Assessing Public Awareness and Stakeholder Influence in Renewable Energy Implementation: A Case Study from Sulawesi, Indonesia

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Abstract

This study aims to assess public awareness and stakeholder influence in implementing renewable energy projects in Sulawesi, Indonesia, focusing on the districts of Jeneponto, Pangkep, Polewali Mandar, and Majene. We employed a mixed-methods approach, combining quantitative surveys and qualitative interviews to provide a comprehensive analysis. The data collected includes responses from 400 residents across the selected districts and in-depth interviews with key stakeholders, including government officials, NGO representatives, and private sector actors. The results indicate that public awareness of renewable energy technologies and policies is generally low, with only 27% of respondents demonstrating basic knowledge. Awareness levels were particularly low in rural areas, where over 70% of respondents were unfamiliar with renewable energy initiatives. The study also found significant correlations between demographic factors, such as education and income levels, and awareness, suggesting that targeted educational campaigns are necessary. In terms of stakeholder influence, the study highlights the challenges faced in implementing renewable energy projects, including financial constraints and regulatory complexities. Despite these challenges, there are opportunities for enhancing renewable energy adoption through multi-sectoral collaboration and culturally adapted strategies. This research's novelty lies in its comprehensive approach, which integrates public perception with stakeholder dynamics, as well as its focus on a regionally specific context within Indonesia, offering practical recommendations for accelerating the renewable energy transition in similar developing regions. This study also provides valuable insights for policymakers and stakeholders aiming to bridge the gap between policy and practice in renewable energy adoption.

Keywords: renewable energy, public awareness, stakeholder influence, energy transition, local governance

1. Introduction

The transition to renewable energy is an essential strategy in global efforts to mitigate climate change and reduce greenhouse gas emissions [1–6]. Energy consumption in Asia, including Indonesia, is rapidly increasing, while this region still relies on fossil fuels for its energy [7]. Since Asia is the largest energy consumption region, it is projected that energy growth in this region will continue, which makes it essential for countries to strategize the use of renewable sources of energy [8]. Indonesia, with the Paris Agreement in place, has taken ambitious and legally binding emission reduction targets as set out in her ENDC. These targets are a reduction of emissions by 31.89% domestically and 43.20% with international support by 2030. Switching from fossil energy sources to RE sources is one of the most essential directions in achieving these goals, and RUED (Regional Energy Planning) is a vital practice-based reference tool for subnational governments for this transformation in Indonesia [8].

However, within Indonesia's regional context, the progress in the installation of renewable energy has been slow [9]. In this regard, the South and West Sulawesi provinces, which are resource rich and strategic for the national energy ambiance, face some specific issues [8,9]. The political and societal success of renewable energy projects has long been accepted as critical to public participation and stakeholder engagement [7,10]. Comprehensive and cooperative approaches among government, civil society, and the private sector have been reported to be necessary to break these restrictions [8,10]. However, such dynamics, particularly in Sulawesi, remain limited in the exploration [9].

A significant research gap lies in the lack of studies aimed at raising awareness among residents of the places near the projects. However, the acceptance of the local community to investigate local sentiment and communication of renewable energy technologies in regions such as Sulawesi, as well as achievements and promotions of renewable energy sources, is low [7]. It has been noted that the primary reasons for the public opposition to renewable energy programs are the lack of adequate compensation and inducements regarding the community hosting these renewable energy facilities [8,10]. In addition, there are ways in which renewable energy projects undertaken in countries such as China have shown that management in government ventures can extend to greater involvement of the community [9,10]. However, there is insufficient research on how the promotion of awareness projects that focus on culture and perceptions of people helps to address this knowledge problem [11].

Another critical gap is the need for more examination of multi-sectoral collaboration within the Indonesian context. Although we acknowledge the crucial role of various stakeholders, including government agencies, nongovernmental organizations, and the private sector, our understanding of these interactions at the regional level remains limited. Studies in other countries have shown that effective collaboration between stakeholders can significantly enhance the success of renewable energy projects [12–14]. Yet, the dynamics of such collaborations in Indonesia, particularly in Sulawesi, remain underexplored [15].

Furthermore, the documentation of regional governments' challenges in implementing national renewable energy policies is inadequate. Local governments often need to pay more attention to the regulatory and financial barriers they face despite the RUED framework that provides a structure for regional energy planning [16–18]. This gap in the literature leaves policymakers without the necessary insights to develop effective strategies for addressing these barriers. Understanding these challenges is crucial to accelerate the energy transition in regions such as Sulawesi, where

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local governments play a crucial role in policy implementation [19].

In addition to these gaps, there is a need for a deeper investigation of how public perceptions influence community participation in renewable energy projects [20,21]. Despite the widespread policy support for renewable energy, we need a clearer understanding of how this support translates into active community participation [22,23]. Research has indicated that public perceptions, shaped by cultural beliefs and local experiences, play a significant role in determining the success of renewable energy initiatives [22]. However, this area remains underexplored in the context of Sulawesi, where diverse cultural factors may influence public engagement [24].

This study aims to fill these research gaps by assessing the current state of public awareness and stakeholder influence in the implementation of renewable energy in Sulawesi. By focusing on the unique challenges and opportunities in this region, the research will provide information on how localized strategies can improve public engagement and stakeholder collaboration, ultimately contributing to the larger goal of a sustainable energy transition in Indonesia.

2. Materials and Methods

2.1. Research Design and Instrument

This study used a mixed methods research design that incorporates both quantitative and qualitative approaches to comprehensively analyze public awareness and stakeholder influence on the implementation of renewable energy in Sulawesi. The use of mixed methods allows for a more nuanced understanding of the phenomena under study, addressing both the breadth (through surveys) and depth (through interviews) of public and stakeholder perspectives [25–27]. The combination of these methods is particularly suitable for exploring complex social and policy-related issues in renewable energy transitions, where statistical trends and personal experiences are relevant [28]. The quantitative method involved the use of a survey questionnaire to measure the levels of awareness, understanding, and perceptions of renewable energy technologies and policies. The questionnaire is designed with a total of 18 structured questions divided into four parts, parts A to D; Part A has details about the research objectives; Part B has written consent; Part C has proforma for the socio-demographic and personal characteristics of the study participants (Gender, Education, and Occupation); Part D consists of renewable energy knowledge; 2) stakeholder influence; 3) renewable energy management. In collecting data, the researchers recruit enumerators to distribute the questionnaire. This enumerator has previously been equipped with an enumerator orientation and explains the purpose of the study to the enumerator. This is so that when the enumerator meets with the selected respondents, they have sufficient information related to the purpose of the survey. In addition, the qualitative method is used to explore data related to the roles of stakeholders in the implementation of renewable energy, their perceptions of public awareness, and the challenges they face in engaging the public. A total of 20 respondents who were directly involved in the formulation and implementation of renewable energy policies were interviewed.

2.2. Respondents

This study involved 400 respondents from four districts in the south and western Sulawesi: Jeneponto, Pangkep, Polewali Mandar, and Majene. We chose these districts due to their varying levels of urbanization, economic development, and involvement in renewable energy initiatives. The diversity of these areas allows the study to capture a wide range of perspectives and experiences, making the findings more generalizable across different contexts within Sulawesi. The

selection of these districts is informed by the need to explore the regional disparities in public awareness and stakeholder engagement, which have been identified as critical gaps in the current literature. The participation of the respondents based on random and voluntary selection gives every individual in the target population an equal chance of being selected, thus minimizing selection bias and ensuring that the sample reflects the diversity of the population in terms of gender, education, and occupation. This ensured that larger districts contributed more respondents while maintaining general randomness [29].

Table 1: *Number of sample*

No.	District	Population	Sample	Percentage (%)
1	Jeneponto	420,123	107	26.75
2	Pangkajene	357,846	91	22.75
3	Mamuju	292,395	75	18.75
4	Polewali Mandar	495,371	127	31.75
Total		**1,565,735**	**400**	**100**

2.3. Data Analysis

In analyzing the quantitative data from the surveys, we used descriptive and inferential statistics. We used descriptive statistics to summarize the data and provide an overview of public awareness levels and attitudes towards renewable energy. We used inferential statistics to investigate the relationships between demographic variables and levels of awareness and support for renewable energy. This helped identify key factors that influence public perceptions and behaviors. In addition, in analyzing the qualitative data from the interviewees, we used thematic analysis. There are six steps; familiarizing ourselves with the data; generating initial codes; searching for theme; reviewing potential theme; defining and naming themes; and producing the report [30].

3. Results and Discussion

3.1. Public awareness of renewable energy in Sulawesi

The results of the survey revealed that the public awareness of renewable energy in the four districts studied - Makassar, Pangkep, Polewali Mandar and Majene - is relatively low. Only 27% of the respondents were familiar with basic renewable energy concepts, such as solar and wind power. Among those who were aware, the knowledge about specific renewable energy policies, such as the Regional Energy Planning (RUED) framework, was even lower, with only 15% of the respondents indicating any awareness. This lack of knowledge was more pronounced in rural areas such as Pangkep and Polewali Mandar, where more than 70% of the respondents admitted not knowing of renewable energy technologies or policies.

This finding is consistent with broader trends in other developing regions, where limited access to information and education often hinders public awareness. Sulawesi's low level of awareness highlights the need for localized educational campaigns, as generic national campaigns might not effectively reach or resonate with these communities [19, 24]. Based on survey results and stakeholder interviews, we present the findings in tables and figures to help visualize the data. Table 2 summarizes the survey results, showing the percentage of respondents in each district who are aware of renewable energy technologies and policies. Table 3 summarizes the key themes that emerged from the qualitative interviews, such as challenges, opportunities, and recommendations.

Table 2: *Awareness of renewable energy technologies and policies by district*

District	% Aware of Renewable Energy Technologies	% Aware of Renewable Energy Policies
Jeneponto	35%	20%
Pangkep	18%	10%
Polewali Mandar	22%	12%
Majene	25%	15%
Overall Average	**25%**	**15%**

Table 3: *Summary of qualitative themes from stakeholder interviews*

Theme	Description	Example Quotes
Financial barriers	Stakeholders highlighted the difficulty in securing funding for renewable energy projects.	The initial investment is too high for small businesses.
Regulatory challenges	Complexity and bureaucracy in the regulatory framework were frequently mentioned.	Navigating the regulations is a major hurdle for project approval.
Cultural resistance	Traditional beliefs and skepticism towards new technologies were noted in rural areas.	People are not convinced that renewable energy can meet their needs.
Need for collaboration	The importance of stronger partnerships between sectors was emphasized.	We need more collaboration between government, NGOs, and the private sector to make progress.

3.2. Demographic correlates of awareness

Further analysis of the survey data revealed significant correlations between demographic factors and levels of awareness. As shown in Table 4, education level was the strongest predictor of awareness, with respondents having higher education degrees nearly three times more likely to be aware of renewable energy technologies compared to those with only primary education ($p < 0.05$). Income level also played a significant role, with higher income households showing greater awareness, likely due to better access to information and technologies.

These findings suggest that educational attainment and economic status are critical factors in determining public awareness of renewable energy. This is consistent with existing literature, which highlights that awareness is often higher among more educated and economically stable populations. However, the stark disparities observed in this study indicate that without targeted interventions, large segments of the population may remain uninformed and disengaged from renewable energy initiatives [15, 24].

Table 4: *Correlation between demographic Factors and awareness*

Demographic Factor	Correlation with Awareness	p-value
Education level	0.68	< 0.05
Income Level	0.54	< 0.05
Age	-0.15	> 0.05
Gender	0.10	> 0.05

3.3. Stakeholder engagement and influence

The qualitative interviews with stakeholders provided deeper insight into the dynamics of renewable energy implementation in Sulawesi. Local government officials expressed a strong commitment to renewable energy, citing alignment with national policies such as the ENDC and RUED. However, they also highlighted significant challenges, including limited financial resources and regulatory constraints, which hinder more aggressive implementation efforts. Stakeholders

from NGOs and the private sector echoed these concerns, emphasizing the need for more robust public-private partnerships to overcome these barriers.

One notable observation was the divergence in stakeholder influence across the different districts. In urban areas like Jeneponto, where there is greater access to resources and infrastructure, stakeholder engagement is more coordinated and effective. In contrast, rural areas suffer from fragmented efforts with limited collaboration between stakeholders, resulting in slower progress in renewable energy adoption [19].

3.4. Perceived barriers to renewable energy adoption

The public respondents and stakeholders identified several key barriers to the adoption of renewable energy in Sulawesi. The most commonly cited barriers were the high initial costs of renewable energy technologies, lack of access to financing, and the complexity of the regulatory environment. For instance, 65% of respondents indicated that the cost of installing solar panels was prohibitively expensive, even with potential long-term savings.

Stakeholders also pointed out that the regulatory framework, although well-intentioned, is often cumbersome and difficult to navigate, particularly for small and medium-sized enterprises (SMEs) looking to invest in renewable energy. These findings are consistent with global studies that identify financial and regulatory barriers as significant obstacles to the adoption of renewable energy, particularly in developing regions [24].

Regulations create problems with respect to the adoption of renewable energy in Indonesia and other developing areas. In Sulawesi, there are also problems because the regulations are neither consistent nor clear, increasing the risks for investors and developers. Hence, projects face delays or cancellation. The implementation of such guidelines is also further aggravated by the fact that there are variations in local, regional, and national laws that may contradict each other. Opaque applications and documentation, especially regarding the obtaining of permits or even legal permits related to land use and environmental regulations, tend to pose problems. Renewable energy initiatives are subject to several interwoven policies that are not realistic to the requirements of renewable energy systems [7, 8]. For example, they may face challenges in securing grid connection approval, as many regulations remain preoccupied with conventional fossil fuel-driven power systems.

Furthermore, the regulatory framework in Indonesia remains centralized, which limits the ability of local governments to promote renewable energy initiatives. Within such governance structures, without enough decentralization, it becomes difficult for local authorities to implement regional energy tactical plans in line with the national energy management strategic plan such as the RUED. In China, for example, national policies have been supportive of the transition to renewable energy and have reinforced local policies that help to engage local exchanges [31]. Therefore, Indonesia may also be under similar regulatory and structural dynamics as the explanation, except that these factors promote both large grid-based and small distributed renewable energy systems in a more province-wise manner.

Apart from policies responding to particular technologies or institutions, generating policies supporting the adoption of renewable energy in much of Sulawesi and Indonesia has still remained largely policy- oriented. Solar energy initiatives often face significant financial barriers, which is a critical challenge in market promoting renewable energy technologies in Sulawesi and throughout Indonesia. There is a high risk of development that involves high development cost, as renewable energy seeking financing operates at the threshold of modern innovation. With low economies like that of Sulawesi that are mostly rural or semi-urban, the challenge to finance such projects is even compounded more because of lower funding options for these kinds of projects. In fact,

even traditional commercial lenders are scrupulous in extending loans or lending facilities to renewable energy developers because of the question of the feasibility of investments because of long payback periods, uncertainty over existing regulations, and viability of projects to provide income.

It is worth mentioning that the existence of high interest rates and the absence of adequate financing approaches to renewable energies worsen the situation. For example, concepts such as microfinancing or the incorporation of public-private partnerships are still disregarded in Indonesia. In countries such as China, the implementation of the Solar Energy for Poverty Alleviation Program (SEPAP) program narrates the necessity of government funding to participate in the development of renewable energy projects [32]. If such a comprehensive financial structure in Indonesia existed at the national level, such as subsidies, taxation policies, or guarantees for investments in renewable energy, the FDI inflows and local resource investments in such projects would have been enhanced.

Regulatory and financing imperatives are also needed to harness the possible appreciation of renewable energy in Sulawesi. Despite improving regulatory activities, Indonesia will be able to achieve the set goals on the promotion of renewable energy through less complicated and inexpensive financing systems, which will be advantageous both economically and ecologically for members of this region.

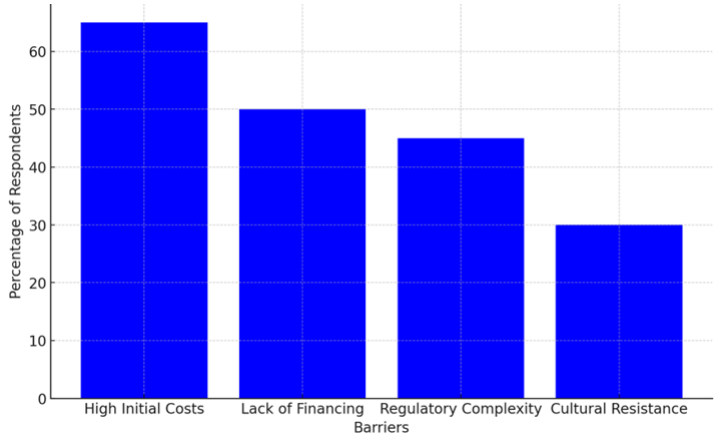

Figure 1: *Perceived barriers to renewable energy adoption*

3.5. The role of cultural factors

The interviews also revealed the significant role of cultural factors in shaping public perceptions and acceptance of renewable energy. In rural areas, traditional beliefs and practices play a crucial role in influencing community decisions [33, 34]. For example, some respondents expressed skepticism about the benefits of renewable energy, citing traditional views on energy sources and a preference for conventional methods. Previous studies have underexplored this critical barrier to cultural resistance.

The findings suggest that any effort to promote renewable energy in Sulawesi must consider these cultural dynamics. Tailored communication strategies that respect and integrate local cultural values could be more effective in gaining community support than standard approaches [24].

Cultural beliefs and traditional practices are particularly strong in the area of the Mamminasata region, i.e., Sulawesi Selatan. This can either help or create barriers to the uptake of renewable

energy technologies. The Bugis-Makassars, a group of people well known for their closeness to nature, have a long history of using renewable energy such as wind power in their daily activities, especially sailing. The history of the famous Bugis sailors reveals that they navigated their traditional Pinisi ships using wind energy long before the advent of motorboats. This mastery of wind power allowed them to expand their trade networks and engage in foreign exchanges of commodities such as spices, fabrics, and metals, reaching as far as Southeast Asia. These seafarers meticulously observed wind patterns and sailing conditions, learning to select the appropriate sails for each voyage, a practice that was eventually institutionalized in their navigation techniques.

Similarly, wind energy has been utilized in agriculture in Sulawesi Selatan. An age-old practice involved the use of wind-powered devices, such as simple whirligigs, to scare birds away from rice fields. This demonstrates that communities around the world have harnessed wind energy long before the modern era of renewable technologies.

These enduring practices suggest a culture that embraces the use of available natural energy sources. The introduction of modern renewable energy technologies, such as wind turbines, may evoke a mix of curiosity and apprehension among communities. This reflects their history with harnessing wind energy. However, newer devices might feel out of place and integrating them into existing lifestyles can present significant challenges unless adequate training and educational resources are provided. Historically, the Bugis-Makassar people have relied on burning wood and biomass for their energy needs. In many underdeveloped countries, wood continues to be used for cooking and heating. This dependency comes from the accessibility and ease of use of these traditional practices, rather than from the exploitation of resources. The transition from traditional biomass to renewable energy sources such as wind and solar power, while promising, faces the challenge of altering deeply ingrained habits and overcoming logistical barriers related to access and affordability.

In Pangkep, for example, there is evidence of localized biomass use specifically for biogas production, particularly by using cattle manure for energy. This approach aligns with the sociocultural practices of the community, making them more receptive to alternative renewable energy sources such as biogas. However, broader adoption will necessitate increased community support and education about the benefits of these alternatives, which is often lacking in traditional practices.

Renewable energy projects in Sulawesi Selatan, such as the Sidrap Wind Farm, highlight the importance of considering local sociocultural factors in the implementation of renewable energy technologies. The successful and timely execution of these projects is closely related to community involvement in both the installation and the operation of the systems. This participation fosters a sense of ownership that helps minimize conflicts over resources. The traditional use of wind by the local population, particularly in relation to wind energy projects, is deeply rooted in their sociocultural practices. This connection underscores the potential for sociocultural acceptance when implementing renewable energy initiatives that leverage local culture and customs. Engaging the community in these projects not only improves acceptance, but also ensures that the initiatives are more effectively integrated into their way of life.

In addition, the cultural appreciation of natural elements in Sulawesi Selatan favors the region for the acceptance of renewable energy technologies. If these technologies are framed in a way that resonates with local culture—such as describing wind turbines as modern wind factories—they are more likely to be integrated into the community's practices. However, the long-term viability of these programs is based on addressing technical skills gaps and the training necessary to maintain them over time. This focus on capacity building is essential to ensure that the community can effectively manage and maintain these renewable energy initiatives.

Cultural factors in Sulawesi Selatan play a significant role in shaping the perception and

acceptance of renewable energy technologies. The local population's traditional use of wind energy presents opportunities for integrating wind systems into their daily lives. However, successful implementation goes beyond simply developing the technology; it requires cultural appropriateness. This means involving local citizens throughout all phases of the project, from planning to execution. By considering renewable energy in the context of integrating them with established traditional practices and focusing on education and training, communities can effectively harness renewable energy while respecting their cultural and religious values. This approach not only helps preserve energy sources, but also fosters a sense of ownership and commitment to sustainable practices within the community.

3.6. Opportunities for multi-Sectoral collaboration

There are opportunities for improvement, especially in enhancing the utilization of renewable energy in Sulawesi through inter-sectoral collaboration, even with the challenges present. A consensus was reached on the fact that identified barriers could be addressed by making the government, NGOs, and the private sector work in a better manner. For example, NGOs could carry out public education and information, while the private sector could provide finance and technology [35,36].

Such collaborations have been documented to succeed in other domains according to the literature, and thus it could be assumed that such partnerships could boost the development of renewable energy in the Sulawesi regions, given the right structures. This study draws attention to the presence of intersectoral collaboration, which appears informal and ad hoc, without preempting criticism and objections directed at such initiatives [19,24].

Multisector collaboration offers significant opportunities to promote and advance renewable energy projects in Indonesia, especially in the Sulawesi Selatan region. All stakeholders, including national and regional governments, participants in the private sector, and local communities, have actively participated in utilizing renewable energy. However, the complexities of regulatory, financial, and logistical challenges require the formation of more interconnected partnerships.

The development of renewable energy in Indonesia has received strong backing from legal frameworks. In particular, Undang-Undang No. 30 Tahun 2007 focuses on renewable energy issues, while Peraturan Pemerintah No. 79 Tahun 2014 regarding National Energy Policy underscores that energy policy encompasses broader social and economic development goals. Furthermore, Indonesia's commitment to the Paris Agreement, adopted through Undang-Undang No. 16 Tahun 2016, aims to reduce greenhouse gas emissions and increase the use of clean energy sources. Although these national regulations foster an environment conducive to renewable energy growth, there remains significant potential to improve coordination among various levels of government.

Over time, new regulations have emerged, implementing various policies such as the Rail Investment Policy Guidance and Peraturan Presiden No. 22 Tahun 2017, which pertains to the National Energy Plan (RUEN). Furthermore, measures like Peraturan Presiden No. 112 Tahun 2022, aimed at accelerating renewable energy development for electricity supply, and Peraturan Presiden No. 11 Tahun 2023, help clarify government responsibilities in renewable energy while promoting both vertical and horizontal integration. However, challenges persist, particularly in regional and local contexts, where many areas struggle with limited provincial budget allocations for effective policy implementation.

Despite these policies, there are still gaps in authority and funding, especially at the Kabupaten/Kota organizational level. Local authorities often lack the full powers needed for energy projects, preventing them from developing or promoting renewable energy initiatives within their jurisdictions. This lack of authority and budgetary support hinders local governments from

actively participating in renewable energy development, even though they are located near project hubs.

The private sector, particularly PT PLN (Persero), plays a crucial role in the supply of electricity throughout Indonesia. As a government-owned corporation, PLN faces challenges related to infrastructure, manpower, and the operational costs of renewable energy sources compared to non-renewable options like coal-based power plants. For instance, while solar power plant electricity costs range from 6 to 12 cents per kilowatt-hour, the costs for solar energy businesses and units are between 4 to 6 cents, making investments in renewable energy plants less appealing.

To address these financial challenges, it is essential to pool resources from both the public and private sectors. Such financing strategies can alleviate the financial burden on the state while attracting private investments. Additionally, incorporating Corporate Social Responsibility initiatives, as seen in Sidrap, provides stakeholders with a profitable means to support local infrastructure development and enhance public acceptance and engagement with renewable energy projects.

Notably, the restructuring of the energy sector necessitates the delegation of responsibilities to regional governments, which are tasked with formulating Regional Energy Plans (RUED) based on the National Energy Plan (RUEN). However, this has posed significant challenges, as provincial budgets are often insufficient to support the implementation of large-scale projects. Additionally, local governments at the kabupaten/kota levels have shown reluctance to accept energy responsibilities, despite the presence of various renewable energy project sites within their jurisdictions.

Community participation has played a crucial role in the success of renewable energy projects in the province of Sulawesi Selatan. Initiatives like the Sidrap Wind Power Plant (PLTB Sidrap) and Jeneponto Wind Power Plant (PLTB Jeneponto) actively involved local community members in both construction and maintenance phases. This approach not only accelerated project timelines but also mitigated potential social conflicts by fostering a sense of ownership among locals. Similarly, the biogas production project in Pangkep highlights how energy interventions can benefit the community by utilizing local resources, such as cattle dung.

Although there is significant potential for interaction, several issues persist in collaborative relationships. One major challenge is the lack of effective coordination between high- and low-level government officials. Although the National Energy Plan (RUEN) and Regional Energy Plans (RUED) provide a strategic framework to enhance capacity and utilizing renewable energy sources, coordination between the national and local levels has not been adequate. Policies tend to exist more as formalities, adhered to only insofar as they are politically expedient. Consequently, many critical factors can be overlooked, which undermines the viability of action plans.

The significant initial capital expenditure required for the deployment of new technologies remains a major concern. Specifically, the return on investment (ROI) of renewable energy projects, compared to coal-based energy investments, continues to challenge many investors. This issue is exacerbated by the lack of financial instruments tailored to the unique characteristics of renewable energy projects. To address this financing gap and promote investment in renewable energy, innovative financing mechanisms such as green bonds and climate finance are essential.

Moreover, the willingness of the people of Bulukumba to accept biomass or biomass briquettes remains limited. Many continue to rely on charcoal as an energy source because of its low cost and established use. Addressing these market barriers requires not only government subsidies but also effective public awareness campaigns to encourage a shift in consumer habits toward cleaner energy alternatives.

To fully realize the potential of multi-sectoral collaboration, a shift in approach is necessary. This includes empowering local governments to manage renewable energy resources and increasing

budgets for new renewable energy technologies at the provincial and local levels. Additionally, fostering connections between the state sector, private sector, NGOs, and communities is essential.

A balanced regulatory model that encourages coordination among all levels of government while stimulating private sector engagement through cost-sharing mechanisms could help address the challenges of high initial capital investment and low market penetration. In addition, ensuring the sustainable maintenance of renewable energy installations will require plans that incorporate technical training and capacity building for local communities.

4. Policy Implications

The results of this study have important implications for policymakers. First, there is a clear need for more localized and culturally sensitive public awareness campaigns to address the low levels of knowledge about renewable energy. Second, simplifying the regulatory environment and providing more accessible financing options could remove significant barriers to adoption. Finally, fostering stronger multi-sectoral collaborations could leverage the strengths of various stakeholders, leading to more coordinated and effective implementation efforts. Particularly in regions like Sulawesi that are currently lagging, these policy recommendations are crucial for meeting the national targets for renewable energy transition. The findings suggest that without targeted interventions, the disparities in awareness and adoption rates will likely persist, affecting the overall progress of Indonesia's renewable energy goals [15,19].

In Indonesia, particularly in Sulawesi Selatan, there are several common barriers to the success of renewable energy projects. Financial and cultural obstacles must be addressed. While governments have initiated regulatory frameworks like the RUEN (Rencana Umum Energi Nasional) and RUED (Rencana Umum Energi Daerah) policies to support renewable energy development, it is equally important to focus on policies that tackle the cultural and financial barriers, which often require more resources than are currently available.

Among the various barriers to the promotion of renewable energy in Indonesia, the high cost of renewable energy infrastructure stands out as a significant challenge. This is mainly due to the substantial upfront investment required compared to traditional energy sources. For example, the cost of electricity generation from solar power plants (PLTS) in Indonesia ranges from 6 to 12 cents per kWh, while coal-fired power generation (PLTU) costs only about 4 to 6 cents per kWh. This disparity makes renewable energy less viable and appealing to investors, especially since they often face longer payback periods and a generally lower return on investment (ROI) for renewable energy projects.

To address these financial constraints, the government should provide targeted subsidies and tax rebates to support renewable energy projects. For instance, developers could benefit from reduced interest rates on loans for renewable energy investments or receive subsidies to cover a portion of their development costs. Additionally, the government could utilize green bonds and other climate finance instruments to attract both local and foreign investors.

Another effective policy measure is to promote Public-Private Partnerships (PPPs), where the public and private sectors share the risks and returns of renewable energy investments. By harnessing private sector participation through these collaborative financial models, the limitations of government financing for renewable energy development can be effectively addressed.

The ministry should encourage the development of innovative financial approaches or products geared to facilitate the fundraising of renewable energy projects. For example, blended finance can play a crucial role in mitigating the risks faced by investors due to insufficient funding from local or external partners.

Additionally, encouraging community financing for small renewable energy systems can be achieved through strategies like microfinance or contributions from local governments. This approach fosters local investment in renewable energy projects and cultivates a sense of ownership, reducing reliance on the central government for funding.

Many individuals resist adopting renewable technologies because they perceive them as too different from their traditional practices. The local population continues to rely on conventional energy sources, such as firewood and biomass. The long-standing use of firewood and biomass, along with cultural practices that incorporate wind for activities such as sailing, farming, and fishing, suggests that the acceptance of renewable energy technologies depends on their alignment with local customs and norms.

When implementing renewable resource projects, it's essential to consider the inclusivity of affected communities. Evidence-based government policies should support the introduction of new technologies by involving the local population from the initial stage of the project through the integration process. For instance, wind energy projects in Sidrap and Jeneponto could be marketed as innovative extensions of traditional sailing practices among the Bugis-Makassar, thus fostering cultural identification.

A significant cultural barrier is the public's lack of understanding regarding the importance of renewable energy. Some initiatives may appear foreign or intrusive, leading to resistance. To address this, the government could implement public education programs that inform communities about the ecological and economic benefits of renewable energy. These campaigns should resonate with local culture and emphasize how renewable energy can complement rather than replace traditional practices.

Strategies must also focus on actively engaging and empowering local populations. To foster a sense of ownership, community members should be involved in the design, construction, operation, and maintenance of renewable energy projects. The government could establish vocational programs to equip residents with the necessary skills for these projects, ensuring their sustainability while creating job opportunities that contribute to local economic growth.

Renewable energy technologies that respect and incorporate the values of indigenous societies can effectively help overcome cultural barriers. For example, in the rural areas of Pangkep, where residents embrace biogas production from cattle manure, traditional farming practices can be seamlessly integrated to promote the use of renewable energy. This paper argues that when the government understands and incorporates local cultures into renewable energy projects, it improves community willingness to accept and actively participate in these initiatives.

To facilitate the adoption of renewable energy initiatives in Indonesia, it is essential to address both supportive policies and cultural considerations simultaneously. Solutions should not only focus on providing financial assistance and local incentives but also take into account the cultural context of the targeted communities. By fostering collaboration that aligns global perspectives with local participation, Indonesia can become a focal point for sustainable energy development, attracting international investment while ensuring community engagement.

5. Conclusion

This research indicates that the level of public awareness of renewable energy in Sulawesi, especially in rural areas, is still low. Of 400 respondents, only 27 percent understood renewable energy technologies, including solar and wind, and their levels were significantly low in rural areas such as Pangkep and Polewali Mandar. This situation is made worse by the unavailability of sources, including education and information in such areas. In terms of public awareness, the study concludes that there is a statistically significant relationship between demographic factors such as

education level, income, and the level of public awareness of renewable energy, necessitating the formulation of relevant campaigns. The campaigns should address the cultural aspects, such as defining how renewable technologies align with local norms. In some areas, this alignment can pose challenges for the implementation of additional mechanisms.

Under stakeholder engagement, this study goes beyond public awareness to highlight the challenges faced in the adoption of renewable energy. At the subnational level, financial constraints and regulatory complexities present significant barriers to implementing renewable energy policies. However, there is substantial potential for cross-sectoral collaboration among government, the private sector, and communities to enhance the acceptance of renewable energy sources. Policies that are more accommodating and that address local practices and culture, while also empowering communities with technical knowledge, are crucial for ensuring the long-term sustainability of renewable energy projects in Sulawesi. This study provides practical recommendations for stakeholders to navigate existing obstacles and foster a more effective energy transition in Indonesia's energy policies.

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