



Impact Assessment Tools for Renewable Energy Investments in Orang Asli Communities

Muhammad Ridhuan Tony Lim Abdullah, Farrah Ilyani Che Jamaludin and Mohd Ikhwan Izzat Zulkefli

Department of Management and Humanities, Universiti Teknologi PETRONAS, 32610 Seri Iskandar, Perak Darul Ridzuan Malaysia.
farrahilyanicj@gmail.com

Abstract. This study addresses the pressing need for comprehensive impact assessment instruments tailored to renewable energy investments in Orang Asli territories, indigenous peoples of Peninsular Malaysia. Despite the promises of sustainability, such investments present challenges and risks to indigenous communities, including land displacement and socio-cultural disruptions. Traditional impact assessment methodologies often fail to capture these complexities. Therefore, employing the Nominal Group Technique (NGT), this study identifies indicators and sub-indicators for impact assessment instruments specific to Orang Asli communities. Seven participants, including policymakers, academics, Orang Asli representatives, and NGOs, engaged in structured group discussions to prioritize key indicators. The results revealed seven indicators and 25 sub-indicators, with economic improvement ranking highest. Specifically, "Improving the Economic Level of Orang Asli" ranked first, followed by "Ensuring the Safety of Residents" and "Improving the Social Value of Orang Asli Communities," both at second place, "Improving the Level of Education Among Orang Asli" and "Preserving the Customs and Culture of Orang Asli" at fourth place, "Improving the Skills of Orang Asli" at sixth place, and "Improving the Quality of Health Among Orang Asli" at seventh place. This study contributes to ongoing dialogue on renewable energy development and indigenous rights, fostering inclusive and equitable outcomes for Orang Asli communities.

Keywords: Renewable energy investments, Orang Asli communities, Impact assessment, Nominal Group Technique (NGT), Indigenous rights

1 Introduction

The Orang Asli, the indigenous peoples of Peninsular Malaysia, possess a unique cultural heritage and a profound connection to their ancestral lands, which have sustained their traditional livelihoods and spiritual practices for generations (Ahmad et al., 2022). However, the increasing demand for renewable energy, driven by Malaysia's commitments to sustainability and energy security, has intensified the development of renewable energy projects in these regions. These projects, including hydropower, solar, and wind energy installations, often intersect with Orang Asli territories, raising critical

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concerns about their impacts on indigenous communities (Yalamala et al., 2023). While renewable energy initiatives are generally viewed as environmentally beneficial and economically advantageous, they also pose significant risks to indigenous populations. These risks include land displacement, disruption of access to natural resources, and socio-cultural upheavals, all of which threaten the Orang Asli's way of life (Rioux-Gobeil & Thomassin, 2024; Senyapar & Bayindir, 2023; Stephanie & Pouhe, 2024a). Conventional impact assessment methods, such as Environmental Impact Assessments (EIA) and Social Impact Assessments (SIA), fall short in addressing the unique challenges faced by the Orang Asli, as they frequently overlook the socio-cultural dimensions of Orang Asli and long-term consequences of these projects.

The limitations of conventional impact assessment approaches highlight the need for more inclusive and culturally sensitive instruments that can effectively capture the specific concerns and priorities of indigenous communities. This need is particularly vital in the context of the Orang Asli, whose cultural identity, traditional knowledge systems, and spiritual ties to their land are intertwined with their overall well-being. The absence of tailored assessment tools not only risks overlooking these critical aspects but also exacerbates the marginalization of the Orang Asli in decision-making processes related to renewable energy development. To address the gap, this study is to identify key indicators and sub-indicators for developing a comprehensive impact assessment instrument specifically tailored to renewable energy investments in Orang Asli communities.

2 Literature Review

The global shift towards renewable energy has been driven by the urgent need to mitigate climate change and reduce reliance on fossil fuels. However, the development of renewable energy projects, particularly in indigenous territories, has raised significant concerns regarding the socio-cultural and economic impacts on indigenous communities. Research has shown that while renewable energy projects can offer potential benefits, such as economic opportunities and improved infrastructure, they often bring challenges related to land rights, displacement, and cultural erosion (Rioux-Gobeil & Thomassin, 2024; Senyapar & Bayindir, 2023; Stephanie & Pouhe, 2024b). For instance, hydropower projects in indigenous regions have led to the flooding of ancestral lands, disrupting traditional livelihoods and displacing communities (Randell & Curley, 2023). Similarly, solar and wind energy projects have been associated with land acquisition conflicts and the marginalization of indigenous voices in decision-making processes (Stephanie & Pouhe, 2024b).

Traditional impact assessment methodologies, such as Environmental Impact Assessments (EIA) and Social Impact Assessments (SIA), have been criticized for their inability to adequately capture the complex socio-cultural dimensions of indigenous communities (Kwon et al., 2024; Putu Wulan Romianingsih et al., 2023). These assessments often focus on quantifiable factors, such as economic loss and environmental degradation, while overlooking intangible aspects, such as cultural identity, spiritual

values, and community cohesion (Chong et al., 2024). Furthermore, conventional assessments typically involve top-down approaches, with limited participation from indigenous communities, leading to assessments that do not fully reflect the needs and concerns of the affected populations (Adams et al., 2023; Kūkea Shultz & Englert, 2023). In response to these challenges, there has been a growing call for the development of culturally sensitive and participatory impact assessment frameworks that incorporate indigenous knowledge systems and prioritize the voices of indigenous communities (Akalibey et al., 2024; Sakapaji et al., 2024). Such frameworks should be designed to address the unique vulnerabilities of indigenous peoples, including their dependence on land and natural resources, as well as their cultural and spiritual connections to the environment (Cram et al., 2023).

The Orang Asli, the indigenous peoples of Peninsular Malaysia, have a rich cultural heritage and a deep connection to their ancestral lands (Sadeka et al., 2023a). However, the expansion of renewable energy projects in Malaysia has posed significant challenges to the Orang Asli communities, including land displacement, loss of access to traditional resources, and disruptions to their socio-cultural practices (Selvaratnam et al., 2023a). Despite the Malaysian government's efforts to promote sustainable development, the implementation of renewable energy projects in Orang Asli territories has often been met with resistance from the communities due to concerns over land rights and the potential negative impacts on their way of life (Guglyuvatyy, 2024; Risamasu, 2024). Research on the Orang Asli's engagement with renewable energy projects has highlighted the need for more inclusive and participatory approaches to impact assessment. Studies have shown that the Orang Asli communities are often excluded from the decision-making processes, leading to outcomes that do not align with their values and priorities (Pelet et al., 2023; Sadeka et al., 2023b; Yh Loh & Idrus, 2023a). Additionally, there is a lack of culturally sensitive assessment tools that can adequately address the specific challenges faced by the Orang Asli in the context of renewable energy development.

The Nominal Group Technique (NGT) is a structured method for facilitating group discussions and reaching consensus among participants (Lee et al., 2024). NGT has been widely used in various fields, including healthcare, education, and community development, to identify and prioritize issues of concern (Al-Yateem et al., 2024; A. Q. Othman et al., 2023; Phuong & Huynh, 2023; Smith et al., 2024a). The technique involves gathering a diverse group of stakeholders to discuss a particular topic, generating ideas, and ranking them based on their perceived importance (Smith et al., 2024b). In the context of impact assessment for indigenous communities, NGT offers a participatory approach that allows for the inclusion of multiple perspectives, including those of indigenous representatives, policymakers, and researchers. By facilitating open dialogue and consensus-building, NGT can help ensure that the identified indicators and sub-indicators for impact assessment reflect the priorities and values of indigenous communities, leading to more culturally sensitive and relevant assessment tools.

The intersection of renewable energy development and indigenous rights presents a complex challenge that requires careful consideration of both environmental and socio-cultural factors. Traditional impact assessment methodologies have often fallen short in addressing the unique needs of indigenous communities, highlighting the need for more inclusive and culturally sensitive approaches. The use of participatory methods, such as the Nominal Group Technique (NGT), represents a promising step towards developing impact assessment instruments that are better aligned with the priorities and values of indigenous peoples, including the Orang Asli in Malaysia. By incorporating indigenous perspectives into the assessment process, renewable energy projects can achieve more sustainable and equitable outcomes for all stakeholders involved.

3 Methods

The Nominal Group Technique (NGT) was employed to identify relevant indicators and sub-indicators for developing Impact Assessment Instruments for Renewable Energy Investment in the Orang Asli community. NGT is a systematic group discussion technique established to facilitate discussion of diverse viewpoints, provide novel ideas, and establish criteria for ranking options (Maguire et al., 2022). The fundamental nature of the system promotes collaboration and expedite the generation of tangible outcomes (Mullen et al., 2021). NGT, based on social science research, serves as a systematic technique for gathering and prioritising information in a group setting. The technique involves structured group conversations where members individually produce ideas or priorities, followed by sharing and discussing collectively to reach a consensus (Herron & Runacres, 2023). This adaptable approach has been effectively utilised in different settings, such as assessing support needs of dementia caretakers (Martin et al., 2023), constructing complex nominal group structures in various linguistic settings (Mahmood et al., 2023), identifying critical employability skills for finance graduates (Nonterah et al., 2023), ranking barriers and motivation in renal transplant evaluations and formulating informed consent declarations for dry needling treatment (Ickert et al., 2023). This study provides an in-depth understanding of participant views and preferences by utilising NGT and including them collaboratively in the research process. This method provides a process-oriented approach to collect and analyse data, providing a better understanding of the intricacies of developing Impact Assessment Instruments for Renewable Energy Investment on Orang Asli.

3.1 Participant

After a thorough selection process, seven (7) participants had been selected to participate in this phase of the study. Purposive sampling was employed in the present study, wherein participants were deliberately chosen based on predetermined criteria that were considered essential to achieving the study's objectives. This study included important stakeholders, including policymakers, academics, representatives of the Orang Asli, and NGOs. A diverse range of backgrounds and perspectives was ensured through the detailed selection process for these individuals, which is important when

studying relevant indicators and sub-indicators for Impact Assessment Instruments on Orang Asli in the Context of Renewable Energy Investment.

3.2 Data Collection Process

In this study, data collection was carried out via an interactive workshop that invited selected participants to the session. Through the workshop, the NGT can be implemented conveniently, and participants can propose indicators and sub-indicators as well as discuss the reason for their selection. According to Srivastava, et al., data collection through a workshop can provide an opportunity to collect information interactively and analyse it continuously.

3.3 Procedure and Data Analysis

In this study, the procedure for conducting the NGT approach consists of five steps. Therefore, the procedure of the NGT is as follows:

Step 1: Briefing on the Research.

The first step of the NGT involves the facilitator explaining the research to the participants. In this study, the facilitator begins the workshop session with the following agenda: (i) welcome all participants and introduce each participant, (ii) explain the background of the study, the objectives of the study, and the method of study, and (iii) explain the anticipated outcomes should be obtained after the workshop.

Step 2: Silent Generation Idea.

Ideas for the proposed indicators and sub-indicators for the Impact Assessment Instruments for Renewable Energy Investment on Orang Asli were created during a brainstorming session. Every participant had the opportunity to generate ideas individually and without interacting. Participants must jot down suggestions that align with the indicators and sub-indicators for the Impact Assessment Instruments for Renewable Energy Investment on Orang Asli on the sticky notes provided, drawing upon their expertise and experience.

Step 3: Round Robin Sharing.

After the brainstorming session, the facilitator collected all the sticky notes and sticks them on the board without engaging in discussion until all ideas have been presented (Ritter & Mostert, 2018).

Step 4: Discussion of Ideas.

All the ideas generated by the participants were listed on the board to be shared with others. They are allowed to discuss and clarify their ideas until all ideas are clear and agreed upon by all group members. However, the same idea will be selected by the facilitator to obtain opinions from the participants. Subsequently, all ideas were

grouped and divided into relevant themes without removing any of the ideas presented (Ritter & Mostert, 2018).

Step 5: Voting and Ranking of Ideas.

The voting process was conducted privately to determine the importance of each indicator and sub-indicator (Yahaya, 2020). The questionnaire was developed based on the list of indicators and sub-indicators for the Impact Assessment Instruments for Renewable Energy Investment on Orang Asli to obtain the opinions of the participants. Subsequently, participants were asked to rate the importance of each indicator and sub-indicators for the Impact Assessment Instruments for Renewable Energy Investment on Orang Asli using a Likert scale, ranging from 1 (extremely unimportant) to 7 (extremely important). In this study, the data were analysed descriptively to acquire the total score and percentage agreement using Microsoft Excel. In order to include each indicators and sub-indicators for the Impact Assessment Instruments for Renewable Energy Investment on Orang Asli, the percentage of agreement between participants must exceed 70%. According to the study conducted by Dobbie (2004), a score percentage above 70% was considered acceptable (Dobbie et al., 2004). Therefore, as shown in Table 2, the five steps of data analysis for NGT are as follows:

Table 1: Steps of data analysis.

Steps	Activities
Step 1	The number of participants involved in the study
Step 2	The formation and calculation of score values are based on the analysis of NGT template data (excel sheet)
Step 3	Convert the score values into percentage form to obtain the percentage of agreement value: $\text{Percentage (\%)} = \frac{\text{Total score} \times 100}{A \times B}$ <ul style="list-style-type: none"> – A = Total of participants – B = 7- point Likert scale
Step 4	Determining the acceptance of indicators and sub-indicators based on the percentage of agreement
Step 5	Determining the ranking of the indicators and sub-indicators based on the percentage agreement

4 Results

Table 2 presents the list of identified indicator and sub-indicators for the Impact Assessment Instruments for Renewable Energy Investment on Orang Asli. The results obtained from the feedback of the participants used a scale of seven through the Nominal Group Technique. The outcome displays that 7 elements and 25 sub-elements were agreed upon by the participants. The results indicated that “improving the economic level of orang asli” ranks first with 96% (Total Score = 47/ 49) among all indicators of Impact Assessment Instruments for Renewable Energy Investment on Orang Asli. This is followed by “improving the social value of orang asli communities” with 94% (Total

Score = 46/ 47), “ensuring the safety of residents” with 94% (Total Score = 46/ 49), “improving the level of education among orang asli” with 92% (Total Score = 45/ 49), and “preserving the customs and culture of orang asli” with 92% (Total Score = 45/49). On the other hand, “improving the quality of health among orang asli” was given the lowest priority with 89% (Total Score = 43/49).

Table 2: List of identified indicator and sub-indicators for the Impact Assessment Instruments for Renewable Energy Investment on Orang Asli.

No.	Indicator Sub-Indicator	Total Score	Percentage (%)	Status	Rank
A	IMPROVING THE ECONOMIC LEVEL OF ORANG ASLI	47	96%	Accepted	1
1	Measurement of household income level.	46	94%	Accepted	4
2	Increasing the diversity of economic activities (such as online businesses, marketing, and eco-tourism).	42	86%	Accepted	25
3	Development of agricultural technology.	44	90%	Accepted	10
4	Attracting foreign investors.	45	92%	Accepted	6
B	IMPROVING THE LEVEL OF EDUCATION AMONG ORANG ASLI	45	92%	Accepted	4
1	Increase in school attendance of Orang Asli students.	48	98%	Accepted	1
2	Improvement in academic performance of Orang Asli students.	43	88%	Accepted	15
3	Increase in the number of Orang Asli students attending higher education institutions.	42	86%	Accepted	21
4	Improvement in the literacy level of Orang Asli students.	42	86%	Accepted	22

5	Improvement in the literacy level of Orang Asli adults.	44	90%	Accepted	8
C	IMPROVING THE SOCIAL VALUE OF ORANG ASLI COMMUNITIES	46	94%	Accepted	2
1	Improvement of community unity (e.g., attendance at places of worship, community involvement in mutual aid programs).	44	90%	Accepted	9
2	Increase in the number of community activities (e.g., social activities such as recreational activities, local community meetings).	45	92%	Accepted	5
3	Enhancement of communication skills among Orang Asli society.	42	86%	Accepted	23
4	Increase in the level of interaction among the community members.	43	88%	Accepted	16
D	IMPROVING THE QUALITY OF HEALTH AMONG ORANG ASLI	43	88%	Accepted	7
1	Quality of healthcare services.	44	90%	Accepted	11
2	Orang Asli health level.	43	88%	Accepted	17
3	Improved disease control quality (e.g. dengue, polio, malaria).	43	88%	Accepted	18
4	Awareness of family planning.	42	86%	Accepted	24
E	ENSURING THE SAFETY OF RESIDENTS	46	94%	Accepted	3
1	Reduction of the threat posed by wild animals.	44	90%	Accepted	12
2	Improvement in the safety of residents (e.g. fewer accidents, falling trees, and so on).	44	90%	Accepted	13

F	IMPROVING THE SKILLS OF ORANG ASLI	44	90%	Accepted	6
1	Improvement of IT literacy among Orang Asli.	43	88%	Accepted	19
2	Enhancing of the employability skills of Orang Asli.	44	90%	Accepted	14
3	Creation of job opportunities channels (e.g. job vacancies advertisements).	45	92%	Accepted	7
G	PRESERVING THE CUSTOMS AND CULTURE OF ORANG ASLI	45	92%	Accepted	5
1	The level of practice of Orang Asli customs and traditions.	47	96%	Accepted	3
2	Improvement of Orang Asli handicraft products.	48	98%	Accepted	2
3	Increased efforts to promote Orang Asli culture.	43	88%	Accepted	20

Note: Acceptance percentage $\geq 70\%$

5 Discussion

The study has identified indicators and sub-indicators as a foundation for the development of impact assessment instruments specifically tailored to evaluate the effects of renewable energy investment on Orang Asli communities. These indicators span various dimensions including economic, educational, social, health, safety, skill development, and cultural aspects, thus reflecting the intricate nature of community development and the diverse range of impacts that renewable energy projects may have.

The economic well-being of Orang Asli communities is closely tied to renewable energy projects, offering opportunities for economic growth and livelihood enhancement. Indicators such as household income levels, economic diversification, and foreign investment attraction are crucial for assessing the impact of renewable energy initiatives on the Orang Asli's economic resilience and sustainable development Asli (Abdul Razak et al., 2023; Mahmud et al., 2022; Mohamed Yusoff et al., 2023). These projects not only create jobs and stimulate local economies but also alleviate financial

burdens associated with traditional energy sources. By integrating renewable energy into sustainable development agendas, policymakers can address broader socio-economic challenges, including poverty alleviation and infrastructure improvement, while preserving cultural heritage. Ultimately, renewable energy initiatives offer a pathway to inclusive and sustainable development that empowers indigenous communities and fosters long-term prosperity.

Understanding indicators related to school attendance, academic performance, and literacy levels among Orang Asli students is vital for evaluating the educational impact of renewable energy initiatives. By examining these indicators, valuable insights can be gained into the potential long-term benefits of renewable energy projects on educational attainment and socio-economic mobility within Orang Asli communities. Enhancing educational outcomes for Orang Asli students is critical for advancing human capital development (Abdullah, 2022; Ahmad et al., 2022). Monitoring school attendance among Orang Asli students, as highlighted in various studies (Ahmad et al., 2022; Puspa et al., 2023; Razak, 2022), plays a crucial role in identifying gaps in the education system and informing policies for enhancing accessibility and inclusivity. By tracking attendance, educational institutions can identify areas where Orang Asli students may face challenges, such as high dropout rates (I. W. Othman, 2022) and cultural mismatches in mainstream education (Rahman et al., 2021). Studies demonstrate that education significantly enhances renewable energy consumption (Hussain & Yousaf, 2022). The installation of renewable energy systems in educational facilities can lead to increased energy independence and improved educational conditions (Gilmour, 2022). By empowering Orang Asli individuals with education, they can access better opportunities, leading to improved living standards and overall well-being. Education acts as a comprehensive indicator of community development, reflecting progress in multiple dimensions. Therefore, investing in education for the Orang Asli is essential for assessing the holistic impact of initiatives like renewable energy projects on their communities, as education plays a pivotal role in shaping the future and sustainability of the Orang Asli population (Wallace et al., 2022).

Assessing the impact of Renewable Energy Investment on Orang Asli communities hinges on understanding their social value (Diansyah et al., 2022). Their participation in forest management underscores their deep connection with the land, emphasizing responsible resource utilization and minimal disruptions vital for ecosystem resilience (Selvaratnam et al., 2023b). However, persistent challenges confront some Orang Asli communities, including low socioeconomic status, limited healthcare access, and reliance on traditional medicine (Yh Loh & Idrus, 2023b). Moreover, the marginalization of Orang Asli by both state and society underscores the imperative for inclusive development initiatives that address their fundamental needs and safeguard their cultural heritage (Mahmud et al., 2022). Recognizing the social dynamics, community unity, and communication skills among the Orang Asli is pivotal in evaluating the potential impacts of Renewable Energy Investment on their well-being and sustainable development (Wallace et al., 2022). Considering these indicators and sub-indicators in Impact Assessment Instruments for Renewable Energy Investment on Orang Asli is crucial for

capturing the social dynamics and community well-being affected by such projects. Positive changes in these social aspects indicate the potential social benefits and sustainability of renewable energy initiatives within Orang Asli communities.

Investing in renewable energy has the potential to positively impact the accessibility and quality of healthcare services for Orang Asli communities, a crucial consideration for Impact Assessment Instruments for Renewable Energy Investment. Orang Asli communities often face challenges in accessing healthcare due to inadequate infrastructure, as highlighted in studies (Ithnin et al., 2021). Implementing off-grid renewable energy solutions can address this issue by enhancing healthcare facilities' electricity management (Selvaratnam et al., 2023b). Such solutions ensure reliable electricity supply, which is essential for powering medical equipment and maintaining healthcare services. By optimizing the use of renewable energy sources, these solutions contribute to improved healthcare services within Orang Asli communities. Furthermore, addressing the energy needs of Orang Asli communities through renewable energy investment can have broader socio-cultural implications, ultimately enhancing their overall well-being (Mahmud et al., 2022). Access to reliable energy supports various aspects of daily life, including healthcare, education, and economic activities, thus improving the quality of life for community members. This holistic approach aligns with the goal of leaving no one behind in healthcare advancements (Ndinechi et al., 2022). Therefore, investing in renewable energy not only enhances healthcare accessibility but also contributes to the sustainable livelihoods of Orang Asli communities, underscoring the importance of considering healthcare impacts within Impact Assessment Instruments for Renewable Energy Investment.

The safety of residents, which encompasses efforts to mitigate threats from wild animals and enhance overall safety, serves as a critical aspect of Impact Assessment Instruments for Renewable Energy Investment among Orang Asli communities. Addressing wildlife threats is imperative to safeguard community members from physical harm and property damage, as emphasized by Le et al. (2023) (Le et al., 2023). Additionally, enhancing safety involves the prevention of accidents and risks such as falling trees, a goal that renewable energy projects can achieve through appropriate infrastructure measures and the provision of reliable electricity access, thereby reducing dependence on hazardous energy sources, as suggested by Trevisan et al. (2023) (Trevisan et al., 2023). By incorporating these safety indicators into assessments, stakeholders can comprehensively evaluate the safety impacts of renewable energy investments on Orang Asli communities, ultimately contributing to the enhancement of their quality of life and overall well-being, as highlighted by Hrinchenko et al. (2023) (Hrinchenko et al., 2023).

Enhancing IT literacy, improving employability skills, and creating job opportunities are pivotal aspects of Impact Assessment Instruments for Renewable Energy Investment among Orang Asli communities, as highlighted by Rendana et al. (2023) and Selvaratnam et al. (2023) (Rendana et al., 2023; Selvaratnam et al., 2023b). These sub-indicators play a crucial role in empowering Orang Asli individuals by providing them

access to digital resources, equipping them with valuable job skills, and expanding their employment opportunities, as emphasized by Mohd Khir et al. (2023) and Thi et al. (2023) (Mohd Khir et al., 2023; Thi et al., 2023). The objective is to integrate community members into the formal labor market, improve their economic prospects, and alleviate poverty within Orang Asli communities, as advocated by Ahmad et al. (2022) (Ahmad et al., 2022). Incorporating these indicators into Impact Assessment Instruments enables the comprehensive evaluation of the socio-economic impacts of renewable energy investments, aligning with sustainable development goals and fostering overall community development.

Preserving the customs and culture of indigenous communities like the Orang Asli is crucial for Impact Assessment Instruments in renewable energy investments. The level of practice of Orang Asli customs and traditions reflects cultural continuity and identity (Malakar & Roy, 2022; Tradisi et al., 2023), essential for maintaining heritage and social cohesion. Improving Orang Asli handicraft products not only preserves cultural heritage but also enhances economic sustainability by providing income opportunities (Agatha et al., 2022; Nur Farziana & Rahah, 2023). Additionally, efforts to promote Orang Asli culture through events, education programs, and media campaigns raise awareness and appreciation for indigenous traditions (Diansyah et al., 2022; Erlangga, 2023). These indicators ensure a comprehensive evaluation of cultural impacts, emphasizing the importance of cultural preservation alongside economic and environmental considerations in renewable energy investments among the Orang Asli, crucial for sustainable development (Mouco, 2023).

5.1 Limitation and Recommendation

The identified indicators for assessing the impacts of renewable energy investment on Orang Asli communities offer a comprehensive approach to community development. They encompass various dimensions, including economic, educational, social, health, safety, skill development, and cultural aspects. This holistic perspective aligns with previous research emphasizing interconnectedness in community development. However, while these indicators cover a broad spectrum, there may be gaps in capturing certain nuanced aspects of Orang Asli communities' experiences and priorities. For instance, less quantifiable factors like traditional knowledge systems and land rights issues may not be adequately addressed. Additionally, the absence of indicators related to environmental sustainability raises concerns about the assessment framework's comprehensiveness, given the close relationship between indigenous communities and their ecosystems.

Future studies should aim to address these limitations by incorporating additional indicators that capture the cultural, environmental, and governance dimensions of renewable energy projects among Orang Asli communities. Qualitative research methods could be employed to delve deeper into the less quantifiable aspects of community experiences and perceptions. Longitudinal studies could also be conducted to track changes over time and assess the long-term impacts of renewable energy investments

on Orang Asli communities. Moreover, engaging Orang Asli community members in the research process through participatory approaches can ensure that their voices and priorities are adequately represented. By addressing these recommendations, future studies can contribute to a more holistic understanding of the impacts of renewable energy investment on Orang Asli communities and inform more effective and equitable development strategies. developments, including biodiversity conservation, land use changes, and ecosystem services (Yalamala et al., 2023).

6 Conclusion

In conclusion, while the identified indicators provide a solid foundation for developing impact assessment instruments for renewable energy investment on Orang Asli communities, there is a need for critical reflection and refinement to address potential limitations and gaps. By balancing the inclusion of tangible development outcomes with the consideration of intangible cultural and environmental dimensions, the impact assessment instruments can offer a more comprehensive understanding of the complex impacts of renewable energy projects on Orang Asli communities. Moving forward, interdisciplinary collaboration and engagement with community stakeholders will be essential to ensure the relevance, accuracy, and effectiveness of the assessment framework in guiding sustainable development efforts tailored to the specific needs and aspirations of Orang Asli communities.

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