of the wealth of a family that spans generations, but in the *Tunggu Tubang* culture, land represents the care and responsibility to guide all families down the right path (Harsuno et al. 2018). Within this tradition, inherited land typically includes agricultural fields, residential properties, and, in some cases, fish ponds (Ismi 2025). The acquisition of this symbol for the needs of geothermal projects or for any other reason might be complicated for the local people to achieve.

This region is also renowned for its strong adherence to Islamic values in daily life. For example, after Maghrib prayer, children go to *Guru Ngaji*'s<sup>1</sup> house to recite the Quran. Another example is that drinking alcohol, which is common in some other cultural backgrounds, is forbidden in the region because it is against Islamic values. These cultural–religious values became a source of resistance to the geothermal project, as local residents recalled experiences from other developments where external workers were reported to consume alcohol. Fears arose that such habits could negatively influence their own family members if they were employed alongside outsiders. Concerns of this nature surfaced from the very beginning of the project, particularly during the construction of infrastructure and drilling activities. Nevertheless, systematic research among residents to substantiate these claims remains lacking.

In general, despite its importance, analysis of Indonesian media revealed that social issues such as cultural–religious factors are less represented (Trisiah et al. 2021). Key stakeholders, such as the state government and companies, emphasised energy security and economic issues, but often overlooked cultural–religious issues in their debate (Ministry of Energy and Mineral Resources 2021; Rayhanna 2017; Saptadji 2016). This oversight contributes to a limited understanding of the broader societal implications of geothermal energy, particularly as experienced by local communities. To bridge this gap, empirical research is essential for capturing local perspectives and providing a more nuanced, comprehensive analysis.

This knowledge gap leads to the following central research question:

*“What roles do cultural and religious values play in shaping local debates around geothermal energy in South Sumatera?”* To effectively explore this question, conducting fieldwork and engaging directly with local Indonesian communities through interviews is essential.

## **Methodology**

### **Interview**

To answer the research question, the first author collected information about local knowledge and how they perceived geothermal energy. Knowledge plays a critical role in shaping stakeholders' perceptions (Cousse et al. 2021; Willems et al. 2020), whether

---

<sup>1</sup> The teacher for reciting the Quran

derived from their experience or media exposure (Stauffacher et al. 2015). The semi-structured interview topics acknowledge the locals' dual role as both residents and key stakeholders in the geothermal energy project, thereby enabling meaningful comparisons across diverse Indonesian geothermal contexts. Moreover, exploring cultural and religious values was essential, as these dimensions critically inform local perceptions and framings of geothermal energy (Shortall & Kharrazi 2017).

The interview instrument encompassed three main constructs, and all respondents were asked the same set of questions. The constructs are as follows:

- a. *Knowledge*: To assess local people's understanding of geothermal energy, they were asked questions such as, "What do you know about the exploration that occurred in the village?" Follow-up questions were developed based on the information given by the respondents.
- b. *Benefits and risks*: To assess respondents' perceptions of geothermal energy, they were asked about the benefits and risks of geothermal development. The questions that followed were about the arguments for these perceptions.
- c. *Cultural–religious issues* were explored by questions such as: "To what extent do you think local cultural–religious issues affect geothermal exploration?"

### Research process

We conducted field research in the Sumatera Selatan province in Indonesia, in five villages across two districts. From the capital city of South Sumatera, it is 190 km away (a five-hour drive) to the first capital regency of the affected areas. From there, another four hours of driving on asphalt and rocky roads through the trees are needed to reach the first destination, the nearest village to a geothermal energy project site. To reach the other four villages, two were higher up the mountain; each trip takes one to two hours.

Among other locations, this site has significant potential for geothermal energy, as it hosts 10% of Indonesia's total supply (Pengkajian et al. 2006). Besides its potential, we chose this place because the implementation of a geothermal project faced considerable challenges. Locals opposed the project for several reasons. First, the plant is located in preserved forests, as most of Indonesia's geothermal supply is, which may disturb the flora and fauna ecosystems (Agustina 2019). Second, the exploration may also impact the groundwater (Haryanto & Supriatma, 2020), which is crucial to the locals' lives in their paddy farming fields. Third, the projects need land, which contradicts the locals' lives related to the *Tunggu Tubang* culture,<sup>2</sup> as explained above.

The first author personally travelled to the region to conduct interviews with local residents. Given the remote location of the villages and the limited internet connectivity, telephone or online surveys were not feasible. Interviews were carried out in participants' homes and fields to ensure accessibility and comfort. Conducting interviews in these natural settings was intended to provide a deeper understanding of the local context (Garcia & Sunderlin 2011).

---

<sup>2</sup> Preliminary interviews with local people

To facilitate communication and ensure that the data collection ran smoothly, the first author first contacted a local person to guide and interpret, helping her better understand the local language, as it differs from her native language. The guide also helped her find a local house where she could stay during data collection, as the location is remote and no hotels are available nearby.

## Methods

The field research was conducted between July and August 2021, during the COVID-19 pandemic, when restrictions were still in effect worldwide. The first author needed to be quarantined for eight days after arriving in Indonesia. During data collection, regular COVID-19 protocols were followed, including wearing masks, maintaining social distancing, and washing hands frequently. The data collection for the five villages took five days, including a two-day journey.

Respondents consisted of fifteen local participants drawn from all five affected villages (see Appendix A), selected through stakeholder mapping and snowball sampling (Etikan 2016). The first author began by conducting interviews with the five village heads, each lasting between one and two hours. During these sessions, she outlined the objectives of the data collection and emphasized that respondent anonymity would be strictly maintained.<sup>3</sup> The village heads serve as the formal leaders of their respective communities. In the Indonesian context, a village head (*kepala desa*) is an elected official responsible for local governance and representing the collective interests of the community in matters such as land use and development projects. They are chosen through community voting and hold the position for a five-year term, which may be extended if re-elected. Their position as gatekeepers made them crucial entry points for identifying additional respondents.

From the head villages' references, ten respondents were gathered who met the following criteria: local people aged 18 years or older, and affected directly or indirectly by the project, e.g., their land was used for the project's infrastructure. Among the interviewees, three held postgraduate degrees, four had bachelor's degrees, and eight respondents were senior high school graduates. While local people's views may not reflect those of the entire community, they often appear as legitimate spokespersons with influence within their community. Therefore, their views on the project are important in terms of general acceptability.

Interviews were conducted with the assistance of a DMP to ensure clarity and cultural sensitivity. In most cases, respondents were interviewed individually; however, in two instances, respondents were accompanied by their spouse. For consistency, only the statements provided directly by the respondents were included in the analysis.

This study employed a qualitative data analysis approach as outlined by Faherty (see Joseph 2025). The process involved five sequential steps. First, the interview recordings were transcribed and subsequently translated from the local language into English. Second, all transcripts were carefully reviewed, and responses were coded according to the main constructs of the interview, namely, knowledge, perceived benefits and risks, and

---

<sup>3</sup> The research procedure follows the TU Delft HREC (Human Research Ethics Committee)

cultural–religious considerations. Third, the codes were grouped based on their similarities and differences (see Appendix B). Fourth, the findings were organized and discussed. Finally, selected results are disseminated through this paper as part of the fifth step.

## Results

We first elaborate on local knowledge about the regional development of geothermal energy projects. The following sections will further explain the pivotal issues of geothermal energy development from local people’s perspectives relating to risks and cultural–religious issues.

### Knowledge of geothermal energy and other related information

All fifteen respondents were aware that the geothermal energy project was being developed in their region. However, only one demonstrated a proper understanding of geothermal energy, describing it as water vapor heated in the Earth’s subsurface and drilled to reach the Earth’s surface.<sup>4</sup> Some interviewees mentioned that geothermal energy is electricity, meaning that whatever comes out of drilling beneath the earth’s surface is electricity and can be directly used by households.<sup>5</sup> Some likened the project to coal mining operations in a neighbouring area.

This perceived similarity with coal mining is not without reason, as local people have been exposed to negative experiences associated with coal mining. A mining area, located 131 km from the geothermal project, remained barren despite reforestation initiated by the coal company. The majority of workers were outsiders, with only a few locals, and a smaller number of them were permanent workers. Although employment benefits the region, interviewees expressed concern that the influx of culturally diverse outsiders posed a social risk to the community.<sup>6</sup>

Media exposure also served as an important source of information about the project’s development. Respondents noted that online news outlets reported negative experiences of geothermal exploration in other Indonesian provinces, such as depletion of groundwater resources, raising concerns among locals about similar environmental impacts in their region.<sup>7</sup> Furthermore, media coverage shaped negative perceptions among community members who viewed geothermal development as a threat to cultural heritage regarding the potential disruption of *Tanah Ulayat* (customary ancestral land).<sup>8</sup>

Despite prior socialisation from the project owner, high resistance and tension surrounding the geothermal project emerged during the planning phase. Local people protested the project plan by blocking the access roads. One of the respondents stated, “*They invited the local representatives, especially those whose land was directly affected. They also negotiated with the elders and the religious leaders to smooth the implementation.*”<sup>9</sup>

---

<sup>4</sup> Interview with respondent In8.

<sup>5</sup> Interview with respondents H1, H2, H3, In2, and In3.

<sup>6</sup> Interview with respondent In7.

<sup>7</sup> Interview with respondents H3, H4, and In3.

<sup>8</sup> Interview with respondents In2 and In4.

<sup>9</sup> Interview with respondent In6. The original statement: “*Perusahaan waktu itu ngundang beberapa perwakilan masyarakat sini, terutama yang rumahnya tekeno proyek. Wong perusahaan jago ngundang tetuo-tetuo disini, samo pemuka agama, agar proyek mereka nih pacak bejalan.*”

Several meetings were held, but stakeholders were unable to reach an agreement on exploring geothermal energy.<sup>10</sup> Local people argued that opening energy exploration in their area would disturb the environment, much as coal mining does. Furthermore, the project would harm the environment, increase pollution, damage their coffee plantation, and contribute to deforestation.<sup>11</sup> The regent affirmed these arguments and officially rejected the implementation plan. This decision triggered a wave of protests from local people against the project, halting its implementation.<sup>12</sup>

Prolonged negotiation and the dynamic political situation in the regions caused the project, initially planned in 2005, to be delayed until 2012 (Mudassir 2022; Pemerintah Provinsi Sumatera Selatan et al. 2006; PT Marubeni Indonesia 2013). The decision to resume the geothermal project was made between the newly appointed regent, the province, the State government, the company, and the local people's representatives.<sup>13</sup> Despite the agreement, up until the time of our interviews, local people remained unaware of geothermal energy's potential as a renewable, sustainable, and environmentally friendly energy resource.

### **The roles of cultural–religious issues of geothermal energy in local debate**

Cultural–religious issues were quite dominant in the debate, especially at the beginning of the project's development. Central to these concerns was the traditional *Tunggu Tubang* practice, which prohibits the transfer or trade of land and its associated properties, such as farming fields and fish ponds, thereby reinforcing the region's exclusivity. In addition, the religious values of Islam, shared by all local residents, were perceived as in conflict with the values and practices of incoming outsiders, further intensifying apprehensions about the project's social and cultural implications.<sup>14</sup>

In general, locals were concerned about three important topics: economic, environmental, and quality of life issues.

#### **1. Economic issues**

Issues related to employment were the most dominant economic concerns in the debate. This topic relates to *Tunggu Tubang*'s traditional culture because one of its legacies is the cultivation of inherited farming fields by the inheritors. If locals were more interested in working at the company, the farming field would be wasted. Regardless of the situation, working in the company was attractive for local people. Compared to being farmers, they earn more from the company, thereby raising their economic level. One respondent claimed, "*It was good when I worked in the company. I could buy a motorcycle and even buy a new house.*"<sup>15</sup>

However, the different levels of economic status between those who worked in the company and those who did not revealed social jealousy among the locals. One

---

<sup>10</sup> Interview with respondents H4, In1, In4, and In7.

<sup>11</sup> Interview with respondents H3, In2, In3, and In8.

<sup>12</sup> Interview with respondents H1, H2, In6, In7, and In8.

<sup>13</sup> Interview with respondents H5, In6, and In8.

<sup>14</sup> Interviews with respondents In6 and In7

<sup>15</sup> Interview with respondent In7. The original statement: "*Dulu aku lumayan Bu, walaupun cuma begawe sebentar, pacaklah mbeli motor samo mbenerin rumah.*"

respondent stated, “It is nice to see those working in the company. They can buy furniture and motorcycles, and live in luxury houses. Therefore, people in the villages are keen to work for the company.”<sup>16</sup>

Locals mostly worked as temporary workers during the construction of the infrastructure. Their contracts typically lasted for one year, and workers from other villages often substituted for them. A respondent noted that the company employs a rotational hiring system, alternating recruitment among five villages to mitigate potential inter-community tensions: “During this term, employers are hired from villages A and B. Next term, the turn is for other villages, C, D, and E.”<sup>17</sup> Although the company had coordinated with the village heads and religious leaders to ensure employment was fairly distributed, tension among local people continued to increase due to a structural imbalance between labour demand and community expectations.<sup>18</sup>

Given the legacy of the Tunggu Tubang tradition in which the farming field needs to be exploited to support the family, the situation where locals prefer to work in the company instead of working in the farming field raised concerns among the elders. Such a shift was seen as potentially disruptive to the cultural equilibrium, as the Tunggu Tubang fields are vital for sustaining the livelihoods and identity of Tunggu Tubang families.<sup>19</sup>

Another economic issue is the compensation provided by the project owners. The company incurred substantial financial costs to mitigate risks at the affected houses, including noise pollution, structural damage to homes caused by construction activities, and land acquisition for infrastructure development.<sup>20</sup> “Thank God we received good compensation and can renovate our house.”<sup>21</sup> However, the compensation, particularly for noise pollution, was distributed only during the early stages of the project.<sup>22</sup> When the interviews were conducted, the locals were no longer receiving benefits, despite the pollution remaining.

## 2. Environmental issues

Tunggu Tubang culture is represented through a set of symbolic artefacts, including a fishing net, spear, axe, jar, and *tubang* (rice storage) (see Fig. 1). These symbols carry deep philosophical meaning. The fishing net signifies the role of unifying and safeguarding the family, preserving ancestral wealth, serving as a central gathering point, and demonstrating decisiveness in family leadership. The spear (*tombak*) symbolises visionary guidance, underscoring the need for the *Tunggu Tubang* to direct the family toward a clear and sustainable future. The axe (*kapak*) embodies justice and the capacity to resolve intra-family conflicts equitably. The jar (*guci*) represents the ability to mediate differences, accommodate diverse familial aspirations, and protect both honourable and

<sup>16</sup> Interview with respondent In5. The original statement: “oi lemak kaba yang begawe di perusahaan itu, rato-rato lah mbagusi rumah, beli isi rumah, motor, mewalah pokoknyo, makonyo wong maseh berijo nak begawe disano.”

<sup>17</sup> Interview with H3. The original statement: “Nah misalnyo di periode ini, yang nak begawe tuh diambek dari dusun A samo B. kagek periode selanjutnyo gentian Dusun C, D samo E.”

<sup>18</sup> Interview with respondents H3 and H4.

<sup>19</sup> Interview with respondents H5, In7, and In8.

<sup>20</sup> Interviews with respondents H4 and In3.

<sup>21</sup> Interview with respondent In3. The original statement: “Alhamdulillah Ganti ruginyo kemarin lumayan besar, jadi kami pacak mbeneri rumah.”

<sup>22</sup> Interviews with respondents H4 and In3.



**Fig. 1** Tunggu Tubang symbol (<https://kebudayaan.kemdikbud.go.id/ditkma/pancapedia-keseruan-pernikahan-tunggu-tubang/>)

difficult family narratives. The rice storage (*tubang*) reflects the family's preparedness to face any circumstances that may affect their well-being (Harsuno et al. 2018). The symbols also serve practical functions closely tied to environmental stewardship. The fishnet facilitates fishing in community ponds, the spear aids in forest hunting, the axes are essential for cutting firewood for cooking, and the *tubang* ensures the proper storage of harvested rice from paddy fields. Together, these symbols reflect the harmonious relationship between tradition and the environment.

The symbolic representations in Tunggu Tubang culture reflect the profound interdependence of local communities with their surrounding environment, including farms, forests, and ponds. Meanwhile, the environmental concerns regarding geothermal energy, as discussed by local people, primarily focus on the adverse effects of geothermal project development on the local environment and the natural imbalance that disrupts wildlife.<sup>23</sup>

The regencies where this research was conducted are well-known for their potential energy resources. There has been a long history of coal exploration, dating back to the Dutch colonization era in the seventeenth century, and continuing to the present day (Sumardi et al. 2022). The project area is barren, and pollution persists despite the company's reforestation efforts. Although this coal location is 131 km away from the geothermal project site, local people who lived close to the area where the heat power was manifested were exposed to the negative experiences of the coal company.

Environmental issues were raised in 2008, at the project's early stage. They argued that opening energy exploration in their surroundings would disturb the environment. Like coal mining, the project would harm the environment, increase pollution, deplete the

<sup>23</sup> Interview with respondents H2, H3, In3, and In5

land's water resources, disrupt their coffee plantation, and lead to deforestation.<sup>24</sup> *"If the trees were cut and the land was getting unfertilized, how can we live when our life depends on nature?"*<sup>25</sup> In response, the local community protested the project plan by blocking the access roads.

The company and state government representatives worked hard to negotiate with the local people.<sup>26</sup> *"The meeting occurred many times, but no agreement was reached then."*<sup>27</sup> Furthermore, the regent supported this argument by stating that the regions declined the geothermal energy implementation plan. The regent's decision sparked a high wave of protests from local people against the project, thereby halting its implementation.<sup>28</sup> The agreement was finally reached in 2012, following further negotiations and the dynamic political situation (Mudassar 2022; PT Marubeni Indonesia 2013).

Environmental concerns resurfaced during the construction of the project infrastructure. The development of roads, pipelines, towers, and related facilities was perceived to increase pollution levels, particularly noise and dust. Beyond air pollution, the dust had direct consequences for local agriculture: coffee farming became less productive as dust settled on the flowers, rendering them infertile.<sup>29</sup> These impacts not only disrupted livelihoods but also reinforced negative community perceptions of energy technology implementation.

Another environmental issue emerged with the unexpected presence of tigers appearing dangerously close to residential areas during the well-drilling phase, an occurrence that had never been reported previously.<sup>30</sup> Media coverage noted five accidents linked to these encounters, resulting in three fatalities and two injuries (Agustina 2019). The governor attributed this phenomenon to the clearing of approximately 2,000 acres of forest for geothermal exploration (CNN Indonesia 2019). Although some reports claimed that biodiversity had increased and that exploration activities did not disturb the wildlife ecosystem (Aji et al. 2022), evidence suggested that seismic activity from drilling contributed to tiger displacement. This situation posed risks not only to local communities but also to the tigers' safety and well-being.

### 3. Quality of life issues

The development of geothermal projects impacts the quality of life for local people. The effects primarily benefit local people by improving access to electricity and infrastructure. For details, two of the affected villages are located in a remote area of the region's highlands. The National Electricity Enterprise (PLN)'s access to electrify the villages is lacking. The power the villages used came from generators or hydropower, but it was insufficient to meet local needs. The current power supply can only be used for lights

<sup>24</sup> Interview with respondents H3, In2, In3, and In8

<sup>25</sup> Interview with respondent In3. The original statement: *"Kalu segalo pohon nih ditebang trus tanah nih kan laju jadi dak subur lagi, cakmano kami nak idup Bu, sementaro idup kami tergantung dari sinilah."*

<sup>26</sup> Interview with respondents H4, In1, In4, and In7

<sup>27</sup> Interview with respondent H4. The original statement: *"Lah berapa kali pokoknyo pertemuan nih Pak, maseh dak sepakat tulah?"*

<sup>28</sup> Interview with respondents H1, H2, In6, In7, and In8

<sup>29</sup> Interview with respondents H3 and In3

<sup>30</sup> Interview with respondent In4

and phone chargers, not for refrigerators, fans, air conditioners, or other electricity-consuming devices, in households with a significant power supply.<sup>31</sup> Therefore, local people highly expected that geothermal energy would benefit them by providing full access to electricity.<sup>32</sup> However, at the time of the interviews, the electricity access was still limited.

Regarding infrastructure, transportation access was mentioned positively in the local debate. People talked about the easier access between villages, thanks to the roads and bridges built by the company. Although dust and noise were the consequences, local people agreed that the project infrastructure eased their lives.<sup>33</sup> *“It took some time to reach Village B because we had to go around the forest. However, it is now accessible due to the new road being open.”*<sup>34</sup>

However, there is a price to be paid for this ease. Locals needed to consider trading their ancestral land for the construction of the electricity tower and for access to roads. Despite it being for a wider public purpose, locals learned from their ancestors that the land was not only about inheritance but also a symbol of family unity that goes over the generations (Harsuno et al. 2018; Velinda et al. 2017). Trading the land for any purpose was considered a violation of cultural values.<sup>35</sup>

This situation led to a dilemma for the indigenous people. On one hand, they need to preserve the tradition; on the other hand, this project is designed to meet the broader public’s needs. Therefore, locals allowed the company representatives to negotiate regarding the land acquisition. The representatives must meet and talk to all heirs, following the mother’s line, until the agreement is reached.<sup>36</sup> *“In some cases, the project owners need to move the tower locations because they could not reach a good agreement with the heirs. However, at least one case resulted in a mutually accepted agreement between the heirs and the project developer.”*<sup>37</sup>

The issue of compensation raised was not limited to the monetary restitution given to the locals; it also encompassed cultural considerations associated with land ownership. In cases where the land is part of the Tunggu Tubang inheritance system, it is forbidden to be traded unless no living heirs remain in the region.<sup>38</sup> In this geothermal project case, the negotiation proved particularly challenging, as the project owners were required to obtain approval from all ancestral custodians.<sup>39</sup> One respondent said, *“The company owner needs to find a new place for the tower construction site because they don’t have access from the Tunggu Tubang ancestors.”*<sup>40</sup>

---

<sup>31</sup> Interviews with respondents In2, In6, and In7

<sup>32</sup> Interview with respondents H1, H2, and I5

<sup>33</sup> Interview with respondents H5, In2 and In3

<sup>34</sup> Interview with respondent H5. The original statement: *“Dulu kalo nak ke dusun B itu jalannya muter, sekarang lah terbuka oleh proyek ini.”*

<sup>35</sup> Interview with respondents H3, H4, In8, and U1

<sup>36</sup> Interview with respondents In2, In3, U1, and U2

<sup>37</sup> Interview with respondent H2. The original statement: *“Ado beberapa kejadian, pihak Perusahaan laju mindahkan Lokasi tower karena dak sepakat dengan keluarga pewaris ini kan. Tapi ado jugo sikok tower yang pacak dibangun dilokasi itu karena lah ado kesepakatan akhirnya.”*

<sup>38</sup> Interview with respondents In1, In6, In7, In8, and U2

<sup>39</sup> Interview with respondents H1, H3, In4, and In5

<sup>40</sup> Interview with the respondent In4. The original statement: *“Dulu pernah Perusahaan laju mindahke rencana posisi tower karena tanahnya dak dilepas oleh keluarga Tunggu Tubang.”*

The locals stated that if only other places were still possible without using the Tunggu Tubang heritage land, they would support the project even more.<sup>41</sup> *“I can understand why people in my villages resist using their Tunggu Tubang land property for the project. It is not only a property but also an inheritance that goes through generations.”*<sup>42</sup> *“If no other choice is available, I would say, for the sake of wider public needs, sacrificing the land is allowable.”*<sup>43</sup>

Another quality-of-life issue is the cultural effects of outsiders. Locals learned from coal mining in the neighbouring region that some skilled workers were foreigners; others were from different provinces in Indonesia and had diverse cultural backgrounds. Some had habits like drinking alcohol, which were against the locals’ values. Few mingled with the locals, which widened the gap. This situation frightened the local people in the area where the geothermal project was developed. They worried that these external habits might negatively affect their traditional cultures.<sup>44</sup>

## Discussion

Geothermal energy can be found everywhere, not only in these five villages described in this chapter. Its implementation is not solely about renewable energy exploration but also about ensuring harmonious coexistence with local communities.

This research has underscored the importance of taking local perspectives on geothermal energy into account. From this finding, we further discuss the roles of cultural–religious values in the local debate on geothermal energy in Indonesia by elaborating on the cultural–religious embeddedness of other issues and their relation to regional decision-making.

We found that the dominant issues in the local debate on geothermal energy, embedded in cultural–religious concerns, were the economy, the environment, and quality of life. Employment and compensation were the economic topics mentioned most during the interviews with local people. Employment benefits local people by providing new work schemes and payment. However, it creates a socio-economic gap between those who were recruited and those who were not, which, if not properly managed, could lead to polarisation in the future.

The shift from being farmers to company workers also raised concerns among the local elders. This alteration affected, more or less, the balance of local cultural traditions because the Tunggu Tubang field needed to be exploited to earn a living for the Tunggu Tubang families, as represented in the Tunggu Tubang symbol (Harsuno et al. 2018). Local traditions might be affected if being a farmer were no longer the only option. Compare this to what happened in New Zealand, where the development of geothermal energy projects also employed local people and boosted the local culture simultaneously (Daysh et al. 2020; Neilson et al. 2010). Local people promote their living culture with

<sup>41</sup> Interview with respondents U1 and U2

<sup>42</sup> Interview with respondent U1. The original statement: *“Ngerti sih ngapo masyarakat di sano kuat nian nolak nggunoke tanah Tunggu Tubang mereka untuk proyek. Karena ini bukan cuma urusan tanah tapi peninggalan dari generasi ke generasi.”*

<sup>43</sup> Interview with respondent U2. The original statement: *“kalo memeang katek pilihan laen, dan ini untuk kepentingan masyarakat luas, tanah ini boleh bae digunoken.”*

<sup>44</sup> Interview with respondents In6 and In7

heat power as a tourist attraction, which the company and the government fully support. In Japan, local employment was proposed intensively by the project proponents for various local benefits, while putting their concerns on the economic effect on the hot springs business (Kubota 2015).

Compensation for land acquisition, as well as noise and dust pollution, was another economic topic frequently mentioned during the interview. These were also common topics in local debates, particularly in developing countries (see Ochieng 2019; Ramírez et al. 2017). The adverse effects of geothermal energy exploration are the most mentioned environmental issues in this research. The drainage of land water, the noise, and air pollution were among the topics. These findings stand in contrast to prevailing narratives in Indonesian media and stakeholder analyses, which predominantly portray geothermal development in a positive light (Trisiah et al. 2021). While geothermal energy is widely recognised as a renewable energy resource by state governments, companies, and stakeholders at the national level (Baek et al. 2021), local communities experience the adverse effects of geothermal energy exploration in their neighbourhoods. The construction of infrastructure causes pollution, either water, air, or noise, and people fear incidents such as pipe leakage, which releases poisonous gas and even causes death. (Wicaksono 2024).

Geothermal energy development in this region inevitably benefits local people by increasing their quality of life in terms of facilities development, such as roads and bridges, as well as access to electricity, which, at the time of the interview, was still in process. The direct use of geothermal energy at the local level in Indonesia is, however, not comparable to that of other countries such as Turkey. Direct-use applications, such as district heating, greenhouse agriculture, and thermal tourism in Turkey, are not only technologically feasible but have become economically empowering for local communities (Kilic 2016). This community-centred deployment may offer lessons for enhancing social acceptability of geothermal projects in Indonesia.

In conclusion, we found that local understanding of geothermal energy as a valuable renewable energy source is not yet represented in local perspectives. This makes the local decision to agree on renewable energy for a sustainable future less likely and delays the implementation of renewable energy, i.e., geothermal energy, in Indonesia (Anggur 2025; Waluyo 2025).

Cultural–religious issues and their embeddedness in the economy and environment are reasons for local resistance at the beginning of the project, as geothermal energy may pose potential adverse effects on livelihoods, particularly for farming-dependent communities. However, this current research limits its method to field interviews with local people over a limited time. Further research must account for the relationships between the communities and their natural surroundings, especially in the context of energy exploration (Mardiastuti 2019; Vargas-Payera et al. 2020). Approaches such as action research or ethnographic inquiry can provide more nuanced and context-rich data, enabling more profound insights and more targeted findings (Cannon et al. 2023; Gobbo 2022; Jorgenson & Stephens 2022).

These results also have little scope for generalisation. This is because the survey was conducted in Indonesia, which has a distinctive culture and potential for energy resources that prevent the validated results from being applied to other nations. Future

studies can employ the findings of this research and learn the values of locals' respect for nature to maintain local engagement, as in Alaska, where Pilgrim Hot Springs, located in northwestern Alaska on the Seward Peninsula, was reinvigorated using ecological, historical, and cultural sensitivity to drive the design and maintain a good relationship with the locals (Hallbert & Marie 2013).

Lastly, while geothermal energy exploration offers undeniable economic benefits and enhances local living standards, it also poses significant environmental risks that may threaten cultural and religious traditions. In addition, the uncertain natural characteristics of geothermal energy and the location of geothermal resources in Indonesia in the preserved forests in which wildlife lives, thorough analysis and examination from all perspectives, e.g., technical, economic, social, and cultural–religious aspects, whether or not the benefits outweigh the risks or vice versa, must be referred to decide the geothermal project implementation.

## Conclusion

Advocates of geothermal energy projects, such as project owners and the government, should approach local communities not merely as stakeholders but as co-inhabitants of place, whose wisdom, traditions, and lived experiences must shape the contours of any proposed intervention. Cultural and religious values are not merely peripheral concerns; they are deeply embedded in how local people perceive change, assess risks, and define what constitutes a meaningful future, including the adoption of new energy resources.

This context creates space for negotiation. Engaging in open-ended dialogues, building long-term relationships, and conducting participatory research that values community members as knowledge holders are essential strategies. Respect for sacred spaces, belief systems, and ecological symbols must be integrated from the earliest stages of the project planning. Ultimately, asking not only “Can we build here?” but “How do we belong here?” invites a deeper ethic of care, one that grounds innovation in respect, reciprocity, and place-based understanding.

## Appendix

### Appendix A: The respondents

Respondents	Backgrounds	N	Label
Local Officials	Head of the Affected Villages	5	H1
			H2
			H3
			H4
			H5
Indigenous respondents	Affected directly by the project	8	In1
			In2
			In3
			In4
			In5
			In6
			In7
			In 8

Respondents	Backgrounds	N	Label
Urban indigenous respondents	Local people who live in the urban area	2	U1 U2

### Appendix B: Mapping of interview results

Constructs	Statements	Themes
Knowledge	Geothermal energy is electricity	Knowledge
	Geothermal energy is assumed to be similar to coal mining	Knowledge
	Geothermal energy is heat/steam from the earth's subsurface	Knowledge
	A geothermal project was being developed in their region	Knowledge
Benefits	Employment opportunities raised economic status (house renovations, motorcycles, furniture)	Economy
	A rotational hiring system among villages to reduce tensions	Economy
	There was compensation for noise pollution, structural damage, and land acquisition	Economy
	Geothermal energy was expected to provide electricity for the community	Quality of life
Risks	People talked about the easier access from one village to another, thanks to the roads and bridges built by the company	Quality of life
	Social jealousy between employed and unemployed villagers	Economy
	The exploration would disturb the environment, similar to coal mining	Environment
	a structural imbalance between labour demand and community expectations	Economy
	Compensation was only distributed during the early stages and was later discontinued	Economy
	Locals argued that exploration would have the same environmental impact as coal mining	Environment
	The project would increase pollution, deplete groundwater, harm coffee plantations, and cause deforestation	Environment
	Dust and noise from construction reduced coffee productivity (flowers infertile)	Environment
Cause adverse effects on the local environment and the natural imbalance that disrupts wildlife	Environment	
Cultural-religious issues	Negotiations with elders and religious leaders to facilitate a smooth implementation	Environment
	Farming identity threatened when locals prefer company jobs (Tunggu Tubang concern)	Economy
	Tunggu Tubang's inheritance tradition complicated land acquisition; ancestral land is not easily traded	Quality of Life
	Religious values of Islam are assumed to conflict with outsiders' values	Quality of Life
	The presence of external skilled workers was assumed to introduce lifestyles and practices that conflicted with local traditions and religious values	Quality of Life
	Trading the land for any purpose was considered a violation of cultural values	Quality of life
The issue of compensation raised was not only due to the monetary restitution given to the locals, but it also encompassed the cultural considerations associated with land ownership	Quality of life	

#### Acknowledgements

The authors would like to thank Prof. Dr. J.A. (Hans) de Bruijn for his conceptual contribution to this research.

#### Author contributions

A.T. contributed to data collection, data analysis, and manuscript writing. G.d.V. contributed to data interpretation, supervision, writing review, and editing. All authors read and approved the final manuscript.

**Funding**

This research was sponsored by the 5000-Doctor Overseas Program, the Ministry of Religious Affairs, Republic of Indonesia.

**Data availability**

The data used and/or analysed during the current study are available in the TU Delft Data Management Plan (DMP) and from the corresponding author on reasonable request.

**Declarations****Ethics approval and consent to participate**

Applicable.

**Competing interests**

The authors declare no competing interests.

Received: 19 August 2025 Accepted: 6 March 2026

Published online: 24 March 2026

**References**

- Agustina, D. Getaran panas bumi salah satu penyebab munculnya harimau dari hutan lindung hingga menyerang warga. *Tribunnews.Com*. 2019. <https://www.tribunnews.com/regional/2019/12/14/getaran-panas-bumi-salah-satu-penyebab-munculnya-harimau-dari-hutan-lindung-hingga-menyerang-warga>.
- Aji BS, Kusri MD, Rahman DA. Large mammals occupancy in geothermal power plant activities. *J Pengelolaan Sumberdaya Alam Dan Lingkungan (j Natl Resourc Environ Manag)*. 2022;12(2):317–29. <https://doi.org/10.29244/jpsl.12.2.317-329>.
- Anggur G. Menteri ESDM tegaskan proyek PLTP di NTT tidak dilanjutkan jika masih ada penolakan dari masyarakat. *Msn*. 2025.
- Antara. Pembangunan geothermal tetap ditolak gubernur bali. *Investor.Id*. 2013. <https://investor.id/energy/62977/pembangunan-geothermal-tetap-ditolak-gubernur-bali>.
- Anzari P, Sarwono B. Respected but subordinated (a study of silenced Tunggu Tubang in south Sumatera). *Kota Depok: Universitas Indonesia*; 2019.
- Artyanto A, Sapiie B, Abdullah CI, Sidik RP. Identification of natural fractures and in situ stress at Rantau Dedap geothermal field. *IOP Confer Ser Earth Environ Sci*. 2018. <https://doi.org/10.1088/1755-1315/103/1/012022>.
- Azrian I, Utami A, Prasetya JD. Karakteristik dan Potensi Mata Air Panas Untuk Pengeringan Biji Kopi Di Candi Gedong Songo, Desa Candi, Kecamatan Bandungan, Kabupaten Semarang, Provinsi Jawa Tengah. *Prosiding Seminar Nasional Teknik Lingkungan Kebumihan SATU BUMI*. 2023;4(1):364–70. <https://doi.org/10.31315/psb.v4i1.8907>.
- Baek H, Chung J-B, Yun GW. Differences in public perceptions of geothermal energy based on EGS technology in Korea after the Pohang earthquake: national vs. local. *Technol Forecast Soc Change*. 2021. <https://doi.org/10.1016/j.techfore.2021.121027>.
- Berita Bali. Ini Dia Kronologi Penolakan Geothermal Bedugul. *Beritabali.Com*. 2013. <https://www.beritabali.com/index.php/berita/201107023004/ini-dia-kronologi-penolakan-geothermal-bedugul>.
- Bargh M. Rethinking and re-shaping indigenous economies: Māori geothermal energy enterprises. *J Enterp Communities People Places Glob Econ*. 2012;6(3):271–83. <https://doi.org/10.1108/17506201211258423>.
- Cannon C, Bonnell J, Padilla M, Sulca D. Along the energy justice continuum: An examination of energy disposal through the lens of feminist community based participatory action research. *Energy Res Soc Sci*. 2023;96:102948. <https://doi.org/10.1016/j.erss.2023.102948>.
- Cousse J, Trutnevyte E, Hahnel UJJ. Tell me how you feel about geothermal energy: Affect as a revealing factor of the role of seismic risk on public acceptance. *Energy Policy*. 2021. <https://doi.org/10.1016/j.enpol.2021.112547>.
- Darma S. Indonesia: vast geothermal potential, modest but growing exploitation. In: DiPippo R, editor. *Geothermal power generation: developments and Innovation*. Amsterdam: Elsevier Ltd; 2016.
- Daysh S, Carey B, Doorman P, Luketina KM, Zarrouk SJ, White B. 2020 New Zealand country update. *World Geothermal Congress*, April. 2020. 2020: 19–25.
- Dutu R. Challenges and policies in Indonesia's energy sector. *Energy Policy*. 2016;98:513–9. <https://doi.org/10.1016/j.enpol.2016.09.009>.
- Erfurt-Cooper P. The importance of natural geothermal resources in tourism. *Proceedings World Geothermal Congress*, April, 25–29. 2010. <https://www.geothermal-energy.org/pdf/IGAstandard/WGC/2010/3318.pdf>.
- Etikan I. Comparison of snowball sampling and sequential sampling technique. *Biom Biostat Int J*. 2016;3(1):1–2. <https://doi.org/10.15406/bbij.2016.03.00055>.
- Garcia VR, Sunderlin WD. Methods for research and fieldwork. *Measur Livelih Environ Depend*. 2011. <https://doi.org/10.17528/cifor/003341>.
- Gobbo AD. Energy and the ethnography of everyday life: A methodology for a world that matters. *Ethnography*. 2022. <https://doi.org/10.1177/14661381211065598>.
- Hallbert DM. *Pilgrim Hot Springs: Bringing together geothermal energy, history and Iñupiaq culture to create a sustainable and economically viable eco-tourism destination to the Seward Peninsula, Alaska*. Tucson: The University of Arizona; 2013.
- Harsuno S, Maskun, Ekwandari YS. Makna simbol tunggu tubang pada masyarakat semendo di desa sukaraja kecamatan way tenong. *PESAGI J Pendidikan Dan Penelitian Sejarah*. 2018;6:2.

- Iman VCA, Priyanta M, Muslim D. Penyelesaian Sengketa Penolakan Proyek PLTP Bedugul Melalui Gugatan Perbuatan Melanggar Hukum Oleh Badan Dan/Atau Pejabat Pemerintahan (Onrechtmatige Overheidsdaad). *Krtha Bhayangkara*. 2023;17(3):637–56. <https://doi.org/10.31599/krtha.v17i3.2905>.
- CNN Indonesia. Habitat Harimau Rusak, Gubernur Minta Korporasi Ganti Lahan. *Cnnindonesia.Com*. 2019. <https://www.cnnindonesia.com/nasional/20191218081041-20-457934/habitat-harimau-rusak-gubernur-minta-korporasi-ganti-lahan>.
- Ismi N. Tunggu Tubang, perempuan hebat penjaga pangan masyarakat adat semende. *Mongabay*. 2025. <https://www.mongabay.co.id/2025/01/27/tunggu-tubang-perempuan-hebat-penjaga-pangan-masyarakat-adat-semende/>.
- Jónsson ÖD, Rastrick Ó. Enjoying the outdoor pool in a cold climate: appropriate technology, utilisation of geothermal resources and the socialisation of everyday practices in Iceland. *Geotherm Energy*. 2017. <https://doi.org/10.1186/s40517-017-0060-5>.
- Jorgenson S, Stephens JC. Action research for energy system transformation. *Educ Action Res*. 2022;30(4):655–70. <https://doi.org/10.1080/09650792.2022.2084434>.
- Joseph D. Lived experiences of elderly persons living alone in rural areas of Botswana. *Am J Qual Res*. 2025;9(2):20–41.
- Kilic FCFC. Geothermal energy in Turkey. *Energy Environ*. 2016;27(3–4):360–76. <https://doi.org/10.1177/0958305X15627544>.
- Kubota H. Social acceptance of geothermal power generation in Japan. *World Geothermal Congress 2015*, April, 19–25. 2015.
- Malik Ibrahim M, MAharani A, Pranata R. Characteristics of manifestations and recommendations for the use of geothermal potentials in lake ranau area, Ogan Komering Ulu (OKU) Selatan, Province of South Sumatra. *Seminar Nasional AVoER XIV*. 2022. <https://www.researchgate.net/publication/368463812>.
- Mardiastuti A. Gubernur Bali Minta Jonan Setop Proyek Listrik di Lahan Sakral. *Finance Detik*. 2019. <https://finance.detik.com/energi/d-4694888/gubernur-bali-minta-jonan-setop-proyek-listrik-di-lahan-sakral>.
- PT Marubeni Indonesia. Marubeni corporation to enter into power purchase agreement for Rantau Dedap Geothermal Project in Indonesia. 2013. <http://marubeni-indonesia.co.id/en/mods/news/view/path/marubeni-corporation-to-enter-into-power-purchase-agreement-for-rantau-dedap-geothermal-project-in-indonesia.html>
- Meirbekova R, Bonciani D, Olafsson DI, Korucan A, Derin-Güre P, Harcouët-Menou V, et al. Opportunities and challenges of geothermal energy: a comparative analysis of three European cases—Belgium, Iceland, and Italy. *Energies*. 2024. <https://doi.org/10.3390/en17164134>.
- Ministry of Energy and Mineral Resources. Road map to carbon neutrality is being prepared, Says Energy Minister. 2021. <https://www.esdm.go.id/en/media-center/news-archives/ini-prinsip-dan-peta-jalan-pemerintah-capai-net-zero-emission>
- Mudassir R. PLTP Rantau Dedap Senilai Rp 10 Triliun Mulai Beroperasi, Suplai Listrik ke Sumatera. *Ekonomibisnis.Com*. 2022. <https://ekonomi.bisnis.com/read/20220108/44/1486647/pltp-rantau-dedap-senilai-rp10-triliun-mulai-beroperasi-suplai-listrik-ke-sumatra#:~:text=PT Supreme Energy Rantau Dedap,dan pengeboran sumur pengembangan dimulai.&text=Saat ini%2C Supreme Energy telah,S>
- Murdiati E, Sriati S, Alfitri A, Muhammad M, Taqwa R. The local Wisdom of Tunggu Tubang culture in the challenges of the times (Study on Ethnical Semende District Muara Enim South Sumatera). *E3S web of conferences*. 2018. <https://doi.org/10.1051/e3sconf/20186802011>
- Musembi R. Corporate Social Responsibility (CSR) in geothermal development : the case of the geothermal development company (GDC), Kenya. *Third East African Rift Geothermal Conference*, November, 22–25. 2010.
- Neilson G, Bignall G, Bradshaw D. Whakarewarewa a living thermal village—Rotorua, New Zealand. *Proceedings of the world geotherma*, April, 25–29. 2010. <https://www.gns.cri.nz/index.php/gns/content/download/6899/37705/file/Whakarewarewa%E2%80%94Living%20thermalvillage,Rotorua.pdf>.
- Nurdifa A. R. ESDM Dorong Kelanjutan PLTP Bedugul di Bali Usai Insiden Black Out. *Ekonomibisnis.Com*. 2025. <https://ekonomi.bisnis.com/read/20250505/44/1874521/esdm-dorong-kelanjutan-pltp-bedugul-di-bali-usai-insiden-black-out>.
- Ochieng EA. Print media coverage of geothermal energy in Kenya- a case of the nation and the standard newspapers. 2019.
- Pambudi NA, Pramudita VS, Biddinika MK, Jalilinasrabad S. So close yet so far - how people in the vicinity of potential sites respond to geothermal energy power generation: An evidence from Indonesia. *Evergreen Tokyo*. 2022;9(1):1–9. <https://doi.org/10.5109/4774210>.
- Pavlaković B, Turnšek M. Adding value with experiences: industrial tourism and geothermal food production. *Tour Southern Eastern Eur*. 2019;5:507–20. <https://doi.org/10.20867/tosee.05.39>.
- Pemerintah Provinsi Sumatera Selatan, Badan Pengkajian dan Penerapan Teknologi, Universitas Sriwijaya, Pengkajian, B, Teknologi, P, Sriwijaya, U, Provinsi, P, Selatan, S, Pemerintah Provinsi Sumatera Selatan, Badan Pengkajian dan Penerapan Teknologi, & Universitas Sriwijaya. *Master Plan Provinsi Sumatera Selatan sebagai Lumbung Energi Nasional Tahun 2006–2025*. 2006. [http://bappeda.sumselprov.go.id/userfiles/files/1427690254\\_1433951036.pdf](http://bappeda.sumselprov.go.id/userfiles/files/1427690254_1433951036.pdf)
- Pengkajian B, Teknologi P, Sriwijaya U, Provinsi P, Selatan S. *Pemerintah Provinsi Sumatera Selatan, Badan Pengkajian dan Penerapan Teknologi, & Universitas Sriwijaya. Master Plan Provinsi Sumatera Selatan sebagai Lumbung Energi Nasional Tahun 2006–2025*. 2006. [http://bappeda.sumselprov.go.id/userfiles/files/1427690254\\_1433951036.pdf](http://bappeda.sumselprov.go.id/userfiles/files/1427690254_1433951036.pdf)
- Ramírez E, Macías J, Pineda J, Martínez K, Malo M, López-Sánchez J, Raymond J, Blessent D. Public awareness and perception on deep geothermal energy : preliminary results from an international survey. *IGCP636 annual meeting 2017*, November, 1–4. 2017.
- Rayhanna N. institutional analysis of geothermal energy investment in Indonesia: operationalization of the IAD framework [Delft University of Technology]. 2017. <https://repository.tudelft.nl/islandora/object/uuid%3A79fa9663-47b1-4e70-8ce4-140a1ff1c44a>.
- Renoth R, Buchner E, Schmieder M, Keim M, Plechaty M, Drews M. Social acceptance of geothermal technology on a global view: a systematic review. *Energy Sustain Soc*. 2023;13(1):1–19. <https://doi.org/10.1186/s13705-023-00432-1>.
- Saptadji N. *Sekilas Tentang Panasbumi*. In: *geothermal master program ITB*. 2016. [http://geothermal.itb.ac.id/sites/default/files/public/Sekilas\\_tentang\\_Panas\\_Bumi.pdf](http://geothermal.itb.ac.id/sites/default/files/public/Sekilas_tentang_Panas_Bumi.pdf).

- Sastra Hadi E, Vidya Putra E. Resistensi Masyarakat Terhadap Rencana Pembangunan PLTP (Pembangkit Listrik Tenaga Panas Bumi) Di Gunung Talang Kabupaten Solok. *J Perspektif*. 2019;2(3):236. <https://doi.org/10.24036/perspektif.v2i3.95>.
- Shortall R, Kharrazi A. Cultural factors of sustainable energy development: a case study of geothermal energy in Iceland and Japan. *Renew Sustain Energy Rev*. 2017;79(November 2016):101–9. <https://doi.org/10.1016/j.rser.2017.05.029>.
- Stauffer M, Muggli N, Scolobig A, Moser C. Framing deep geothermal energy in mass media: the case of Switzerland. *Technol Forecast Soc Change*. 2015;98:60–70. <https://doi.org/10.1016/j.techfore.2015.05.018>.
- Sumardi JA, Rizqi M, Asy'ari Geoenergis A, Ramadhan RF, Sumardi JA, Asy'ari AL, Fadhilah Ramadhan R, Pinandito FS, Purba D, Adityatama, DW, Siregar S, Hafly MN, Fadhilah FR. Indonesia geothermal drilling history: what we can learn from it? *P ROCEEDINGS, 47 workshop on geothermal reservoir engineering*. 2022. 7(9): 1–9. <https://www.researchgate.net/publication/358634987>.
- Trisiah A, de Vries G, de Bruijn H. Framing geothermal energy in Indonesia: a media analysis in a country with Huge Potential [Article submitted for publication]. Manuscript Submitted for Publication. 2021.
- Utami SS. Pemerintah Siapkan Insentif untuk Kembangkan Panas Bumi. *Medcom.Id*. 2019. <https://www.medcom.id/ekonomi/energi/PNgL6v8b-pemerintah-siapkan-insentif-untuk-kembangkan-panas-bumi>.
- Vargas Payera S. Understanding social acceptance of geothermal energy: case study for Araucania region, Chile. *Geothermics*. 2018;72:138–44. <https://doi.org/10.1016/j.geothermics.2017.10.014>.
- Vargas-Payera S, Martínez-Reyes A, Ejderyan O. Factors and dynamics of the social perception of geothermal energy: case study of the Tolhuaca exploration project in Chile. *Geothermics*. 2020. <https://doi.org/10.1016/J.GEOTHERMICS.2020.101907>.
- Velinda A, Wilodati, Kosasih A. Tunggu tubang dalam pembagian harta warisan pada masyarakat suku semende. *Sosietas*. 2017;7(2):420–3.
- De Vries G. How positive framing may fuel opposition to low-carbon technologies: The Boomerang Model. *J Lang Soc Psychol*. 2017;36(1):28–44. <https://doi.org/10.1177/0261927X16663590>.
- Waluyo D. Ramai Proyek PLTP Ditolak Masyarakat Lokal, Apa Penyebabnya? *Katadata*. 2025.
- Wicaksono RA. H2S Bocor Lagi, NGO: Setop Operasi Geothermal PT SMGP. *Betahita*. 2024. <https://betahita.id/news/detail/9940/h2s-bocor-lagi-ngo-setop-operasi-geothermal-pt-smgp.html?v=1708734169>.
- Willems CJL, Ejderyan O, Westaway R, Burnside NM. Public perception of geothermal energy at the local level in the UK. *World Geothermal Congress*. 2020;2020:1–9.
- World Bank, Stähler T, Taylor T, Stritih U, Paksoy H, Turgut B, et al. Institutional analysis of geothermal energy investment in Indonesia: operationalization of the IAD framework. *Renew Sustain Energy Rev*. 2017;13(1):19–25. <https://doi.org/10.1016/j.rser.2012.12.020>.

## Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.