

Stakeholder mapping in sustainable renewable energy development in West Sumatra Province, Indonesia

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Abstract. This study investigates the players involved in developing renewable energy in West Sumatra Province, Indonesia, considering the insufficient contribution of renewable energy in 2021, which stood at 11.5% in contrast to the government's set objectives of 23% by 2025 and 31% by 2050. The research methodology encompasses primary data gathering methods, namely interviews conducted with stakeholders who have been selected using the Delphi Stakeholders process. Additionally, secondary data will be incorporated into the study. The findings revealed a disparity in the influence and significance of stakeholders, wherein four primary stakeholders, namely the Ministry of Energy and Mineral Resources, West Sumatra Provincial Energy and Mineral Resources Agency, PLN, and Pertamina, exhibited substantial influence and high levels of importance. Conversely, most other stakeholders demonstrated relatively low levels of importance. In summary, it is imperative to enhance involvement, transparency, and collaboration to effectively tackle these disparities and foster the advancement of sustainable renewable energy initiatives within the area.

1 Introduction

The demand for sustainable energy solutions worldwide has reached unprecedented levels [1–6] driven by an increasing focus on renewable energy sources as a viable strategy to mitigate climate change and decrease reliance on fossil fuels [7–11]. The adoption of greener energy options has gained significant traction among the general people in Indonesia [12, 13]. The administration has demonstrated a firm dedication to enhancing renewable energy (RE) proportion within the country's energy portfolio [14]. Nevertheless, notwithstanding these objectives, considerable scope exists for enhancing renewable energy advancement, particularly in areas such as West Sumatra Province.

In the year 2021, the proportion of renewable energy sources in West Sumatra's total energy consumption amounted to a mere 11.5%, below the government's predetermined

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national objective. The overarching objective of Indonesia is to attain a renewable energy utilization rate of 23% by the year 2025, with a subsequent target of 31% by 2050 [15]. It is evident that a collective endeavor is needed to narrow this disparity and guarantee a substantial contribution of West Sumatra Province towards these overarching national objectives [16].

The involvement of stakeholders is of utmost importance in addressing the intricate challenges associated with the development of renewable energy in the region [17]. Stakeholder involvement must be balanced in promoting collaboration, attracting investment, and addressing the obstacles associated with the shift toward renewable energy sources. Particularly within this geographical area, there has been notable opposition towards developing renewable energy sources [18, 19]. Hence, it is imperative to conduct a thorough stakeholder mapping to fully understand the many actors participating in the process of renewable energy development in the region of West Sumatra [20, 21].

Numerous scholarly works elucidate the significance of stakeholder mapping as an essential procedure in several domains, including project development, risk management, and strategy planning [22, 23]. The approach above facilitates the identification of people and parties who possess a vested interest or exert influence in each effort. Stakeholder mapping facilitates enhanced risk reduction, conflict avoidance, and increased stakeholder engagement by comprehending diverse stakeholders' interests and possible contributions [24]. Moreover, stakeholder mapping plays a crucial role in strategic planning as it facilitates the incorporation of various interests into the overarching strategy [25]. Additionally, it fosters transparency and accountability within the decision-making process [26].

The significance of stakeholder mapping has been empirically demonstrated across many contexts as a pivotal factor in bolstering sustainability and project efficacy. By comprehending and effectively managing the concerns and priorities of many stakeholders, an endeavor is more likely to get the requisite backing and surmount obstacles that may emerge in pursuing its objectives.

This study examines stakeholder mapping in the context of West Sumatra's renewable energy development. It will identify various stakeholders, including government agencies, commercial sector entities, local communities, and environmental groups. This study aims to provide insight into the potential. It challenges the province to achieve a sustainable and environmentally friendly renewable energy future by examining various stakeholders' interests, impacts, and viewpoints.

2 Literature review

Stakeholders refer to individuals or organizations with concerns, interests, and the ability to influence a given issue [27]. According to [28], stakeholders are individuals or groups who are influenced by or influence the outcomes of development policies, programs, and activities. These parties encompass not only formal organizations and institutions but also individuals (both men and women), communities, socio-economic groups, and institutions of different sizes across different levels of society. Therefore, stakeholders can also be classified as actors [29].

Stakeholders can be categorized into two distinct groups: primary stakeholders, who are the main stakeholders, and secondary stakeholders, who are complementary [30]. Primary stakeholders are synonymous with key stakeholders. Secondary stakeholders are individuals or groups indirectly interested in a particular resource or problem [31]. Moreover, to comprehend the viewpoint of the stakeholders engaged, one can discern it by examining their interests and level of influence. Influence can be defined as the capacity of stakeholders to exert control, exert influence, effect change, or impede the progress of a program or policy.

Meanwhile, interest refers to a position, authority, or need that is possessed or held [31]. The stakeholder analysis employed in this article is based on a model developed by [31]. This model effectively examines stakeholder engagement by considering their influence and interest levels.

A related study conducted by [32] explored the topic of rural electrification in India. Their research seeks to identify and thoroughly analyze the factors that promote and hinder the process of rural electrification. The research findings indicate that politics, economics, and finance exert a more significant influence, as evidenced by their higher scores, compared to institutional and social factors, which have a lesser impact. Furthermore, their findings also demonstrated that policies backed by the government were the primary catalyst for the expansion of the grid.

[26] conducted a subsequent study focusing on the systematic analysis of stakeholders in ecosystem services research in the United Kingdom (UK). This study aims to identify stakeholders interested in the provision, regulation, and cultural ecosystem services from forests, distinguish their characteristics, and examine their relationships at different levels. The research aims to construct a comprehensive framework comprising a three-stage model, encompassing a planning stage, an implementation stage, and a stakeholder analysis stage. The framework integrates stakeholders and ecosystem services across geographic, institutional, and ecosystem scales. He determined that employing a methodical stakeholder analysis can aid in formulating forthcoming endeavors about ecosystem services, such as creating novel policies or instruments, engagement activities with stakeholders, and decision-making procedures.

In addition, [33] emphasized the distributional effects of a substantial disparity between the incentives established by the financial price paid for electricity generation and the economic value of the electricity produced in Canada. It was discovered that all participants in the electricity system experienced losses in this project, except the wind farm owners, who are privately owned. The primary beneficiaries of the situation were electricity consumers, followed by the government.

[34] conducted a study to examine the involvement of stakeholders in the planning and implementation of renewable energy initiatives in Australia. Their research examines the influence of international and domestic stakeholders on the expeditious approval and cost-effectiveness of renewable energy projects. Process mapping and stakeholder analysis revealed that renewable energy supply projects can benefit from implementing standardized approval processes and comprehensive stakeholder engagement. Furthermore, stakeholder objections to project approval and implementation impact the effectiveness of policy changes.

Several studies above indicate stakeholders are crucial to planning success, particularly in renewable energy development. Nevertheless, previous studies have not conceptually used Reed's policy analysis framework. Furthermore, this study fills the current empirical void by being conducted in Indonesia, specifically within the local context of West Sumatra Province. This presents a novel case that differs from previous studies.

3 Methods

The present study employed a qualitative methodology and was carried out in the province of West Sumatra from June to October 2022. The qualitative method was used to comprehend the problematic scenario surrounding the growth of renewable energy in this area. The data collection process encompassed both primary and secondary data sources.

Primary data collection was facilitated by in-depth interviews with key players actively developing renewable energy in West Sumatra Province. The selection of stakeholders was conducted using objective criteria and the Delphi Stakeholders technique, as outlined by [35],

to guarantee a thorough representation. The secondary data included in this study was obtained from various sources, including government papers, journal publications, and research reports that were deemed relevant to the research issue.

The stakeholder analysis conducted in this study pertains to the framework proposed by [35], which centers on examining the degree of influence and significance attributed to each stakeholder. The importance and impact of stakeholders are shown through a matrix constructed utilizing Microsoft Excel software, showcasing relevant data. The assignment of points for assessing the degree of stakeholder significance and impact adheres to the adapted framework defined by [35]. Subsequently, the obtained scores were employed to categorize stakeholders into their respective groups.

The findings of the stakeholder analysis were subsequently utilized to categorize stakeholders into four quadrants based on their respective degrees of significance and impact on the advancement of renewable energy in West Sumatra Province. The modeling discussed in this context pertains to the conceptual framework proposed by [36]. This framework delineates stakeholders as significant actors, context setters, subjects, and crowds, hence facilitating the depiction of the dynamics associated with their respective roles within renewable energy production.

4 Results and discussion

4.1 Identification and description of stakeholders in the renewable energy

In the context of the renewable energy development in West Sumatra Province, it is observed that a total of twenty stakeholders are involved, each possessing distinct functions, diversified interests, and considerable impact. The local government holds the critical responsibility in planning and managing the development of renewable energy. The West Sumatra Provincial Development Planning Agency is responsible for designing plans for developing renewable energy in the West Sumatra area. Simultaneously, the West Sumatra Provincial Environment Agency plays a vital role in monitoring and assessing the environmental consequences associated with these initiatives. The Energy and Mineral Resources Agency of West Sumatra Province is entrusted with the task of governing and supervising renewable energy endeavors, as well as ensuring a reliable and uninterrupted energy provision.

Moreover, the participation of the local business sector plays a crucial role in both the financial investment and operational elements of renewable energy initiatives. State-owned enterprises, such as the State Electricity Company (PLN) and Pertamina, play a vital role in easing the provision of energy and fuel necessary to support the sustainability of renewable energy sources. The Indonesian Palm Oil Association (GAPKI) also substantially influences the land allocation of former oil palm plantations. Civil society groups, such as the Indonesian Legal Aid Foundation (YLBHI) and the Indonesian Forum for the Environment (Walhi), are actively monitoring the social and environmental implications linked to the expansion of renewable energy.

Furthermore, other stakeholders, including the local commercial sector, academics, community leaders, and the West Sumatra Provincial Parliament, play significant roles in advocating for the interests and addressing the problems of local populations while offering extensive expertise in renewable energy. Each player involved in this context has distinct interests, including several dimensions such as business, environmental concerns, and the social rights of local populations. Their impact encompasses several aspects, such as project permitting, regulatory oversight, investment decisions, and the identification of suitable technology.

In general, the stakeholder mapping exercise thoroughly represents the many stakeholders engaged in the renewable energy development process in West Sumatra Province. A comprehensive comprehension of the responsibilities and interests exhibited by these stakeholder groups establishes a crucial basis for formulating sustainable policies and strategies aligned with the interests of all involved parties.

Table 1. Stakeholders who have interests and influence in the development of renewable energy in West Sumatra Province.

Code	Stakeholder	Interest	Influence
1	Regional Development Planning Agency of West Sumatra Province	Aligning regional development with the use of renewable energy for sustainable development	Has the authority to direct resource allocation and renewable energy development plans in the provinces.
2	Environment Agency of West Sumatra Province	Protecting ecosystems and maintaining environmental quality	Can influence project permits and make recommendations for projects that have a positive environmental impact
3	Energy and Mineral Resources Agency of West Sumatra Province	Ensure a reliable and affordable supply of renewable energy in the region	Issuing licenses and regulations related to renewable energy development
4	Plantation Agency of West Sumatra Province	Aligning agricultural land use with renewable energy development	May affect access to land needed for renewable energy projects
5	Transportation Agency of West Sumatra Province	Ensure availability of necessary infrastructure	May influence the development of infrastructure that supports renewable energy
6	Public Works and Housing Office of West Sumatra Province	Ensuring the availability of infrastructure that supports the development of renewable energy	May influence the development of infrastructure that supports renewable energy
7	Industry and Trade Agency of West Sumatra Province	Encourage the growth of the renewable energy industry in the province	influence policies related to the renewable energy industry
8	Investment and One-Stop Service Office of West Sumatra Province	Encouraging investment to develop the renewable energy sector	Influence the acceleration of investment licenses for renewable energy projects
9	Forestry Agency of West Sumatra Province	Ensuring sustainable use of forest land	May affect permits and access to forest land required for renewable energy projects
10	West Sumatra Research and Development Center	Providing scientific insights to support the development of new technologies in renewable energy	May influence technological development and innovation in this sector in the province
11	Ministry of Energy and Mineral Resources	Promoting the achievement of national renewable energy targets	Influences the direction of renewable energy policy in the province
12	Local Private Sector	Has a business interest in the investment and operation of renewable energy projects	May influence the development of the renewable energy industry in the region
13	Academics	Contributing to the advancement of knowledge,	Can influence technology, innovation, and policy

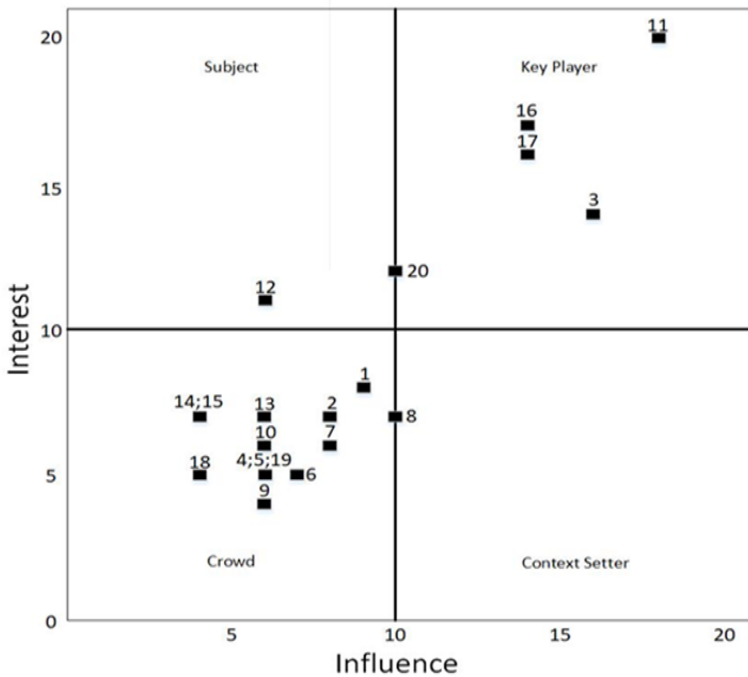
Code	Stakeholder	Interest	Influence
		technology, and policy in the renewable energy sector	developments in renewable energy
14	YLBHI	Protecting community rights and the environment from the negative impacts of renewable energy projects	May influence projects that do not comply with laws or social norms
15	Walhi	Promoting the development of environmentally friendly and sustainable energy	May influence projects that may damage the environment
16	State Electricity Company (PLN)	Ensuring sufficient electricity supply	Has an important role in the provision of electricity from renewable energy sources
17	Pertamina	Providing fuel and energy needed by the renewable energy sector	Can influence fuel supply and energy policy
18	Indonesian Palm Oil Association (GAPKI)	Ensuring that land use does not compete with palm oil production	May influence access to land and policies related to land use
19	Community Leaders	Ensure that the voices and needs of local communities are considered	Can influence policies and decisions regarding projects in their area
20	Regional People's Representative Council of West Sumatra Province	Ensure renewable energy development is in the best interest of local communities	Can influence the formation of regulations and budgets related to renewable energy in the province

Source: Research results.

4.2 Analysis of the interests and influence of different stakeholders

The findings derived from a comprehensive stakeholder mapping analysis conducted on the development of renewable energy in West Sumatra Province shed light on the intricate dynamics of the roles and impact of many stakeholders. Based on the present study, it is evident that four distinct parties may be recognized as "Key Players" with substantial authority and impact in advancing novel and sustainable energy sources within the region. The four stakeholders identified in this context are the Ministry of Energy and Mineral Resources (MEMR), the Energy and Mineral Resources Agency of West Sumatra Province, the State Electricity Company (PLN), and Pertamina. The Ministry of Energy and Mineral Resources (MEMR) positioning on the far right of the matrix signifies its significant authority and influence in the given context.

The Ministry of Energy and Mineral Resources holds significant influence over the development and execution of renewable energy initiatives at the regional level since it is the primary governing body with national jurisdiction in energy and mineral resources policy. The Energy and Mineral Resources Agency of West Sumatra Province has a prominent position due to its jurisdiction in overseeing and facilitating the execution of renewable energy initiatives at the local level. State Electricity Company (PLN) and Pertamina, as prominent energy corporations at the national level, assume a crucial responsibility in facilitating the establishment of requisite infrastructure and allocation of resources for the advancement of renewable energy.



Description:

1=Regional Development Planning Agency of West Sumatra Province, 2=Environment Agency of West Sumatra Province, 3=Energy and Mineral Resources Agency of West Sumatra Province, 4=Plantation Agency of West Sumatra Province, 5=Transportation Agency of West Sumatra Province, 6=Public Works and Housing Office of West Sumatra Province, 7=Industry and Trade Agency of West Sumatra Province, 8=Investment and One-Stop Service Office of West Sumatra Province, 9=Forestry Agency of West Sumatra Province, 10=West Sumatra Research and Development Center, 11=Ministry of Energy and Mineral Resources, 12=Local Private Sector, 13=Academics, 14=YLBHI, 15=Walhi, 16=State Electricity Company (PLN), 17=Pertamina, 18=Indonesian Palm Oil Association (GAPKI), 19=Community Leaders, 20=Regional People's Representative Council of West Sumatra Province.

Fig. 1. Stakeholder mapping in renewable energy development in West Sumatra Province.

Nonetheless, two distinct categories of stakeholders occupy a significant position in this context, notably the local private sector and the Regional People's Representative Council of West Sumatra Province. Despite the relatively lower level of power compared to the primary actors, these organizations nonetheless possess considerable potential impact, particularly in the event of the successful formation of coalitions or partnerships. This implies that the involvement and endorsement of the indigenous private sector and the Regional People's Representative Council of West Sumatra Province may significantly advance renewable energy within the province.

Based on the findings of this research, it was determined that no stakeholder organizations occupied the context setter position, which refers to entities possessing significant influence but displaying limited interest in advancing renewable energy initiatives. Most stakeholders hold a position in the crowd category, signifying their relatively modest levels of interest and influence over the anticipated outcomes in the realm of renewable energy development in West Sumatra Province. The groupings mentioned above encompass a range of governmental entities, including the Regional Development Planning Agency of West Sumatra Province, the Environmental Agency of West Sumatra Province, the Plantation Agency of West

Sumatra Province, the Transportation Agency of West Sumatra Province, the Public Works and Spatial Planning Office of West Sumatra Province, the Industry and Trade Agency of West Sumatra Province, the Investment and One-Stop Service Office of West Sumatra Province, the Forestry Agency of West Sumatra, and West Sumatra Research and Development Center. Furthermore, this group encompasses academics, non-governmental organizations, community leaders, and the Indonesian Palm Oil Association (GAPKI). Given this comprehension, further endeavors are required to actively include and incentivize these cohorts to augment their backing and involvement in advancing renewable energy inside the province of West Sumatra.

The findings of the stakeholder mapping study conducted in West Sumatra Province reveal a notable disparity in the degree of influence and interest exhibited by different stakeholders in the context of renewable energy development initiatives. Four distinct parties are "key players" in this project, exerting significant influence and possessing vested solid interests. These groups are specifically identified as the Ministry of Energy and Mineral Resources, the Energy and Mineral Resources Agency of West Sumatra Province, State Electricity Company (PLN), and Pertamina. In contrast, most of the remaining groupings assume a "crowd" stance, indicating diminished interest and influence regarding the anticipated effects of renewable energy advancement inside the area.

The factor above can exert a substantial influence on the endeavors aimed at advancing renewable energy. Parties with significant power and vested interests may exhibit a propensity for dominance over decision-making processes and shaping initiatives in alignment with their objectives. This phenomenon can lead to disparities in the distribution of benefits arising from the growth of renewable energy. Conversely, individuals or collectives with fewer vested interests may have reduced levels of engagement and motivation to endorse or actively engage in those endeavors.

Prior studies conducted at national and global scales have emphasized mitigating disparities in stakeholder influence and interests within renewable energy [37–39]. Efforts required to rectify these disparities encompass: 1) Enhanced Stakeholder Engagement: It is imperative to facilitate a more extensive and all-encompassing involvement of diverse stakeholders, including individuals from the public, to foster a more inclusive approach. By actively engaging individuals in the decision-making process, their level of involvement and comprehension of the advantages of renewable energy may be enhanced. 2) The promotion of transparency in decision-making processes and the identification and resolution of possible conflicts of interest can contribute to the mitigation of disparities in influence. It is essential to enhance stakeholders' access to information and establish effective systems that enable them to monitor project implementation closely. 3) Collaboration and Alliances: The facilitation of collaboration among diverse stakeholders, especially organizations occupying subordinate positions, can contribute to the establishment of a more equitable distribution of power. Strategic partnerships can enhance these organizations' impact, facilitating their collective ability to shape the trajectory of renewable energy growth. 4) Skills and Capacity Development: Providing training and educational opportunities to marginalized stakeholder groups can enhance their efficacy and influence as stakeholders. This may encompass instruction on the technical facets of renewable energy, with comprehension of the advantages and socio-environmental ramifications associated with these technologies.

By implementing these measures, the endeavors to promote renewable energy in West Sumatra Province may be enhanced in terms of inclusivity, equity, and sustainability while ensuring fair distribution of benefits among all relevant parties. This research highlights the significance of mitigating disparities in power dynamics and vested interests within renewable energy to attain more favorable and enduring results.

The results of this study align with studies conducted by [40]; 41], who state that there needs to be inclusive engagement of all stakeholders in the development of renewable energy

that aims to optimize all available resources. Thus, this study concludes that institutional factors should be a concern in developing renewable energy. This aligns with research from [42, 43], which states that the most formidable challenge in the transition to new renewable energy lies not in engineering and science but in culture and institutions. However, the weakness of this study is that it needs to look at the influence of culture in encouraging or hindering the development of renewable energy at the local level. In addition, this study has also yet to analyze the information network relationships that occur among stakeholders or actors. The researcher feels this analysis needs to be done to map further the parties who can become central intermediaries in realizing more collaborative renewable energy institutions in this area. These two weaknesses are suggestions this research provides for future research agendas.

5 Conclusion

The study's findings indicate that stakeholder mapping in the context of renewable energy development in West Sumatra Province has shown the intricate interactions among the diverse entities engaged in this undertaking. A notable discrepancy exists in the degree of influence and significance among the many stakeholders, with four distinct groupings emerging as prominent actors possessing substantial influence and vested interests. The entities encompassing the Ministry of Energy and Mineral Resources (MEMR), the Energy and Mineral Resources Agency of West Sumatra Province, State Electricity Company (PLN), and Pertamina are involved.

In contrast, most of the remaining stakeholders might be considered part of the general public, needing more engagement and influence about the anticipated results of renewable energy advancement within the area. The parties involved include governmental entities, non-governmental organizations, community leaders, and scholars. Efforts to rectify this disparity encompass a range of strategies, such as heightened involvement of stakeholders, enhanced transparency and accountability, collaborative initiatives, and capacity development. Implementing these measures, the advancement of renewable energy in West Sumatra Province may be enhanced to foster inclusivity, equity, and sustainability while ensuring fair distribution of benefits among all stakeholders.

The findings mentioned above offer significant insights into the development of renewable energy policies and their execution in West Sumatra Province, aligning with Indonesia's overarching objective to mitigate carbon emissions and expedite the adoption of sustainable energy sources. Gaining a comprehensive comprehension of the various responsibilities and interests of various stakeholders in renewable energy development is a crucial stride toward fostering a sustainable and forward-thinking society.

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