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Strategy and Implementation of Poverty Alleviation through New and Renewable Energy in East Sumba

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ABSTRACT

East Sumba Regency is located in East Nusa Tenggara (NTT) Province, Indonesia, a region known for its abundant natural resource potential, especially New and Renewable Energy (NRE) sources such as biomass, wind, and solar. The people of East Sumba Regency have long utilised NRE, as reflected in traditional concepts and practices, including the local wisdom of "Marapu". This potential and socio-cultural conditions encouraged the central and regional governments to develop NRE projects, referring to the "Asta Cita Pemerintah" concept through the national programme "Sumba Iconic Island" (SSI), with a target of achieving 100% energy availability from NRE by 2024. This study aims to identify, analyse, and implement poverty alleviation strategies through renewable energy management, while ensuring that local wisdom-based regulations can be implemented effectively. The data collection techniques employed are observation, documentation, and focus group discussions (FGDs). The analysis method employed was descriptive analysis, which involved describing the collected data using the PESTLE and SOAR approaches. The results of the study indicate that the most effective strategy for poverty alleviation through the management of new renewable energy (NRE) based on local wisdom in the East Sumba district is the S-A strategy.

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INTRODUCTION

East Sumba Regency is located in the East Nusa Tenggara (NTT) Province, Indonesia, a region known for its abundant natural resource potential, particularly in New and Renewable Energy (NRE) sources such as biomass, wind, and solar energy (Kuswardono, 2023; Lauranti & Djamhari, 2017; W. Setiawan et al., 2018). The intensity of sunlight in East Sumba Regency tends to be hot, dry, and sunny throughout the year, with

temperatures ranging from 25.8°C to 29.3°C, allowing for optimal production of Solar Power Plants (PLTS) (Badan Pusat Statistik, 2024; Mehang et al., 2017; Mukti et al., 2022). The varied topography of East Sumba Regency, with hills and highlands, is ideal for Wind Power Plants (PLTB), a strategic location between the Indian Ocean and the Timor Sea, creating a stable wind flow from both directions with an average wind speed of above 4 m/s to 8.1 m/s, more than the minimum limit of 4 m/s for a turbine with three blades to rotate (Hesty et al., 2025; Wibowo et al., 2020). Additionally, abundant livestock and agricultural waste, such as corn, rice, and sugarcane, can be utilised to meet the community's energy needs (Randjawali & Moy, 2019).

The people of East Sumba Regency have long utilised renewable energy, reflected in traditional concepts and practices, namely, the local wisdom of "Marapu", such as the use of sunlight to dry fishery and agricultural products, the use of wind for traditional sailing, and the management of water sources through customary rules (Kamuri, 2020; Lazuardi et al., 2014). This potential has encouraged central and regional governments to develop renewable energy projects, aiming to improve the economy and public welfare while reducing dependence on fossil fuels. This refers to the "*Asta Cita Pemerintah*" concept through the national "Sumba Iconic Island" (SSI) programme, with a target of achieving 100% renewable energy availability by 2024 (Hamzah et al., 2024; Keputusan Menteri Energi Dan Sumber Daya Mineral Repubik Indonesia, 2015; Lomi, 2016).

However, this achievement is still far from the established target. The latest report from the Central Statistics Agency (BPS) indicates that in 2024, the percentage of households with access to electricity in East Sumba Regency remained below the provincial and national averages, at 76.90% (BPS Provinsi Nusa Tenggara Timur, 2025). The electricity network in East Sumba Regency is fully distributed by PLN (State Electricity Company) using fossil fuels or Diesel Power Plants (PLTD) (Trisnawati & Sudiarto, 2024). On the other hand, many households still rely on traditional energy sources such as firewood and kerosene for cooking and lighting. Low access to electricity can also hinder local economic development, causing Micro, Small, and Medium Enterprises (MSMEs) to struggle in their development (Boer et al., 2015; Fevriera & Bima, 2024; Zebua, 2023).

The above conditions are exacerbated by the significant challenge of poverty, characterised by low levels of electrification, including the large number of villages not yet connected to the electricity grid, and limited access to renewable energy (Firman, 2020; Institute for Essential Services Refrom, 2018). Poverty is measured not only by low per capita income but also by limited access to basic services, such as affordable electricity (Mangi et al., 2024; Stevens et al., 2023). According to BPS, the percentage of people living in poverty in East Sumba Regency reached 30.12% in 2024 (Badan Pusat Statistik, 2025). Unequal access to electricity makes it difficult for low-income individuals to meet basic needs that support daily activities, such as lighting, water, cooking, and washing, thereby increasing the burden of economic expenses (Audina & Saputra, 2023; Christiani & Nainupu, 2021; Wen et al., 2022).

Apart from the problem of poverty, the business of utilising renewable energy still faces various major obstacles, namely, low understanding of long-term economic benefits (cost stability and fluctuations in fossil energy prices) (Asyhadi et al., 2024) and operating renewable energy facilities is still limited in terms of both number and capacity (Syafri & Bestianta, 2024). Limited funding for the development of renewable energy infrastructure is a burden on local governments and the community (Permana, 2023). Difficult-to-reach

geographical conditions can make it challenging to build and maintain renewable energy facilities (Corio et al., 2023; Ebed de Rosary, 2025), and regulatory uncertainty can hinder investment and innovation in the renewable energy sector (Mudhoffar & Magriasti, 2024).

Therefore, it is essential to ensure the sustainability and effectiveness of renewable energy utilisation by increasing understanding (including outreach and training), enhancing community participation, developing renewable energy sources, and strengthening regulations. These efforts are further illustrated by strategies for mapping potential and needs, developing appropriate renewable energy infrastructure, strengthening cooperation and financing, implementing consistent policies and regulations, and increasing research based on local wisdom (Alnavis et al., 2024; Firdaus, 2022; Haryanto et al., 2020; Kementerian Energi dan Sumber Daya Mineral, 2024; Konorop, 2025; Sianipar et al., 2024). The important role of management is a significant factor in addressing poverty alleviation through increased access to electricity, enhanced community income, and the preservation of local wisdom (Khotimah, 2018; Yana et al., 2022).

This research aims to identify, analyse, and implement strategies for poverty alleviation through renewable energy management, while ensuring that local wisdom-based regulations can be effectively implemented. This research also supports the government's strategic steps, as outlined in "Asta Cita" numbers five and six, namely, continuing the downstreaming of renewable energy, development from villages, economic equality, and poverty eradication (Subianto & Raka, 2024).

LITERATURE REVIEW

New and Renewable Energy (NRE) and Energy Transition in Indonesia

New and Renewable Energy (NRE) is an alternative energy source intended to replace dependence on fossil fuels (coal, oil, and gas) (Holechek et al., 2022; Karlilar Pata & Balcilar, 2024; Osman et al., 2023). In general, renewable energy is classified into two main categories according to the Law of the Republic of Indonesia, namely, Renewable Energy and New Energy (Aditya et al., 2025; Pambudi et al., 2023; Yudha & Tjahjono, 2019). Renewable energy is characterised by a significantly lower carbon footprint compared to fossil fuels, making it a key component in climate change mitigation efforts and achieving the Net Zero Emission (NZE) target. In Indonesia, the utilisation of bioenergy and geothermal energy is a primary focus due to the availability of domestic resources (Pambudi et al., 2023).

The Energy Transition is a shift in the global energy system from fossil fuel dominance to a more sustainable, low-carbon, and renewable energy-dominated energy system (Edomah et al., 2020; Genc & Kosempel, 2023). This transition is not only a change in resources, but also a structural, technological, economic, and social transformation. Indonesia faces an urgent energy transition driven by three main pillars: Environmental Sustainability, Energy Security, and Energy Access and Equity (A. Setiawan et al., 2025; Yasin et al., 2024). The energy transition in Indonesia faces challenges, including funding and Investment, Infrastructure and Intermittency, and Limited Human Resources and Technology (Aditya et al., 2025; Resosudarmo et al., 2023; A. Setiawan et al., 2025).

Access to Electricity and Poverty Issues

Electricity access is not just the availability of connections. However, it is broadly defined by international institutions as the Multi-Tier Framework/MTF (Narayan et al., 2018; Rabuya et al., 2021), which means measuring access based on five main dimensions, including: The amount of energy that can be consumed, the amount of energy that can be consumed, stable electricity voltage and frequency, energy prices not exceeding a certain percentage of poor household income, the frequency and duration of power outages, and the legality of the connection and type of service contract. Access to Electricity means a reliable, stable electricity supply capable of running household appliances and productive equipment at an affordable cost (Blimpo & Cosgrove-Davies, 2019; Salite et al., 2021).

Access to electricity serves as a mechanism to break the cycle of poverty through the operation of health facilities (vaccinations, medical equipment), enabling students to study at night with adequate lighting, as well as street and home lighting, extending social/community interaction time, and enabling Micro, Small, and Medium Enterprises (MSMEs) to operate at night (Salite et al., 2021; Sarkodie & Adams, 2020; Xiong et al., 2024).

RESEARCH METHODS

This research was conducted at the Padadita Beach Hotel Ballroom, East Sumba Regency, from May to September 2025. The location was selected purposively, considering that the building can accommodate representatives from various participants, including local government, PLN, sub-districts, community leaders, Non-Governmental Organisations (NGOs), the business world, and academics.

This type of research is descriptive with a combined research method of Sequential Explanatory model/design (combination of discovery sequences), namely, combining qualitative and quantitative research methods (mixed methods) (Babang et al., 2025; Ramompas & Panggabean, 2024; Takona, 2023). Qualitative methods are used to generate hypotheses in specific cases or limited samples, while quantitative methods are useful for testing hypotheses in the broader population. The data collected are primary and secondary. Primary data is obtained through observation, documentation, and in-depth interviews with informants (key informants). In contrast, secondary data is obtained from the results of literature studies in the form of data or information collected from official websites, books, journals, newspapers, magazines, or other written works relevant to the research topic.

This research employs a mixed-methods approach, utilising a descriptive design (Nair & Prem, 2020). Data analysis was then carried out using the Miles and Huberman model, which involves the stages of data collection, data reduction, data presentation, and verification/conclusion drawing (L.J Moleong, 2022). To measure strategy and implementation, data analysis was carried out using the SOAR and PESTLE approaches. The SOAR approach focuses on internal strengths and external opportunities that can be utilised to achieve poverty alleviation goals through local wisdom-based renewable energy management. Meanwhile, the PESTLE approach is used to analyse external factors to determine the most appropriate strategy for poverty alleviation through local wisdom-based renewable energy management.

Table 1. SOAR Matriks

Internal/Eksternal	Strength	Oppurtunities
Aspirations List of internal expectation factors	**SA Strategy** Creating a strategic focus on strengths to achieve aspirations	**OA Strategy** Strategies aimed at aspirations
Results List of measurable outcomes to be achieved	**SR Strategy** Creating strength-based strategies to achieve measurable results	**OR Strategy** Opportunity-oriented strategies to achieve measurable results

The data described using the PESTLE approach was then analysed using the SOAR matrix (Peni & Martayadi, 2022; Zhao & Huang, 2024). This analysis serves to plan the strategy and implementation of NRE in East Sumba by viewing weaknesses and threats as opportunities. The SOAR matrix enables strategic factors, such as strengths and opportunities, to be visualised and described, aligning them with aspirations and expected outcomes, thereby supporting future strategic decision-making (Cole et al., 2022; Stavros, 2017).

The data collection technique used is the Sequential Explanatory model through observation activities, followed by determining respondents, then conducting in-depth interviews with key informants to describe the EBT management strategy based on local wisdom through Focus Group Discussion (FGD), with key informant sources being the Head of the Regional Planning and Development Agency (BAPPEDA), Head of PLN UP3 (Implementation Unit, Customer Service) of East Sumba Regency, District Government (*Camat*, Section Head or Head of Development Section) where the implementation of EBT has been carried out, Community Leaders (Religious, Traditional, and Youth), Academics, Non-Governmental Organizations (NGOs), and MSMEs (Micro, Small and Medium Enterprises) in East Sumba Regency. Determination of the number and criteria of informants is based on the clarification of the representation of areas that have EBT potential in East Sumba Regency, according to sub-districts (north and south), which are divided into 4, namely, Haharu district, Pandawai district, Ngalu Ngada district, and Tubundung district.

After describing and understanding poverty alleviation strategies, further data collection is needed to measure community participation using questionnaires. The data analysis that has been formulated includes the following steps: First, organising and preparing data for analysis, which involves transcribing interviews, optical scanning of materials, typing field notes, collecting documents, sorting, and organising the data. Second, by reading all the data, understanding its meaning, and capturing the general ideas conveyed by participants, we assess the overall impressions, depth, reliability, and use of information using a prepared question framework through the SOAR and PESTLE matrices. Third, coding organises data with the SOAR and PESTLE matrix framework. Fourth, using the results of the SOAR and PESTLE coding matrices descriptively, which involves conveying detailed information about people, places, or events in a particular context. Fifth, interpretation through the SOAR and PESTLE matrices, by concluding the data obtained as a result of the research.

RESULTS AND DISCUSSION

Result

Overview of New and Renewable Energy (NRE) in East Sumba Regency

A general overview of a region includes aspects that explain the actual conditions of the region. Describing the conditions of a region is helpful in understanding the potential for New and Renewable Energy (NRE) in East Sumba Regency. It is also helpful in identifying, measuring, and optimally utilising natural resources. These aspects include geographic data, population occupations, social structure, and climate (He et al., 2022; Kouskoura et al., 2024; Sutton et al., 2023). East Sumba Regency is located in the eastern part of Sumba Island, covering an area of 7,000.50 km2. This region is located between 9°16'–10°20' South Latitude and 119°45'–120°52' East Longitude. It consists of 22 sub-districts. The regency capital, Waingapu, serves as the centre of government and economy (Badan Pusat Statistik, 2025). East Sumba's topography is highly diverse, characterised by coral hills and expansive savannas, with a tropical savanna climate that features a long dry season lasting over seven months. The average temperature in this region ranges from 27.9°C to 35.8°C, with an average humidity of 84% (Agritami, 2025). These favourable climatic conditions make East Sumba very promising for NRE development. Most people in East Sumba work in agriculture, animal husbandry, and fisheries, with the agriculture and animal husbandry sectors being the largest absorbers of labour (Ara, 2013; Henggu et al., 2021; Wadang et al., 2023).

In addition, there are other professions such as ikat weaving artisans, which is a typical regional craft. A small portion of the population works as labourers, private employees, and members of the State Civil Apparatus (ASN). The average educational level of workers in the agricultural, livestock, and fisheries sectors is that of elementary school (SD) and junior high school (SMP) graduates. The level of education and type of work greatly influence the way people behave (Ilham et al., 2024). For example, the people of East Sumba, who work as farmers, generally prioritise raw materials such as rice and corn for sale, rather than processing them to achieve a higher economic value. Socially, the people of East Sumba still adhere to a feudal caste system consisting of three levels. The highest caste is "Maramba" (nobles), followed by "Kabihu" (Middle Class), and "Ata" (servants or commoners) (Amma et al., 2023). This social hierarchy continues to significantly influence daily interactions and the roles of each individual in society (Daniel et al., 2021).

The Situation Regarding the Energy Transition on Sumba Island

Based on literature studies, the issue of energy security is a political priority for every country in the near future, as its political and economic impacts are already clearly visible (Rosa et al., 2022; Strojny et al., 2023). Evidence of this situation is the Indonesian government's decision to have an NRE mix target of 23% by 2025 (Loy et al., 2024). Government support through the "MENTARI" and "Sumba Iconic Island" programmes is the government's commitment to supporting Indonesia's energy transition (Florentina et al., 2024). Economically, Indonesia remains heavily reliant on coal, both for domestic needs and exports. The availability and price of energy (energy issues) are prioritised over efforts to shift to clean energy sources (energy transition). The investment needs for the energy transition are enormous and cannot be fully covered by the government. Limited financial resources make it challenging for regional and central governments to allocate funds for ambitious projects beyond meeting basic needs. The energy transition requires financing beyond the government budget. The only hope lies in financing breakthroughs,

such as collaboration with regional and international institutions, as well as market-based financing mechanisms, including green bonds and solar panel lease-purchase schemes.

Socially, the energy transition presents opportunities to expand electricity access, particularly in remote areas not yet connected to the PLN grid, ensuring equitable implementation. Electricity enables children in the interior of East Sumba to study at night, improves access to information (such as television), and supports local economic activities. However, this transition faces challenges, including a lack of public awareness about the importance of equipment maintenance. Technologically, each region has a varying level of technological readiness, driven by the heterogeneity of a region's ability to adopt, develop, and utilise technology, as well as the limited quality of human resources, such as technicians. Furthermore, solar power technology, especially in remote locations, often encounters technical challenges such as equipment damage and difficulties in obtaining spare parts.

Legally, the implementation of the energy transition in East Sumba depends on the support of local government policies to streamline the licensing and procurement processes for NRE projects. Therefore, clearer regulations are needed, from national to regional levels, to facilitate the investment and implementation of NRE projects. Environmentally, as an archipelagic nation, Indonesia is highly vulnerable to the impacts of climate change, such as rising sea levels and hydro-meteorological disasters (droughts and storms). The energy transition is one mitigation measure at the national and regional levels.

Identification of Internal Factor Evaluation (IFE) and External Factor Evaluation (EFE)

Identification of internal and external factors was conducted to identify factors both within and outside the management of NRE in East Sumba Regency, in order to design strategies and implement poverty alleviation based on local wisdom. The next step was to analyse and assess the external and internal environmental conditions in East Sumba. Identification was carried out through analysis of political, economic, social, technological, legal, and environmental factors (Saraswati et al., 2025).

After identifying factors through PESTLE, the next step is to analyse internal and external factors using SOAR analysis. Integrating PESTLE analysis into SOAR analysis will help identify specific steps for each factor, allowing for the formulation of appropriate strategies. PESTLE and SOAR analysis can also be integrated to uncover past and current successes and failures, as well as future ones, allowing us to address opportunities and challenges arising from current issues. Tables 1 and 2 present the results of internal and external identification formulated through field observations, literature reviews, and discussions with key informants. This process resulted in six specific variables (factors) for each category. The following results have been identified, encompassing both internal and external factors, as presented in Tables 2 and 3.

Table 2. Internal Factor Evaluation (IFE) Analysis for the Development of Renewable Energy in East Sumba

PESTLE Category	Internal Factors	Description
Political (P)	Local Government Commitment	A strong local government vision and mission to promote New Renewable Energy (NRE), reflected in policies and work programmes.
Economic (E)	Local Financial Resources	Limited local government budgets and community capital for initial investment in large-scale NRE projects. Funding often relies on grants or external assistance.
Social (S)	Local Wisdom and Culture	Cultural values and traditions of the East Sumba community support cooperation and sustainable use of natural resources. For example, the "*uma adat*" system, or traditional houses designed for energy efficiency.
Technological (T)	Human Resource Capacity and Local Innovation	Human Resource Capacity and Local Innovation: The ability of local communities to innovate and adapt to simple technologies, such as the independent use of waterwheels or mini solar panels. However, there are limitations in technical knowledge.
Legal (L)	Local Regulations and Customs	The existence of customary regulations governing land use and water resources can support or hinder the implementation of NRE projects. For example, customary rules regarding forest ownership and water sources.
Environmental (E)	Natural Resource Potential	East Sumba has significant potential for NRE, including solar energy (which is available year-round), wind, and micro-hydro. However, comprehensive and sustainable feasibility studies are lacking.

Based on the findings of Table 2, it can be concluded that there are 6 (six) internal factors of local wisdom-based NRE management strategy in East Sumba, including: (i) political factors, namely the commitment of the local government; (ii) economic factors, namely regional financial resources; (iii) social factors, namely local wisdom and culture; (iv) technological factors, namely human resource capacity and local innovation; (v) legal factors, namely regional regulations and customs; and (vi) environmental factors, namely the potential of natural resources.

The findings indicate that political support for NRE initiatives is crucial for the planning, resource allocation, and sustainability of renewable energy projects. Economically, financial constraints necessitate that local governments seek external funding and prioritise smaller projects or those with business models that are attractive to private investors. Socially, local wisdom and culture facilitate the adoption of NRE technologies, as sustainability principles are already accepted and collectively managed, having been passed down through generations. Technologically, the community's ability to adapt to simple technologies is a crucial asset for small-scale (off-grid) operations and maintenance. However, technical knowledge is limited in developing large-scale NRE or using more complex technologies.

Legally, the existence of customary and customary laws regarding forest and water source ownership can be key in obtaining location permits for micro-hydro power plants (PLTMH) or other NRE projects requiring land. NRE management must always consider and comply with both formal (regional regulations) and informal (customary) legal frameworks. Environmentally, NRE's vast potential represents a natural force that can be harnessed. However, this potential is limited by a lack of adequate studies, preventing it from being transformed into large-scale, planned, profitable, and feasible projects.

Table 3. External Factor Evaluation (EFE) Analysis for the Development of Renewable Energy in East Sumba

PESTLE Category	External Factors	Description
Political (P)	Central and Regional Government Policies	National and regional policies on NRE, such as Presidential Regulations (*PerPres*), Regent Regulations (*PerBup*), or laws providing incentives or subsidies, significantly influence project acceleration. Therefore, regulatory uncertainty can pose a threat.
Economic (E)	Foreign Investment and Aid	The flow of funds from private investors, donor agencies, or other countries for NRE projects in Indonesia could present significant opportunities for East Sumba. However, dependence on external funding can also pose risks.
Social (S)	Climate Change and Collective Awareness	Increasing global awareness of climate change is driving international support and collaboration for NRE projects. This issue presents an opportunity to secure technical and financial assistance.
Technological (T)	Technological Developments	Technological advances, such as the increasing efficiency of solar panels and wind turbines, facilitate the adoption of technology in regions, especially East Sumba. Challenges include technological gaps and the high cost of imported goods.
Legal (L)	Legal Framework and International Standards	The existence of international standards and agreements related to the environment and energy can influence national and regional policies. Compliance with these standards is often a requirement for receiving international assistance.
Environmental (E)	Impact of Climate Change	East Sumba Regency is located in an archipelago and is vulnerable to the impacts of climate change. Threats such as extreme droughts, storms, and sea-level rise emphasise the urgency of shifting to NRE.

Based on the findings of Table 3, it can be concluded that there are 6 (six) external factors of local wisdom-based NRE management strategies in East Sumba Regency, including: (i) political factors, namely regulations, central and regional government policies; (ii) economic factors, namely investment and foreign aid; (iii) social factors, namely climate change and collective awareness; (iv) technological factors, namely technological developments; (v) legal factors, namely the legal framework and international standards; and (vi) environmental factors, namely the impact of climate change.

The findings indicate that, politically, the success of the NRE project in East Sumba depends on regulatory support from the central government. Regulatory or policy uncertainty has hampered the sustainability of investment and project implementation. Economically, the NRE project in East Sumba has been highly dependent on funding from private investors, donor agencies, or other countries. This can pose financial and sustainability risks, particularly due to global geopolitical or economic conditions. Socially, climate change issues have increased international attention and support for NRE. This is crucial for attracting external resources to regions with limited capital and technology. Technologically, advances in technology can offer more varied solutions. However, dependence on global supply chains makes NRE projects sensitive to currency fluctuations and import policies. Furthermore, a lack of knowledge or expertise transfer can hinder regions from maximising and maintaining the technology independently.

Legally, the delegation of authority from the national to regional levels simplifies the licensing process for NRE investments while still adhering to international standards

(clean energy and social safeguards). Institutional capacity at the regional level is essential for translating international law into applicable and auditable regional regulations, including environmental impact analysis studies and transparent public consultation mechanisms. Environmentally, the transition to NRE is a form of mitigation (reducing global greenhouse gas emissions) and adaptation (building energy systems that are more resilient to weather disturbances such as storms, droughts, and other disruptions caused by climate change). Off-grid (small-scale) power plants offer resilience in the event of main electricity grid damage due to climate disturbances, such as storms, allowing them to continue operating and maintain energy supplies.

Strategy and Implementation of NRE Management Based on Local Wisdom

The SOAR matrix is a tool or method that can be used to formulate and implement strategies. This approach fosters involvement among stakeholders, making it highly effective in a dynamic environment (Cole & Stavros, 2019).

Table 4. The SOAR Analysis for the Development of Renewable Energy in East Sumba

Eksternal \ **Internal**	**Strengths (S)**	**Opportunities (O)**
	1. Political strength in the form of a commitment from the central and regional governments to develop NRE. 2. Economic strength in the form of abundant natural resource potential, such as solar, wind, and micro-hydro energy. 3. Social strength in the form of local wisdom and cultural values that support sustainable resource management. 4. Technological strength is the community's ability to adapt to simple technology. 5. Legal strength is the existence of customary regulations governing land use and water resources. 6. Environmental strength is the natural potential of East Sumba, such as high solar intensity and consistent winds.	1. Policies and regulations from the central government. 2. Economic opportunities in the form of access to external funding from private investors, donors, and international institutions. 3. Social opportunities in the form of improving the quality of life of the community through stable and affordable energy access, and reducing socioeconomic disparities. 4. Technological opportunities in the form of the development of increasingly efficient and modular NRE technology (small-scale/mini-grid), ideal for remote villages. 5. Legal opportunities in the form of national NRE regulations, supporting the development of small-scale and off-grid power plants, are relevant for remote areas. 6. Environmental opportunities in the form of mitigating climate change and drought, thereby accelerating NRE adoption.
Aspiration (A)	**S – A Strategy**	**O – A Strategy**
1. Political outcomes include establishing East Sumba as	1. Develop and optimise the independent management of	1. Develop investment proposals and feasibility

a national model for local wisdom-based NRE development. 2. Economic outcomes include achieving energy independence by not depending on fluctuating fossil fuel prices. 3. Social outcomes include empowering communities to independently manage NRE infrastructure independently, thereby increasing support for local wisdom-based community energy systems. 4. Technological outcomes include increasing the availability of small-scale equipment ideal for remote areas. 5. Legal outcomes include creating a transparent licensing process, certification, and ownership status for NRE assets, thus avoiding future legal disputes. 6. Environmental outcomes include reducing the impacts of climate change (long dry seasons) that can affect the availability of specific NRE resources, such as water.	small-scale NRE infrastructure to achieve energy independence in villages. 2. Develop an NRE roadmap and blueprint in East Sumba as a national learning centre integrated with culture and the environment. 3. Increase research and conduct feasibility studies on solar and wind energy potential on an ongoing basis to ensure large-scale NRE investments.	studies to attract funding from investors, donors, and international institutions, for example, in the form of a green climate fund. 2. Establish partnerships between universities and companies to introduce the latest technologies and train local human resources to adapt. 3. Improve and develop communication between the central and regional governments to align national and regional policies, ensuring they align with local needs and contexts.
Result (R)	**S – R Strategy**	**O – R Strategy**
1. Political outcomes include the issuance of regional regulations on NRE that adopt a local wisdom approach. 2. Economic outcomes include the creation of local jobs (for technicians and operators) and support for Micro, Small, and Medium Enterprises (MSMEs) through the provision of electricity. 3. Social outcomes include active community involvement in NRE projects, such as determining locations that do not violate sacred sites and establishing NRE management based on local communities or villages.	1. Establish and train community-based NRE management groups at the sub-district level, aligned with social structures or comprised of various community elements (village government, traditional leaders, youth, religious leaders, women, and NGOs). 2. Allocate regional budgets and human resources to establish small-scale NRE pilot projects in underserved villages, maximising the potential of solar and wind energy. 3. Draft and ratify regional regulations explicitly regulating and incentivising community-based NRE.	1. Establish and enhance partnerships with donor agencies and global organisations to secure grants for diesel generator replacement programmes. 2. Utilise international legal frameworks on indigenous peoples' rights and the environment as legitimate arguments in the process of applying for land and water use rights for NRE facilities. 3. Establish and enhance partnerships with NRE supplier manufacturers to establish workshops and provide technical training for local vocational or university graduates.

4. Technological outcomes include the development of low-cost NRE prototypes and increased skills in NRE operation and maintenance.
5. Legal outcomes include the recognition and protection of indigenous peoples' rights, thus providing a legal basis for community-based NRE management.
6. Environmental outcomes include reducing the use of diesel generators, thus aligning with global goals.

Thus, the most appropriate strategy to implement poverty alleviation through local wisdom-based new renewable energy (NRE) management in East Sumba Regency is the S-A strategy, which involves developing and optimising the management of small-scale NRE infrastructure independently, thereby achieving energy independence in the villages. In addition, it is also important to develop a roadmap and blueprint for NRE in East Sumba as a national learning centre integrated with culture and environment. This strategy involves continuously increasing research and conducting feasibility studies on the potential of solar and wind energy, involving both national and local researchers, to ensure the sustainability of large-scale NRE investments. Choosing the S-A strategy means utilising internal strengths (NRE potential and local wisdom) as much as possible to seize external opportunities (poverty alleviation and becoming a national learning centre in the field of renewable energy). This strategy is also often referred to as an "aggressive" or growth-oriented approach (Djadji & Adindarena, 2025; Halkos & Gkampoura, 2020; Juliana et al., 2020; Lv, 2023).

Discussion

NRE Strategy and Implementation for Poverty Alleviation in East Sumba Regency

NRE funding in East Sumba is highly dependent on foreign investment and aid. Funding mechanisms from donor agencies and the private sector must incorporate local financing mechanisms to mitigate the risk of dependence on external funding. Funds should be directed to NRE projects that directly create livelihoods and increase productivity among poor communities. Strategies and implementation must be multi-stakeholder, designed to create strategic partnerships, ensure synergy among various parties, ensure pro-NRE regulations, stable investment funds, and adopt technologies tailored to local capacities and circumstances. Thus, NRE not only provides energy access but also alleviates economic burdens, enhances the adaptive capacity of poor communities, creates employment opportunities, and fosters sustainable economic growth.

Barriers to poverty alleviation through local wisdom-based NRE in East Sumba Regency

Based on the results of the identification of internal and external factors, as well as the formulation of strategies and implementation of NRE for poverty alleviation in East Sumba district, there are complex obstacles and challenges, both from technical, financial, institutional, and socio-cultural aspects, namely: (i) Technical and operational obstacles such as expensive maintenance and spare parts costs, limited local human

resources and access to maintenance, geographical and infrastructure constraints. (ii) Institutional and financial obstacles such as low mobility of private investment, public funding challenges, unclear division of authority and regulations between central and regional governments. (iii) Social obstacles and local wisdom, such as limited understanding and sense of ownership, inability or reluctance to pay contributions, social conflict, and land acquisition. Overall, the biggest challenge in implementing the S-A strategy is bridging the gap between the significant resource potential and the technical, financial, and institutional capabilities required to manage technology continuously or sustainably and independently. The success of poverty alleviation through NRE is highly dependent on the extent to which operational and social obstacles can be overcome.

Figure

The figure presentation shall follow the following format:

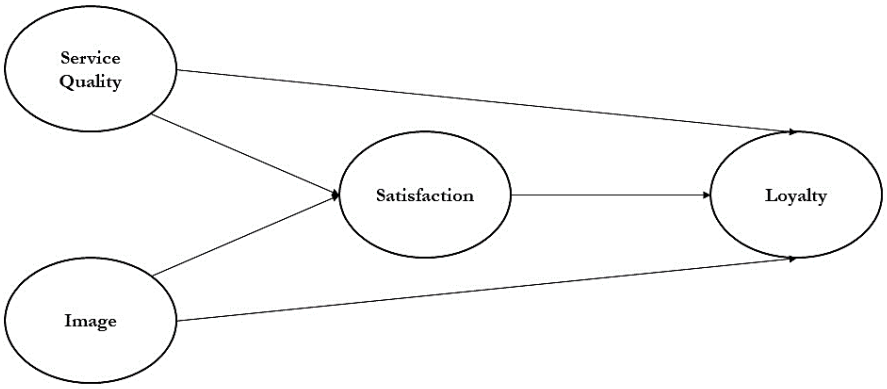

Figure 1. The Relationship between Variables

CONCLUSION

Based on the results and discussions explained above, the strategy and implementation of NRE for poverty alleviation in East Sumba district need to consider several factors, namely: The political aspect requires aligning the government's vision and mission, as manifested in policies among central, regional, district, and village governments, to attract the attention and support of international institutions for the NRE programme. The economic aspect requires the flow of funds from private investors, donor agencies, or other countries to support the NRE project in East Sumba, thereby covering the budget limitations of the central and regional governments. The social aspect requires active community involvement through deliberations, ensuring the project is accepted and aligns with local values and priorities. The technological aspect requires an increase in human resources for the operation and maintenance of NRE technology, through training and certification. The legal aspect requires simplifying NRE regulations, including asset ownership status, regional regulations that recognise and protect the rights of indigenous peoples to forest and water ownership, exemption from import taxes for NRE components, and encouragement of local manufacturing to close the technology gap. The environmental aspect requires the government to prioritise NRE not only in energy plans, but also in disaster mitigation and food/water security plans, making NRE part of the climate change adaptation strategy.

The most effective strategy for alleviating poverty through the management of local wisdom-based renewable energy (NRE) in East Sumba Regency is the S-A strategy. This involves developing and optimising small-scale NRE infrastructure independently. Key components of this strategy include creating a comprehensive roadmap and an NRE blueprint for East Sumba, positioning it as a national centre for learning that integrates cultural and environmental considerations. Additionally, it is essential to enhance research efforts and conduct feasibility studies on the potential for solar and wind energy, with participation from both national and local researchers.

This research faced several challenges. These obstacles stemmed from various aspects, including field issues, such as difficult access to infrastructure and several unconnected roads, which hampered access to the research location. Difficulties in data analysis arose from the limited availability of primary data and the reluctance of some informants to share detailed information or provide data due to a lack of understanding or trust, as was the case with some residents and the State Electricity Company (PLN). Difficulties were encountered in achieving the established targets, as this research was constrained by a limited budget and deadline, which made data analysis challenging and potentially compromised the quality of the output.

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