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# From Villages to Sustainable Energy Transition: Community-Based Financing Model through Village-Owned Enterprises (Bumdes)

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**Abstract**

Transitioning to sustainable energy sources is essential to ensure environmental sustainability and energy security. Integrating energy transition with local economic activities in rural areas remains challenging, particularly in developing innovative community-based financing mechanisms. This study explores how Village-Owned Enterprises (BUMDes), managing water tourism in Klaten district, Central Java, have initiated community-based financing models to support the utilization of water resources as an alternative energy source. The research involved 30 BUMDes affiliated with the Klaten Water Tourism Association. Using a qualitative case study approach, a SWOT analysis was applied to assess the strengths, weaknesses, opportunities, and threats of developing these financing models. Data were collected through in-depth interviews with BUMDes administrators, focus group discussions (FGDs), and analysis of financial and operational documents. The study provides an initial assessment of risk mitigation and implementation feasibility within the current institutional and regulatory frameworks. The results offer a structured framework for policymakers, BUMDes managers, and development institutions to evaluate the potential of community financing and water-based energy synergies in the rural tourism sector. Ultimately, empowering BUMDes to advance innovative community financing is expected to strengthen local community resilience and promote integrated rural development strategies in Indonesia.

**Keywords:** community financing, energy feasibility, SWOT analysis, village-owned enterprises, water-based tourism

## 1. Introduction

As one of the largest and most developed archipelagic countries in the world, Indonesia faces the dual challenge of meeting its climate commitments under the Paris Agreement while ensuring equitable and sustainable energy access for its population (Reyseliani et al., 2022; Rudenko & Tanasov, 2022; Soemanto & Koestoer, 2023). More than 12,000 villages continue to experience energy insecurity, ranging from limited grid connectivity to unaffordable costs or unstable supply (Bappenas, 2020). This situation threatens the achievement of the national renewable energy target of 23 percent in the primary energy mix by 2025, as stipulated in the National Energy Policy (KEN) and the National Energy General Plan (RUEN). One of the main barriers to accelerating the energy transition in rural areas is the absence

of innovative, inclusive, and locally contextualized community-based financing mechanisms (Einfeld et al., 2021).

In Indonesia, the transformation of village development policies is regulated through the Village Law No. 6/2014, which places Village-Owned Enterprises (*Badan Usaha Milik Desa*/BUMDes) as strategic instruments to manage village assets and enhance welfare (Hilmawan et al., 2023). Beyond their economic role, BUMDes can generate local income while pioneering small-scale renewable energy initiatives, highlighting their potential to bridge rural economic growth and the national energy transition agenda (Sofyani et al., 2019). Their established presence, particularly in rural finance and savings-and-loan units, positions them as credible institutions for piloting community financing to support renewable energy.

Community-based financing has long been recognized as an effective strategy for inclusive development in areas with limited access to formal financial services (Butu et al., 2021; Gao et al., 2019). In the energy sector, models such as cooperatives, *arisan* groups, and microfinance institutions have enabled rural communities to invest in small-scale energy systems previously unaffordable (Yoshino & Taghizadeh-Hesary, 2018). These mechanisms rely on trust, leadership, and collective responsibility to manage funds and ensure loan repayments (Ghofar et al., 2022; Hoicka et al., 2021). Previous studies also demonstrate that decentralized energy transitions succeed when financing mechanisms are embedded into governance structures and supported by strong local institutions (Delina, 2021; Hess & Sovacool, 2020; Johnstone, 2024).

Building on this literature, our study applies an analytical lens incorporating three interrelated dimensions. First, institutional capacity, referring to internal governance, leadership, financial management, and accountability mechanisms that shape BUMDes' ability to design and implement financing models (Budiman, 2018; Sofianto & Risandewi, 2021). Second, the community financing model design includes the structure of savings and loan products, repayment schemes, interest rate policies, revenue allocation, and integration with external finance (Liverani et al., 2024). Third, enabling environments, encompassing regulatory support, partnerships with government and private actors, technical assistance, and cross-sectoral policy harmonization (Bertolino et al., 2023; Revida et al., 2023). These dimensions provide a comprehensive framework for understanding how BUMDes can facilitate community-based financing for water-based energy initiatives.

Despite this potential, the role of BUMDes in renewable energy financing remains underexplored. Most prior studies focus on agriculture, trade, and microfinance (Badaruddin et al., 2021; Yaya et al., 2024), while investigations into community financing for energy remain limited (Larasdiputra et al., 2019). Moreover, regulatory frameworks such as the Village Law and Ministerial Decree of Villages, Development of Disadvantaged Regions, and Transmigration PDTT No. 4/2015 provide a legal basis for BUMDes but do not explicitly authorize their involvement in energy development, creating a regulatory vacuum. Weak policy synergy, fragmented coordination, and limited institutional capacity further hinder the scaling of community-based energy financing.

Against this backdrop, our study examines in depth how BUMDes engaged in water tourism in Klaten district, Central Java, and designed and implemented community-based financing mechanisms to facilitate the utilization of water-based energy. Using SWOT analysis, our study evaluates internal and external factors influencing these schemes and provides an initial assessment of their feasibility within current institutional and policy frameworks.

This study aims to address three core research questions. First, how do BUMDes that manage water tourism design and implement community-based financing mechanisms to enable water-based energy development? Second, what organizational and institutional determinants influence the success or failure of these schemes? Third, what policy and institutional support are required to expand and sustain community financing initiatives for rural energy development?

The findings of our study contribute both theoretically and practically. Theoretically, they expand understanding of how local institutions such as BUMDes function as community-based financial intermediaries in the renewable energy sector. Practically, the results provide a structured framework for policymakers, development agencies, and BUMDes managers to formulate strategies that strengthen institutional capacity, broaden access to renewable energy, and enhance rural economic resilience in line with Indonesia's sustainable development and climate change mitigation agenda.

## 2. Methods and Materials

Our study uses a qualitative case study approach (Creswell & David Creswell, 2018), allowing in-depth exploration of phenomena in real-life contexts. This approach was chosen to understand how BUMDes facilitates community-based financing mechanisms to support the use of water-based energy at the village level. The qualitative approach provides the flexibility to capture the perspectives of various stakeholders, trace institutional processes, and analyze local narratives and practices that cannot be measured quantitatively (Strijker et al., 2020).

Our study was conducted explicitly in the Klaten district, Central Java. It was selected purposively because it has a relatively advanced and active BUMDes ecosystem, particularly in managing water tourism business units. Central Java Province serves as a relevant empirical context because, as of 2024, it had 8,437 registered BUMDes, with more than 2,100 of them having achieved Advanced BUMDes status, indicating strong governance capacity and business capabilities. Many of these BUMDes have operated village savings and loan units to support renewable energy initiatives, including solar lighting, household biogas, and small-scale clean water infrastructure. However, the development of such initiatives remains scattered, lacks systematic institutional support, and has not been integrated into sustainable long-term financing policies or frameworks. In this context, our study focuses on 30 BUMDes that are members of the Klaten Water Tourism Association as the unit of analysis. These BUMDes were selected due to their active involvement in community-based water tourism management and their potential to pioneer innovative financing schemes for supporting community-scale water-based energy development.

To contextualize the research area and provide a clearer socio-economic background, Table 1 presents key indicators of Klaten district, including population, poverty rate, unemployment, electricity access, Village Development Index (IPD), and the number of active BUMDes. In 2024, Klaten had a population of approximately 1.17 million, with about 10.02 % living below the poverty line. The district comprises 391 villages, each supported by an active BUMDes (one per village). None of the villages fall under the 'underdeveloped' category according to the Village Development Index (IPD). The Open Unemployment Rate stood at 4.2 % in 2023, down from 4.31 % in 2022, indicating positive labour market absorption trends. Access to electricity reached 99.62 % of households, and the leading economic sectors are agriculture, small-scale industries, and tourism. These socio-economic characteristics provide an important backdrop for understanding the capacity of BUMDes in Klaten to design and implement innovative community-based financing mechanisms for energy transition initiatives.

This research process follows four main stages, as illustrated in Figure 1. The first stage involves the identification of the research context. It begins with exploring BUMDes' role as a facilitator of community-based financing mechanisms to support sustainable energy transitions in villages. Activities included literature studies on community financing and renewable energy policies in Indonesia, analysis of relevant regulations, and initial interviews with BUMDes administrators as a preliminary study.

The second stage focuses on identifying opportunities, threats, strengths, and weaknesses (SWOT) factors. This step is carried out to understand the internal and external factors influencing BUMDes' capacity to develop a community-based financing model. Internal factors analyzed include organizational governance, leadership, financial management, and community participation. External factors include the policy environment, technical capacity, and partnerships with external parties. The analysis tool used is the SWOT Matrix to map the strengths, weaknesses, opportunities, and threats.

Data were collected through in-depth interviews, focus group discussions (FGDs), and document analysis. The informants of this research are presented in Table 2.

**Table 1.** Socio-economic profile of Klaten district in 2024/2025.

| Indicator | Value | Source |
|---|---|---|
| Population (2024) | 1,176,200 people | BPS Klaten, 2025 |
| Poverty Rate (%) | 10.02 % | BPS Klaten, 2025 |
| Number of Villages | 391 villages | BPS Klaten, 2025 |
| Number of Active BUMDes | 391 BUMDes (one per village) | Kemendesa PDTT, 2024 |
| Village Development Index (IPD) | No villages are categorized as "Underdeveloped." | BPS Klaten (via IPD mapping) |
| Open Unemployment Rate (TPT) (2023) | 4.2 % | BPS Klaten / Katadata, Dec 2024 |
| Electricity Access (%) | 99.62 % of households | BPS Klaten, 2025 |
| Main Economic Sectors | Agriculture, Small Industries, Tourism | BPS Klaten, 2025 |

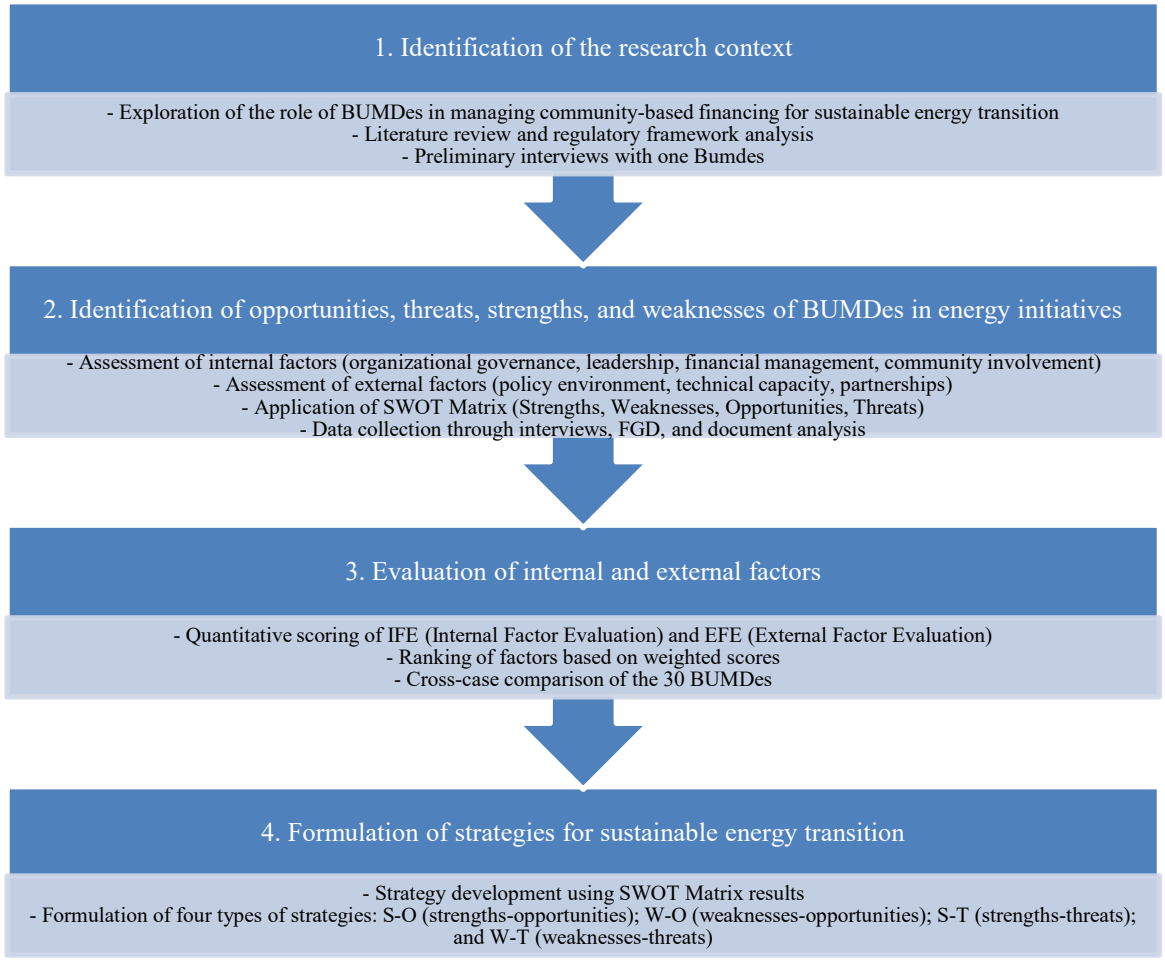


**Figure 1.** Research step.

**Table 2.** List of informants and data collection.

| Step | Type of organization | Data collection | Informant |
|---|---|---|---|
| 1 | 1 BUMDes | Semi-structured interviews | Director |
| 2 | 5 BUMDes | Semi-structured interviews | Director |
| | 8 BUMDes + community | Focus Group Discussion | Director+key informant from the community |
| 3 | 30 BUMDes | Questionnaire | Directors and operational managers |

The third stage is the evaluation of internal and external factors. After identifying the SWOT factors, quantification was conducted using the Internal Factor Evaluation (IFE) and External Factor Evaluation (EFE) approaches. Each factor was given a weight and score to produce a weighted score value (Habiburrahman et al., 2025). The quantification results were used to rank the dominant factors that influence the success or failure of BUMDes in facilitating community financing. In addition, a cross-case comparison analysis was carried out to obtain uniform or varied institutional patterns among the 30 BUMDes studied.

The final stage is the formulation of strategies for community financing development. The strategy is based on the SWOT analysis results and is structured into four primary categories: S-O (Strengths-Opportunities), utilizing BUMDes' internal strengths to seize external opportunities; W-O (Weaknesses-Opportunities), minimizing internal weaknesses by using opportunities; S-T (Strengths-Threats), using internal strengths to overcome external threats; and W-T (Weaknesses-Threats), minimizing weaknesses to avoid external threats.

## 3. Results and Discussions

### *3.1 Implementation of Community-Based Financing by Water Tourism BUMDes*

The socioeconomic profile of Klaten provides critical insights into the feasibility and design of community-based financing for energy. The relatively large population of over 1.17 million people, combined with the presence of an active BUMDes in each of the 391 villages, creates both scale and institutional capacity to mobilize local resources. However, the poverty rate of 10.02 percent and an open unemployment rate of 4.2 percent underline the importance of designing inclusive and affordable financing schemes that can support vulnerable groups while sustaining participation in community projects. Although electricity access has reached 99.62 percent of households, several villages continue to report issues with reliability and affordability, signaling that universal access does not always translate into a secure and sustainable energy supply. These conditions strengthen the relevance of BUMDes-led financing initiatives, which are not only positioned to complement existing government electrification programs but also capable of pioneering small-scale renewable energy solutions tailored to community needs.

BUMDes primarily provides support through low-interest soft loan schemes to community groups or tourism business managers (Nasfi et al., 2023). These schemes fund operational and infrastructure needs, including the construction of bathing pools, water flow management systems, sustainable water discharge control, and maintenance of eco-based water tourism facilities. A key characteristic of BUMDes' community-based financing is the emphasis on collective decision-making and community participation in managing and monitoring funds (Hilmawan et al., 2023). Loan decisions are made through village consensus forums and are accompanied by flexible repayment schemes, which foster strong community ownership and have led to high repayment rates (Arifin et al., 2020).

BUMDes are affiliated with the Water Tourism Association in Klaten District. The findings reveal that most BUMDes have established and operated village-level savings and loan units, which serve as the primary mechanism for supporting financing for water tourism infrastructure while also opening

opportunities for the future integration of water-based energy development. To provide an overview of the units analyzed in this study, Table 3 summarizes the characteristics of the 30 BUMDes under the Klaten Water Tourism Association. The data show that while these BUMDes primarily manage water tourism, many have also diversified into savings and loan services, with average revenues ranging from modest operations to several billion rupiah annually. Community participation, structured reinvestment, and gradual piloting of energy-related initiatives provide important institutional foundations for developing community-based financing schemes that can be scaled up to support village-level energy transition.

**Table 3.** Summary profile of 30 BUMDes under the Klaten Water Tourism Association.

| Indicator | Average / Range | Notes |
|---|---|---|
| Year of establishment | 2014 – 2019 | Most BUMDes were established after Village Law No. 6/2014 |
| Main business units | Water tourism (100%), savings and loans (70%), kiosks/shops (40%) | The majority combine tourism with microfinance services |
| Average number of employees | 12 (range: 5 – 30) | Mix of permanent staff and community-based seasonal workers |
| Annual revenue | IDR 250 million – 6.4 billion (average IDR 850 million) | Highly varied depending on tourist volume and facilities |
| Contribution to Village-Owned Revenue (PAD) | 35% of net profit (average) | Distributed for infrastructure, education, and social programs |
| Community participation | High (through village deliberation) | Decisions on loans and investments are made collectively |
| Main sources of capital | Village funds, internal savings, community contributions | Limited access to banks or formal finance |
| Reinvestment practices | 20–25% of net profit annually | Allocated for business expansion and facility improvement |
| Energy-related initiatives | Piloting water pumping systems (5 BUMDes), micro-hydro planning (3 BUMDes) | Still early-stage, but indicates readiness to engage in the energy sector |

Some BUMDes have also begun piloting community financing to support installing small-scale water pumping systems or micro-hydro infrastructure to manage water distribution within the tourism area. Although these initiatives are still at an early stage, they illustrate how BUMDes can expand its financial intermediation role from conventional tourism services to renewable energy solutions. The piloting practices highlight the ability of BUMDes to mobilize local resources, apply participatory decision-making, and reinvest surplus revenues into energy-related projects. As such, these cases can serve as prototypes for broader village-level energy transition activities, showing how community-based enterprises can simultaneously sustain local economic growth and contribute to Indonesia's renewable energy agenda.

Looking ahead, the potential future involvement of BUMDes in renewable energy development is strongly supported by their institutional strengths. Their long-established community trust, role as local financial intermediaries through savings and loan units, and participatory decision-making practices position them as credible facilitators of community-based energy financing. By leveraging these institutional capacities, BUMDes can integrate financing schemes into small-scale renewable energy projects such as micro-hydro or solar lighting, reinforcing village economic resilience and national energy transition goals. This strategic alignment indicates that BUMDes have the potential to evolve from primarily tourism-based enterprises into key local actors in advancing sustainable energy solutions at the grassroots level.

While some BUMDes have successfully enhanced their financial performance and community welfare, most of these initiatives remain local, fragmented, and lack structured long-term financing frameworks (Alhamidi et al, 2018). The main challenges include the limited technical capacity of BUMDes managers, inadequate access to mentoring and business development services for energy-based tourism projects, and regulatory ambiguity regarding BUMDes' authority to manage community energy initiatives (Syafingi et al., 2020). Nevertheless, field observations indicate substantial potential to expand and formalize community-based financing if supported by clearer policy frameworks and multi-sector partnerships involving local governments, universities, NGOs, and private actors (Badaruddin et al., 2021). This model could be an innovative financing alternative for community-scale micro-hydro energy development, which has traditionally been inaccessible to formal financial institutions or government subsidy programs.

### *3.2 SWOT Analysis*

A SWOT analysis was conducted to identify internal and external factors that influence BUMDes' effectiveness in managing community-based financing for energy transition (see Table 4). The study of 30 BUMDes within the Water Tourism Association of Klaten revealed key internal and external factors that affect the success of community-based financing to support the utilization of water resources for energy.

BUMDes have earned strong trust and legitimacy from their communities (S1), primarily due to their extensive experience in managing village savings and loan schemes (S2) and their reputation for transparent financial management and participatory decision-making (S3, S4). The presence of visionary leadership (S7), strong local partnerships (S5, S8), and a deep understanding of the socioeconomic landscape (S6) has enabled many BUMDes to successfully mobilize internal capital for community-driven development initiatives. These characteristics have laid a solid foundation for BUMDes to act as community-based financial intermediaries capable of supporting local energy innovation.

However, our study also identifies internal constraints that limit the scalability of these initiatives. Many BUMDes lack technical expertise to design and manage financing models linked to water-based energy projects (W1). At the same time, human resource shortages (W2) and limited startup capital (W3) further impede the expansion of community-based financing activities. There is a heavy reliance on government grants and external subsidies (W4), and many BUMDes lack experience in tailoring financial products specifically for community energy projects (W5). These constraints are exacerbated by limited access to technical assistance (W6), suboptimal administrative systems (W7), and relatively low financial and energy literacy among both BUMDes staff and community members (W8).

At the same time, the external environment offers significant opportunities for BUMDes to enhance their role in financing local energy initiatives. Supportive national energy policies (O1), combined with the abundant availability of water resources in Klaten (O2), present substantial potential for piloting community-scale micro-hydro and water-based energy projects. The rising demand for sustainable and eco-tourism (O3) creates further prospects for BUMDes to expand their community-based financing models. Partnerships with government agencies, universities, NGOs, and private actors (O4) can provide much-needed technical support and co-funding mechanisms. The availability of mentoring programs and CSR funding (O5), advancements in affordable micro-hydro technologies (O6), opportunities to tap into the eco-tourism market (O7), and the potential to become a national pilot model for community-based energy financing (O8) provide a strong enabling environment for future expansion.

Despite these positive factors, our study also highlights significant external risks. Regulatory uncertainty and overlapping policies across sectors (T1, T2) present institutional barriers to formally recognizing BUMDes as legitimate actors in energy-linked community finance. Limited external advisory support (T3) and low community awareness about energy-water financing synergies (T4) create additional obstacles to scaling these initiatives. The high upfront costs of project development

(T5), coupled with environmental risks such as the impact of climate change on water resource availability (T6), and further complicated project viability.

**Table 4.** SWOT analysis.

| **Strength (S)** | **Weakness (W)** |
|---|---|
| Strong social legitimacy and trust between BUMDes and the local community (S1) | Limited technical knowledge of BUMDes managers regarding energy-based financing projects (W1) |
| Experience in managing community-based financing through village savings and loan units (S2) | Insufficient human resources and capacity to manage a complex community-based financing model (W2) |
| Good organizational governance and transparent financial reporting (S3) | Limited initial capital to scale up community-based financing for energy infrastructure (W3) |
| High community participation in decision-making and fund utilization (S4) | Dependency on external grants and government subsidies for financing programs (W4) |
| Ability to build trust and collaboration with local stakeholders for financing programs (S5) | Lack of experience in designing financing products for community energy projects (W5) |
| Strong understanding of local socio-economic context and flexible fund management practices (S6) | Limited access to training and technical assistance for innovative financial management (W6) |
| Visionary leadership in promoting local economic empowerment through financing innovation (S7) | Suboptimal documentation and administrative systems for tracking community loan performance (W7) |
| Well-established social networks and partnerships that support collective financial initiatives (S8) | Low financial literacy and energy awareness among BUMDes management and community members (W8) |
| **Opportunity (O)** | **Threat (T)** |
| Government policy support for renewable energy development and community finance schemes (O1) | Regulatory uncertainty regarding the authority of BUMDes to manage energy and financing projects (T1) |
| Abundant water resource potential in Klaten to pilot water-based energy community projects (O2) | Overlapping policies and lack of regulatory harmonization across sectors (village, energy, tourism) (T2) |
| Growing water tourism market offering potential for revenue diversification and financing models (O3) | Limited external technical and legal advisory support for designing financing schemes (T3) |
| Partnership opportunities with local governments, NGOs, and universities to strengthen financial innovation (O4) | Low community awareness regarding the potential for energy-water financing synergies (T4) |
| Availability of mentoring programs and corporate social responsibility (CSR) funds for community finance development (O5) | High upfront costs associated with developing energy-financing pilot programs (T5) |
| Technological advancement making small-scale micro-hydro energy systems more affordable (O6) | Climate change risks affecting water resource availability for community energy projects (T6) |
| Increasing demand for eco-tourism and sustainable community-based financing models (O7) | Competition from more established conventional financing providers or tourism players (T7) |
| Opportunity to become a national pilot model for integrated community-based financing for energy (O8) | Market uncertainty and lack of clear valuation models for community-generated energy (T8) |

**Table 5.** External factor ranking for water tourism BUMDes in supporting community-based energy financing.

| Rank | External Factor (Opportunity) | Weight | Rating | Weighted Score |
|---|---|---|---|---|
| 1 | Abundant water resource potential in Klaten to pilot water-based energy community projects (O2) | 0.102 | 4.127 | 0.421 |
| 2 | Growing water tourism market offering potential for revenue diversification and financing models (O3) | 0.107 | 3.853 | 0.412 |
| 3 | Availability of mentoring programs and corporate social responsibility (CSR) funds for community finance development (O5) | 0.109 | 3.764 | 0.410 |
| 4 | Partnership opportunities with local governments, NGOs, and universities to strengthen financial innovation (O4) | 0.108 | 3.658 | 0.395 |
| 5 | Government policy support for renewable energy development and community finance schemes (O1) | 0.107 | 3.439 | 0.368 |
| 6 | Technological advancement making small-scale micro-hydro energy systems more affordable (O6) | 0.101 | 3.542 | 0.358 |
| 7 | Increasing demand for eco-tourism and sustainable community-based financing models (O7) | 0.107 | 3.315 | 0.355 |
| 8 | Opportunity to become a national pilot model for integrated community-based financing for energy (O8) | 0.109 | 3.215 | 0.350 |
| **Rank** | **External Factor (Threat)** | **Weight** | **Rating** | **Weighted Score** |
| 1 | High upfront costs associated with developing energy-financing pilot programs (T5) | 0.120 | 3.823 | 0.459 |
| 2 | Market uncertainty and lack of clear valuation models for community-generated energy (T8) | 0.118 | 3.675 | 0.434 |
| 3 | Low community awareness regarding the potential for energy-water financing synergies (T4) | 0.116 | 3.584 | 0.416 |
| 4 | Limited external technical and legal advisory support for designing financing schemes (T3) | 0.115 | 3.425 | 0.394 |
| 5 | Regulatory uncertainty regarding the authority of BUMDes to manage energy and financing projects (T1) | 0.113 | 3.352 | 0.379 |
| 6 | Climate change risks affecting water resource availability for community energy projects (T6) | 0.109 | 3.217 | 0.351 |
| 7 | Overlapping policies and lack of regulatory harmonization across sectors (village, energy, tourism) (T2) | 0.109 | 3.104 | 0.338 |
| 8 | Market uncertainty and lack of clear valuation models for community-generated energy (T7) | 0.110 | 2.951 | 0.325 |

Additionally, BUMDes must compete with established tourism providers (T7) and contend with market uncertainties surrounding energy pricing and expected returns (T8). These challenges underscore the importance of strengthening institutional capacity, clarifying regulatory frameworks, and fostering multi-stakeholder partnerships to fulfill BUMDes' potential as community-based financing facilitators for renewable energy in rural Indonesia.

### *3.3 Evaluation of External and Internal Factors Using IFE and EFE Matrices*

The evaluation of external factors in Table 5 highlights the significant role of favorable policy conditions and local natural resource availability in promoting BUMDes' community-based financing initiatives. The most influential external opportunities identified were the strong government support for renewable energy and community finance programs (O1) and the abundant water resource potential

in Klaten (O2), which offer strong foundations for piloting community-scale micro-hydro or water-based energy initiatives. Further external opportunities include the rising demand for sustainable water tourism (O3) and partnership possibilities with local governments, NGOs, and universities (O4). However, the ranking also revealed critical external threats that require urgent attention. The most severe barriers were regulatory uncertainty regarding BUMDes' authority in energy-related financing (T1) and overlapping or conflicting policies across the village and energy sectors (T2). Limited technical and advisory support from external institutions (T3), low community awareness (T4), high upfront investment costs (T5), and environmental risks related to climate change affecting water availability (T6) also present additional challenges that could hinder long-term sustainability.

Table 6 summarizes the internal evaluation of BUMDes' capacity to manage community-based financing mechanisms. The most dominant internal strength was BUMDes' ability to build strong trust and legitimacy with the community (S1), followed by their proven experience in managing savings and loan schemes (S2) and their established organizational governance and transparency (S3). These strengths collectively empower BUMDes to act as reliable financial intermediaries at the village level. However, the internal factor analysis also highlighted major weaknesses that could constrain the expansion of community-based financing models. Chief among them were the lack of technical expertise related to energy-financing programs (W1), insufficient human resources (W2), and limited access to startup capital (W3). Additionally, over-reliance on external funding (W4), poor experience in developing tailored energy-financing products (W5), lack of access to capacity-building and training (W6), administrative limitations (W7), and low levels of energy and financial literacy among staff and community members (W8) remain substantial internal obstacles. These findings emphasize the need for targeted capacity development and institutional strengthening to enable BUMDes to implement sustainable community-based financing for energy transition initiatives effectively.

### *3.4 Strategy Formulation for Community-Based Energy Financing in Water Tourism BUMDes*

The strategy formulation in Table 7 offers a structured approach to address the internal and external factors influencing BUMDes' capacity to implement community-based financing mechanisms for sustainable energy transition. The S-O strategy emphasizes the importance of leveraging BUMDes' internal strengths, such as organizational governance, community trust, strong partnerships, and visionary leadership (S2, S3, S5, S7, S8), to capitalize on external opportunities, particularly the abundant water resource potential and the growing markets for water-based tourism and eco-tourism (O2, O3, O7). The W-O strategy focuses on overcoming internal weaknesses related to limited technical knowledge and organizational capacity (W1, W2, W6) by fostering partnerships with local governments, NGOs, and universities (O4, O5) to access training, technical assistance, and co-funding mechanisms.

The S-T strategy seeks to mitigate external threats by using BUMDes' internal assets (S2, S5, S6) to design and implement community-based financing schemes that reduce reliance on external grants and address regulatory ambiguity, overlapping sectoral policies, and high upfront investment costs (T1, T2, T5). The W-T strategy addresses the challenge of internal weaknesses and external threats by strengthening internal training programs and improving administrative systems (W6, W7) to reduce market uncertainty and regulatory ambiguity (T7, T8). The findings highlight that while BUMDes hold considerable potential as facilitators of community energy initiatives, they must continue enhancing internal capacities and actively engage with external stakeholders to ensure long-term viability and scalability of these innovative financing models (Buana et al., 2023; Goswami et al., 2017).

**Table 6.** Internal factor ranking for water tourism BUMDes in supporting community-based energy financing

| Rank | Internal Factor (Strength) | Weight | Rating | Weighted Score |
|---|---|---|---|---|
| 1 | Good organizational governance and transparent financial reporting (S3) | 0.117 | 4.173 | 0.488 |
| 2 | Experience in managing community-based financing through village savings and loan units (S2) | 0.124 | 3.869 | 0.480 |
| 3 | High community participation in decision-making and fund utilization (S4) | 0.132 | 3.435 | 0.453 |
| 4 | Visionary leadership in promoting local economic empowerment through financing innovation (S7) | 0.118 | 3.536 | 0.417 |
| 5 | Strong social legitimacy and trust between BUMDes and the local community (S1) | 0.113 | 3.628 | 0.410 |
| 6 | Strong understanding of local socio-economic context and flexible fund management practices (S6) | 0.127 | 3.195 | 0.406 |
| 7 | Ability to build trust and collaboration with local stakeholders for financing programs (S5) | 0.121 | 3.279 | 0.397 |
| 8 | Well-established social networks and partnerships that support collective financial initiatives (S8) | 0.128 | 3.014 | 0.386 |
| **Rank** | **Internal Factor (Weakness)** | **Weight** | **Rating** | **Weighted Score** |
| 1 | Insufficient human resources and capacity to manage complex community-based financing model (W2) | 0.129 | 3.784 | 0.488 |
| 2 | Limited technical knowledge of BUMDes managers regarding energy-based financing projects (W1) | 0.131 | 3.655 | 0.479 |
| 3 | Limited initial capital to scale up community-based financing for energy infrastructure (W3) | 0.127 | 3.524 | 0.448 |
| 4 | Lack of experience in designing financing products for community energy projects (W5) | 0.120 | 3.337 | 0.400 |
| 5 | Limited access to training and technical assistance for innovative financial management (W6) | 0.122 | 3.196 | 0.390 |
| 6 | Suboptimal documentation and administrative systems for tracking community loan performance (W7) | 0.123 | 3.095 | 0.381 |
| 7 | Low financial literacy and energy awareness among BUMDes management and community members (W8) | 0.123 | 2.923 | 0.360 |
| 8 | Dependency on external grants and government subsidies for financing programs (W4) | 0.125 | 2.857 | 0.357 |

**Table 7.** Strategy formulation for a community-based financing model for sustainable energy transition

| **S-O strategy** | **W-O strategy** |
|---|---|
| Promote the integration of water tourism development with micro-hydro energy potential to increase economic value and sustainability (S2, S3, S5, S7, S8; O2, O3, O7). | Establish partnerships with local governments, NGOs, and universities to enhance technical capacity and management of community-based financing schemes (W1, W2, W6; O4, O5). |
| **S-T strategy** | **W-T strategy** |
| Develop innovative community-based financing schemes to reduce reliance on external grants and mitigate risks of regulatory ambiguity, sectoral policy overlaps, and high investment costs (S2, S5, S6; T1, T2, T5). | Strengthen internal training programs and improve administrative systems (W6, W7) to mitigate external risks of market uncertainty and regulatory ambiguity (T7, T8). |
| Notes: S = Strength; W = Weakness; O = Opportunity; T = Threat. | |

### *3.5 Case Study of BUMDes Sumber Kamulyan: A Prototype of Community-Based Financing for Rural Water Tourism and Energy Transition*

To complement the broader analysis of 30 BUMDes under the Klaten Water Tourism Association, our study presents an in-depth case study of BUMDes Sumber Kamulyan in Wunut Village, Tulung Sub-District, Klaten district. Established in 2017, BUMDes Sumber Kamulyan manages the Umbul Pelem water tourism attraction, becoming a prominent community-based business unit and a sustainable village enterprise management model. The village of Wunut has historically been categorized as a disadvantaged village and faced severe financial constraints in utilizing its two major water springs, Umbul Pelem and Umbul Gedhe. The establishment of BUMDes Sumber Kamulyan through the Village-Owned Enterprises Law and the active support of the community has transformed this situation. The BUMDes has successfully mobilized local resources, including gradually developing tourism infrastructure, pools, gazebos, water-based attractions, and complementary facilities. Between 2016 and 2022, village fund allocations for Umbul Pelem totaled IDR 2.35 billion, supporting various phases of construction and revitalization.

In 2024, the BUMDes recorded a remarkable financial performance with total revenue of IDR 6.46 billion and net profit of IDR 4.87 billion (See Table 8). Revenue was generated from diverse business streams, including entrance tickets, parking fees, kiosk rental, locker services, and river tubing. The structured profit-sharing scheme of BUMDes Sumber Kamulyan reflects a strong commitment to community empowerment and financial inclusion. Fifty-five percent (55%) of net profit is allocated as Village-Owned Revenue, 20% is reinvested for business development, and the remainder is designated for social programs, educational and religious activities, operational expenses, and incentives for supervisors and advisors. The distribution mechanism supports the operational sustainability of the BUMDes and provides significant social benefits to the Wunut community. These include zakat distribution to the poor, funding for social assistance programs, funeral expenses, educational subsidies for religious teachers, community training, and social protection through BPJS Ketenagakerjaan and BPJS Kesehatan, ensuring full health insurance coverage for all 2,215 residents of Wunut Village.

**Table 8.** The key financial and social allocation data of BUMDes Sumber Kamulyan in 2024.

| **Item** | | **Amount (IDR)** |
|---|---|---|
| Total Revenue | | 6,465,267,500 |
| Total Expenses | | 1,588,387,100 |
| Net Profit | | 4,876,880,400 |
| **Allocation for Net Profit** | **Percentage (%)** | **Amount (IDR)** |
| Allocation to PAD (Village-Owned Revenue) | 55 | 2,682,284,220 |
| Allocation to Business Development | 20 | 975,376,080 |
| Social Programs (zakat, funeral aid, BPJS) | 7 | 341,381,628 |
| Education and Training | 5.5 | 268,228,422 |
| Operational Costs | 2.5 | 121,922,010 |
| Supervisor and Advisor Incentives | 10 | 487,688,040 |

The case of BUMDes Sumber Kamulyan also provides valuable insights into how BUMDes manages water tourism in the Klaten district and has initiated community-based financing models to support the potential utilization of water resources for renewable energy development. While the primary focus to date has been the sustainable management of tourism infrastructure, key strategic elements of a community-financing model have been established that can be leveraged to support future energy-based projects.

First, BUMDes Sumber Kamulyan has demonstrated an effective model of mobilizing internal capital through accumulating surplus profits, structured reinvestment policies, and establishing flexible community lending mechanisms. These financing practices reflect strong governance principles and the ability to pool and redistribute village resources for collective benefit (Hoicka et al., 2021).

Second, the consistent reinvestment in physical infrastructure, including water flow management, eco-friendly water distribution systems, and planned micro-hydro power facilities, indicates a growing recognition of the dual function of water resources for both tourism and energy purposes. Including a micro-hydro energy investment component of IDR 260 million in the master plan of Umbul Pelem marks a tangible step toward integrating community energy solutions.

Third, the strong community participation and transparent decision-making mechanisms established by BUMDes Sumber Kamulyan have laid a social foundation for future community energy financing schemes. Through village consensus forums, flexible loan repayment terms, and inclusive profit-sharing models, trust and collective ownership have been fostered, which are critical prerequisites for successfully implementing any community-based renewable energy initiative (Ramesh, 2016).

Finally, collaborating with external stakeholders, including local government, the private sector, and NGOs, provides BUMDes with technical knowledge and co-financing opportunities that will be essential in overcoming barriers related to regulatory uncertainty and technical capacity for water-energy projects (Buana et al., 2023).

In conclusion, while BUMDes Sumber Kamulyan has not yet fully implemented large-scale energy generation from water resources, the financing framework and institutional culture developed through their water tourism management model offer a scalable foundation for future renewable energy initiatives at the village level.

## 4. Conclusions

Our study fills a critical gap by empirically exploring the role of BUMDes as community-based financial intermediaries to facilitate rural water-based energy initiatives. This area remains under-researched, mainly in existing literature. Through a qualitative study involving 30 BUMDes affiliated with the Water Tourism Association in Klaten district, we found that BUMDes possess considerable institutional strengths, including strong community trust, well-established savings and loan practices, and transparent organizational governance. These elements position BUMDes as credible actors capable of mobilizing internal and external resources for energy transition initiatives at the community level. Nevertheless, BUMDes also face substantial challenges such as limited technical knowledge, low energy literacy, insufficient startup capital, and regulatory uncertainty regarding their formal role in energy-related financing. The SWOT analysis and IFE-EFE matrices detailed the internal and external factors influencing success and formed the basis for targeted strategy formulation. The strategies recommended include maximizing local partnerships and strengthening internal governance to leverage community-based financing opportunities.

Overall, the results indicate that BUMDes hold strong potential to serve as catalysts for community energy solutions through innovative financing schemes. However, realizing this potential at scale will require addressing existing internal and external barriers and strengthening institutional and regulatory frameworks. The findings contribute to the broader academic discourse on community-driven energy solutions and offer valuable insights for policymakers and practitioners working to enhance rural energy access through local institutional actors.

Our study has several methodological limitations. First, it adopts a qualitative case study approach focusing on 30 BUMDes affiliated with the Klaten Water Tourism Association. While this provides rich contextual insights, it limits the generalizability of the findings to other types of BUMDes or regions in Indonesia. Second, the reliance on interviews, focus group discussions, and document analysis may introduce narrative bias, as the perspectives captured primarily reflect the views of BUMDes directors and selected community representatives. Third, the cross-sectional analysis offers a snapshot of institutional practices rather than capturing their evolution over time.

Despite these limitations, the findings have replicability potential across regions. The institutional mechanisms identified (e.g., trust-based financing, participatory decision-making, structured

reinvestment policies, and multi-stakeholder partnerships) are not unique to Klaten and could be adapted to other contexts where BUMDes or similar community-based enterprises operate. For instance, food-based or agricultural BUMDes in other provinces could employ similar financing models to support small-scale renewable energy initiatives such as solar home systems, biogas digesters, or hybrid village microgrids. Future research using quantitative surveys, longitudinal designs, and multi-region comparisons is needed to test these models' scalability and long-term effectiveness, thereby strengthening their theoretical and policy relevance.

Based on the findings, several policy recommendations are proposed to enhance the role of BUMDes in facilitating community-based financing for energy transition. First, clearer legal frameworks should be established to formally recognize BUMDes as legitimate actors in community energy financing and local energy governance. Second, integrated multi-sectoral policies need to be developed to align village administration, energy policy, and community financing regulations. Third, targeted capacity-building programs should be implemented to improve the financial management and technical skills of BUMDes managers and staff. Fourth, local governments should be encouraged to facilitate partnerships between BUMDes and external stakeholders, including universities, NGOs, and private sector actors. Fifth, co-investment schemes and access to soft financing mechanisms should be created to reduce dependency on grants and subsidies. Finally, knowledge sharing and best practice networks among BUMDes should be promoted to enhance peer learning and foster the replication of successful community-based financing models.

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