Indonesian Journal of Community Engagement
Jurnal Pengabdian kepada Masyarakat
Vol. 11, No. 4, December 2025, Page. 261-267
DOI: http://doi.org/10.22146/jpkm.105656

QREEN Application to Address Water Supply Challenges in Blora Regency

Alfin Sahrin[1]*, Novan Akhiriyanto[1], Erna Utami[1], Susilo Handoko[2]

[1]Department of Instrumentation Engineering, Politeknik Energi dan Mineral Akamigas, Cepu, Indonesia
[2]Department of Mechanical Engineering, Politeknik Energi dan Mineral Akamigas, Cepu, Indonesia

Submitted: March 25th 2025; Revised: August 09th 2025; Accepted: December 15th 2025

Keywords:
Dry season
QREEN
Water supply

Abstract Seasonal dry periods in Blora Regency routinely lead to drought conditions, which make it difficult for communities to secure clean water for daily use and for agricultural irrigation. This community service initiative aimed to deliver a rapid energy-based solution by implementing the Quick Response Energy (QREEN) system to support water distribution and environmental lighting in Ledok, Temengeng, and Joho Villages. The program followed a community based participatory approach with five stages, namely problem identification grounded in field data, technology solution design, site selection, implementation coordination, and program evaluation. Using a mixed methods design, data were collected through direct observation, semi structured interviews, and quantitative surveys administered to selected users. The results indicated high user satisfaction, including improved ease of access to clean water (79 to 85%) and time savings (75 to 83%), as well as increased farming yields (72 to 80%) among users who manage agricultural land. Overall, the findings suggest that QREEN implementation can strengthen local water security, although the magnitude of impact varies across contexts. Sustained, cross sector collaboration is recommended to support long term operation and enable program expansion.

1. INTRODUCTION

Access to clean water remains a critical challenge in many rural and semi arid areas of Indonesia, including Blora Regency in Central Java (Daniel et al., 2023). The region is characterized by an extended dry season, limited water infrastructure, and declining groundwater quality and quantity, which together make it difficult for local communities to meet domestic and agricultural water needs. These challenges are compounded by the lack of reliable monitoring systems and by weak community based governance of water resources (Pambudi & Kusumanto, 2023).

Quick Response Energy (QREEN) is a portable, cabin shaped equipment system designed to provide electrical power during emergencies. It uses solar panels connected to batteries and inverters, and it is installed on a trailer platform equipped with a water distribution pump, a water treatment unit that functions as a filter, and Internet of Things based monitoring for portability and field deployment (Weng, 2025; Yadav et al., 2024). QREEN relies on renewable energy by using solar power as the primary source for generating electricity supplied to connected loads. The system was developed as an appropriate technology product at the Politeknik Energi dan Mineral Akamigas laboratory.

During daytime operation, electricity generated by the solar panels is used directly to run the water pump, and excess power is stored in the battery. At night, when solar panels do not produce electricity, the battery supplies power to electrical loads, such as lighting and water pumping. The QREEN system is integrated and operates (Sigiro & Halimi, 2024; Ilham et al., 2024). For example, the pump delivers water to a reservoir based on sensor input, and when the water level falls below the defined set point, the pump activates to refill the reservoir, then shuts off once the target level is reached. Lighting is also automated, turning on at 17:00 WIB and turning off at 05:00 WIB. Because the system functions automatically, community members do not need to manually operate the pumps or lights

ISSN 2460-9447 (print), ISSN 2541-5883 (online)
*Corresponding author: Alfin Sahrin
Instrumentation Engineering Department, Politeknik Energi dan Mineral Akamigas, Jl. Gajah Mada No.38, Cepu, Blora 58315, Indonesia
Email: alfin.sahrin@esdm.go.id

(Ibraheam & Aslan, 2023; Masthura & Armansyah, 2023).

Blora Regency, located in Central Java, has an economy anchored in agriculture, plantations, and the oil and gas industry (Santosa et al., 2024). Its farmland supports major commodities, such as rice, corn, and cassava, while teak forests managed by Perhutani play a dominant role in the plantation sector (Agfrianti et al., 2023). Blora is also recognized as an oil and gas producing region, with fields that have been exploited since the colonial period. Together, these sectors give Blora diverse and strategically important potential for regional development (Basuki & Pramono, 2020; Dewi et al., 2022).

However, the dry season creates substantial constraints for agriculture and plantations across the regency. Fields that are productive during wetter periods often become dry and cracked when rainfall is limited, which can sharply reduce yields of rice, corn, and cassava (Ahmad et al., 2022; Cuhadar, 2024). Teak forest areas also appear increasingly arid, with leaf shedding and dusty soils, and water sources become more difficult to access, intensifying drought impacts on daily life, particularly for farmers. In response, communities and farmer groups often rely on fossil fuel powered pumps to move water, although these systems can be costly, difficult to maintain, and dependent on fuel availability (Avia et al., 2023; Gery et al., 2022).

In Blora Regency, QREEN has been deployed through collaboration with Politeknik Energi dan Mineral Akamigas to support communities, including in Temengeng Village, by distributing water from wells for household use and for plantations. In many cases, water sources are located far from settlements, and elevation differences between wells and farmland can further complicate distribution. As implemented in Ledok, Temengeng, and Joho Villages, the initiative provided timely energy support that helped communities meet urgent water needs.

This community service program aimed to deliver rapid energy assistance in disaster affected areas, particularly during drought conditions in which electricity was needed to distribute water to isolated locations. In Blora Regency, the QREEN system was positioned as an early response option because it provided temporary electrical power for essential services, including water pumping and basic lighting, which supported households and farming activities when conventional infrastructure was limited or unreliable. By enabling water to be moved from distant sources to reservoirs and distribution points, the program also sought to reduce the time and physical effort typically required to secure clean water, while improving the consistency of supply for daily needs and irrigation.

Beyond these practical outcomes, the program contributed to knowledge development by demonstrating an integration model that linked information technology, environmental engineering, and community empowerment. The implementation process incorporated collaboration between academic partners and local stakeholders, and it emphasized participatory coordination so that the technology aligned with community priorities and operating conditions. As a result, the initiative was expected to serve as a reference for similar service programs, particularly those that rely on appropriate technologies and sustainability oriented innovation to strengthen resilience and expand access to essential resources.

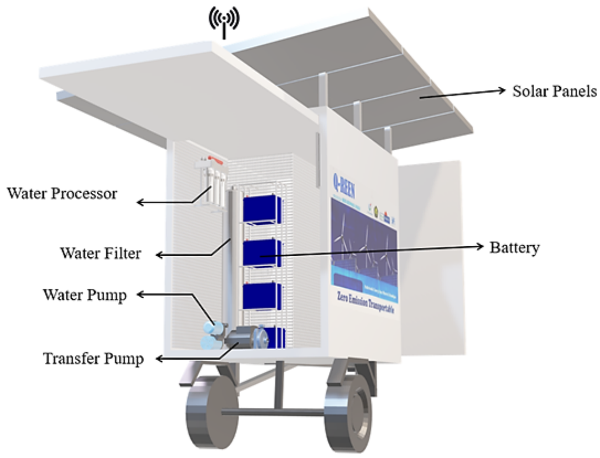

Figure 1 . QREEN design

2. METHOD

The methodology for this community service activity was systematically developed to support effective implementation of QREEN as a response to limited clean water access in Blora Regency. The program followed a community based participatory approach, and it integrated active involvement from local stakeholders at each stage of planning and execution (Daniel et al., 2023; Dewi et al., 2022). Implementation was organized into five main stages, namely identifying field based problems, designing the technological solution, selecting locations, coordinating implementation, and evaluating outcomes. Program execution included material preparation, coordination with village leaders and community groups, site surveys to confirm installation feasibility, and post implementation evaluation. Each stage is described below.

2.1 Material design

QREEN was developed through an appropriate technology research program at the Energy Laboratory

Table 1 . Equipment specification

No.	Equipment	Quantity	Voltage (V)	Current (A)	Power (Watt)	Head (meter)
1.	Solar panels	8	30.4	8.23	250	-
2.	Inverter	1	200 – 240	48	2,000	-
3.	Battery	4	12	100 Ah	-	-
4.	Water processor	1	220	0.2	50	-
5.	Water pump	1	220	1.5	264	15
6.	Transfer pump	1	220	6	1,200	31.5

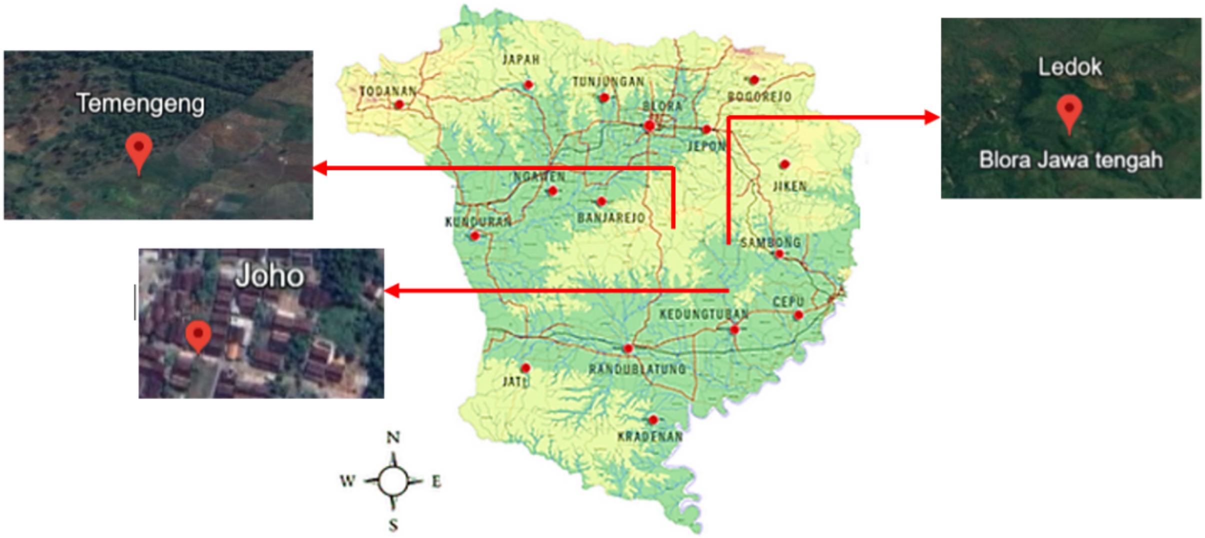

Figure 2 . Servis community program location

of the Politeknik Energi dan Mineral Akamigas. The system was designed as a portable cabin mounted on a trailer, and it provided emergency electrical power by integrating solar panels with batteries and an inverter, along with water distribution pumps (Ibraheam & Aslan, 2023). As shown in Figure 1, the trailer based configuration supported mobility and rapid deployment. Although QREEN could be applied in other disaster contexts, this program deployed it specifically to address drought conditions affecting rice fields and plantations. The lengths and specifications of the operating plates on the system are presented in Table 1.

2.2 Location

Program locations were selected in villages within Blora Regency that experienced recurring water shortages during the dry season. The first deployment took place in Ledok Village in 2020, and it focused on distributing clean water from well sources for household needs and for irrigating corn farmland. The second deployment was implemented in Temengeng Village in 2022, where well water distribution supported daily household use as well as watering agricultural land. The third deployment was conducted in Joho Village in 2023, and it provided well sourced clean water for farmer groups cultivating corn. The three program locations are shown in Figure 2.

2.3 Program implementation

2.3.1 Material preparation

Because QREEN integrates renewable energy technology into a trailer based system, all components were prepared and inspected prior to field deployment. The implementation team, which consisted of lecturers and students, checked key components, including solar panels, the inverter, batteries, water pumps, piping, and other supporting elements, to confirm readiness for installation and operation. Material inspection and preparation activities are shown in Figure 3.

2.3.2 Coordination with the village head

Coordination with village heads and farmer groups was conducted to ensure that implementation aligned with local needs and administrative requirements. Village heads provided direction and facilitated permissions, while farmer groups contributed practical information about local agricultural conditions and water related constraints. This coordination supported more effective execution and improved the likelihood that program outputs would deliver

Figure 3 . (a) Material checking and preparation; (b) Coordination with the village head; (c) Location survey

Figure 4 . QREEN implementation in: (a) Ledok Village; (b) Temengeng Village; (c) Joho Village

measurable benefits for community welfare. Coordination activities are shown in Figure 3.

2.3.3 Location survey

Site surveys were conducted to verify on the ground conditions and refine implementation plans based on actual community needs. Through field visits, the service team engaged residents directly, identified operational constraints, and ensured that installation plans were feasible in terms of access, safety, and proximity to water sources. Surveys also strengthened coordination with village government and community groups, which supported smoother implementation and more sustainable operation. As shown in Figure 3, the team visited the water source, which consisted of a well, together with representatives of the villages and community groups.

2.4 Evaluation

A mixed methods evaluation was used to assess QREEN performance across Ledok, Temengeng, and Joho Villages, with emphasis on both quantitative indicators and user experience. In each village, the researchers conducted semi structured interviews with four to five respondents who routinely used the QREEN system. Participants were selected using purposive sampling to prioritize active users who could provide informed feedback on satisfaction and usefulness.

The evaluation focused on three indicators: (1) ease of access, which captured how easily users obtained water when needed, including considerations such as distance, pressure, and reliability, (2) impact on farming yields, which assessed whether QREEN contributed to higher crop productivity for respondents engaged in agriculture, and (3) time savings, which measured perceived reductions in effort and time associated with collecting water or managing irrigation (Sigiro & Halimi, 2024; Weng, 2025; Yadav et al., 2024). Respondents provided satisfaction ratings as percentages from 0 to 100 for each indicator, and they clarified when an indicator, such as farming yields, did not apply to their situation. Qualitative comments were also collected to capture context and explain variation in user experiences. The combined data were analyzed using descriptive statistics, and results were visualized using radar charts to support comparisons across users and villages.

3. RESULT AND DISCUSSION

As part of the program evaluation, results and discussion were used to assess the effectiveness of the community service activities that were implemented. This section reviewed key outcomes, documented challenges encountered during deployment and operation, and incorporated input from stakeholders involved in planning, implementation, and daily use. Through this reflective process, the program evaluation aimed to identify practical improvements so that future implementation could deliver stronger and more sustained benefits for local communities.

3.1 Results of activities in Ledok Village

In Ledok Village, the program delivered clean water drawn from a well source and provided environmental lighting, as shown in Figure 4.

Ledok Village experienced substantial water stress during the dry season. Drought conditions reduced the availability of local water sources, and residents relied heavily on wells that continued to produce water, although the discharge gradually declined. Community members visited the well daily, carrying buckets and jerry cans to collect the remaining clean water. Rivers that might otherwise have served as alternative sources were not usable because oil waste polluted the waterway, and the water appeared dark and had a strong odor. As a result, residents could not use river water for bathing, washing, or other household needs.

These conditions increased hardship for many households. Some residents traveled long distances to neighboring villages with more reliable water sources, while others began purchasing clean water at higher cost. Concerns about the water situation were particularly acute for families with young children and for older adults, who faced higher health risks when sanitation was compromised.

Under these conditions, QREEN pumped water from the well and stored it in reservoirs. Residents no longer needed to draw water manually from the well, and they accessed water through taps connected to the reservoir (Pambudi & Kusumanto, 2023). The system supported clean water needs for approximately 500 families, and it also supplied water for irrigating about 7 hectares of corn plantations (Weng, 2025). In addition, the system provided lighting at night for public street lighting (Masthura & Armansyah, 2023).

3.2 QREEN implementation in Temengeng Village

In Temengeng Village, the program focused on distributing clean water from well sources, as shown in Figure 4.

Dry season impacts in Temengeng Village were similar to those observed in Ledok Village. Many wells produced little or no water, which made it difficult for residents to meet daily household needs. The community depended largely on a single remaining source, a spring fed well that continued to produce water throughout the dry period. However, this water source was located relatively far from many homes, and residents typically collected water manually, which increased the daily burden. Drought conditions also affected agriculture, and farmers tended to plant crops, such as watermelon and melon, that required less water (Cuhadar, 2024; Pambudi & Kusumanto, 2023). Even so, limited water availability continued to constrain irrigation and crop management (Basuki & Pramono, 2020).

QREEN reduced these constraints by improving the practicality of water access. The system supported the daily water needs of approximately 150 families, and it also enabled irrigation for around 5 hectares of corn plantations by distributing water to farmland through hoses connected to the storage reservoir.

3.3 QREEN implementation in Joho Village

In Joho Village, the program similarly provided clean water from a well source, as shown in Figure 4.

The Implementation in Joho Village resembled activities in Ledok and Temengeng, although local terrain introduced an important difference because farmland in Joho was terraced. During the dry season, rice fields located at higher elevations experienced more severe water shortages. The program therefore focused on providing water to support corn cultivation during the dry season by local farmer groups. Water was drawn from a well located within the rice field area, pumped into a reservoir, and distributed through taps, enabling farmers to access and allocate water more efficiently. The activity supported irrigation for approximately 6 hectares of agricultural land, and it helped maintain productivity during the dry season.

Several challenges were encountered during implementation. Access to installation sites was constrained by narrow routes, undeveloped land, and limited infrastructure, and there were often no prepared foundations for placing equipment. As a result, supporting civil works were required to provide safe placement and ensure that equipment could be transported to the installation point. During operation, intermittent technical interruptions also occurred, which required troubleshooting and maintenance. These challenges were addressed through collaboration with community members and farmer groups, including efforts to improve road access and the designation

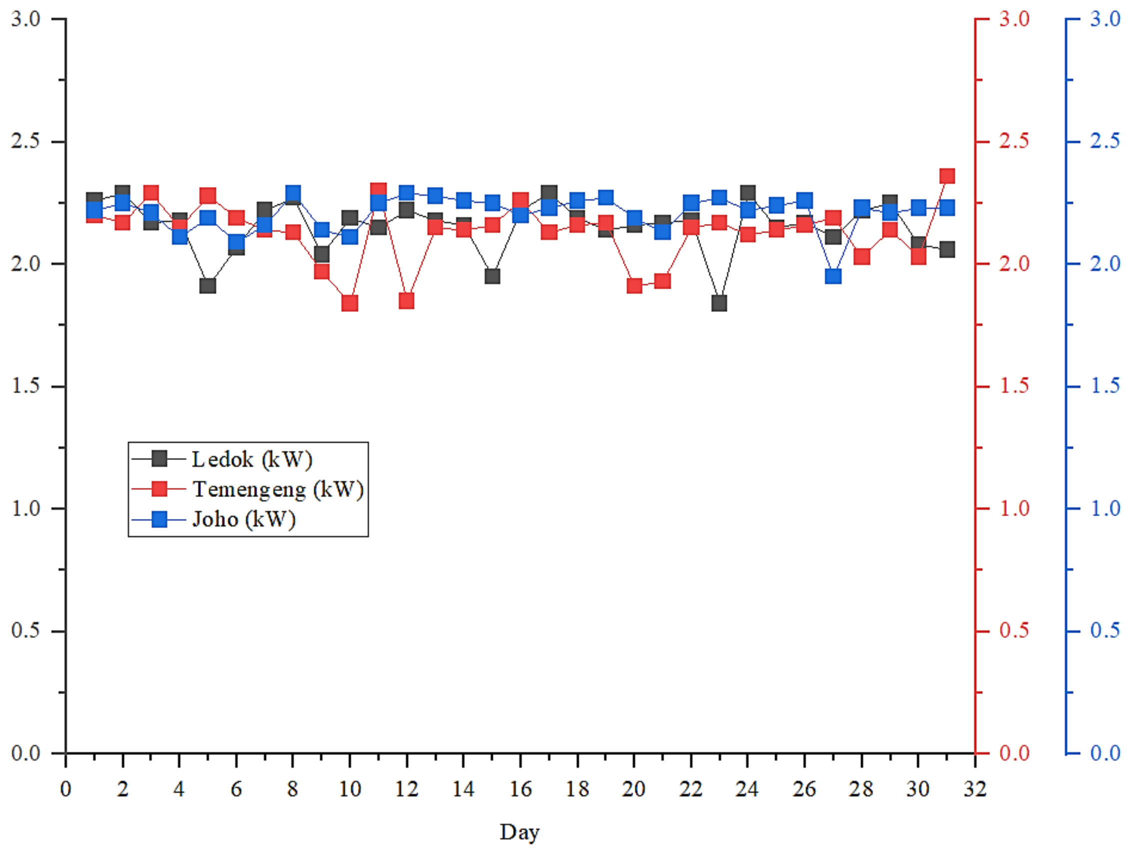

Figure 5 . Power output of QREEN

of trained residents who could support routine operation (Daniel et al., 2023). When disruptions were more complex or could not be resolved locally, professional QREEN technicians were contacted for further support.

Because solar irradiation strongly influenced pump operation and battery charging, system output measurements were conducted to confirm that QREEN could meet load requirements under field conditions, as shown in Figure 5. Power output was calculated using daily average values measured from 06:00 to 17:00 WIB. Measurements were collected in August at each location. The average power output was 2.15 kW in Ledok Village, 2.13 kW in Temengeng Village, and 2.14 kW in Joho Village.

A QREEN impact survey was conducted using a mixed methods approach, and it combined semi structured interviews with user rating data from selected participants across Ledok, Temengeng, and Joho Villages. Participants were selected through purposive sampling and provided percentage-based ratings for three indicators, namely ease of access to water, time savings in daily water related tasks, and, for farming users, perceived impact on crop yields. As shown in Figure 6, satisfaction levels were generally moderate to high. Ease of access ratings ranged from 79% to 85%, and time savings ratings ranged from 75% to 83%, which reflected improved convenience and reduced effort for daily water collection and use. Perceived impacts on farming yields varied from 72% to 80%, and this indicator was not rated by non-farming participants. Together with qualitative feedback, these findings indicated that QREEN delivered clear benefits, although the magnitude of impact differed depending on village conditions and individual usage contexts.

4. CONCLUSION

The prolonged dry season caused many areas of Blora Regency to experience persistent difficulty in meeting clean water needs for both household use and agricultural irrigation. In response to these conditions, the implementation of Quick Response Energy (QREEN) served as an innovative, field ready solution that supported rapid and adaptive energy provision for water distribution in drought affected communities. Consistent with the program's primary objective, which was to provide emergency energy support that enabled water delivery in disaster impacted and access constrained areas, QREEN functioned effectively and contributed to faster, more efficient recovery of local water availability.

Deployment across Ledok, Temengeng, and Joho Villages produced measurable benefits. In Ledok Village, QREEN supplied clean water for approximately 500 families and supported irrigation for about 7 hectares of agricultural land. In Temengeng Village, the system helped meet water needs for around 150 families and enabled irrigation for approximately 5 hectares. In Joho Village, QREEN supported water provision for farming activities across roughly 6 hectares. These outcomes indicated that QREEN contributed directly to improved quality of life and strengthened local food security in drought prone areas.

Sustaining and expanding program impact required a clear development strategy. Key priorities included technical training for community groups and farmers, integration with renewable energy systems, such as solar power, and stronger local institutions capable of managing the technology independently. In addition, continued collaboration among local government, academic institutions, and private partners was needed to support replication in other regions facing similar water and energy challenges. With these steps, QREEN could serve as a model for sustainable, appropriate technology interventions that strengthen water and energy security in resource vulnerable communities.

ACKNOWLEDGMENT

These community service activities were implemented successfully through collaboration with the heads of Ledok,

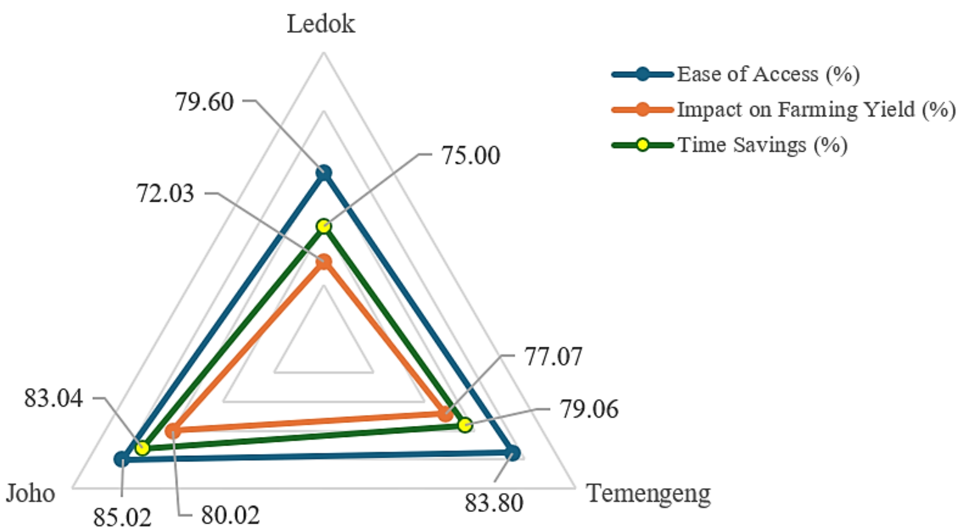

Figure 6 . Community satisfaction evaluation

Temengeng, and Joho Villages and the UPPM of Politeknik Energi dan Mineral Akamigas, which operates under the Ministry of Energy and Mineral Resources of the Republic of Indonesia.

CONFLICT OF INTERESTS

The authors declare no conflicts of interest.

REFERENCES

Agfrianti, S. I., Budiraharjo, K., & Handayani, M. (2023). Analisis Pendapatan Usaha Tani Padi (Oryza sativa L.) dan Faktor-Faktor yang Memengaruhinya. *Jurnal Litbang: Media Informasi Penelitian, Pengembangan Dan IPTEK, 19*(1), 17–30. https://doi.org/10.33658/jl.v19i1.334

Ahmad, M. M., Yaseen, M., & Saqib, S. E. (2022). Climate change impacts of drought on the livelihood of dryland smallholders: Implications of adaptation challenges. *International Journal of Disaster Risk Reduction, 80*(7), 103210. https://doi.org/10.1016/j.ijdrr.2022.103210

Avia, L. Q., Yulihastin, E., Izzaturrahim, M. H., Muharsyah, R., Satyawardhana, H., Sofiati, I., Nurfindarti, E., & Gammamerdianti. (2023). The spatial distribution of a comprehensive drought risk index in Java, Indonesia. *Kuwait Journal of Science, 50*(4), 753–760. https://doi.org/10.1016/j.kjs.2023.02.031

Basuki, T. M., & Pramono, I. B. (2020). The influence of teak plantation areas on water yield and peak discharge from five catchments in Blora Regency. *IOP Conference Series: Earth and Environmental Science, 533*(1). https://doi.org/10.1088/1755-1315/533/1/012010

Cuhadar, M. (2024). Agricultural Economics And Climate Change. In *The Impact of Drought on Agricultural Production and Agricultural Adaptation to Drought Hussen* (Songul AKI, Issue June). NOBEL. https://doi.org/10.69860/nobel.9786053359432

Daniel, D., Al Djono, T. P., & Iswarani, W. P. (2023). Factors related to the functionality of community-based rural water supply and sanitation program in Indonesia. *Geography and Sustainability, 4*(1), 29–38. https://doi.org/10.1016/j.geosus.2022.12.002

Dewi, R. S. T., Harini, R., Ariani, R. D., & Muta'ali, L. (2022). Sustainable Agricultural Development Based on Leading Commodities (Case Study in Blora Sub-District, Blora District, Central Java, Indonesia). *International Conference on Smart and Innovative Agriculture (ICoSIA 2021), 19*, 216–222. https://doi.org/10.2991/absr.k.220305.033

Gery, F., Wijayanti, P., & Tjahjono, G. A. (2022). Pemanfaatan Citra Landsat 8 Untuk Analisis Pengaruh Deforestasi Hutan Jati Terhadap Tingkat Kekeringan Lahan Di Kabupaten Blora Tahun 2013 – 2021. *Indonesian Journal of Environment and Disaster, 1*(2), 11–21. https://doi.org/10.20961/ijed.v1i2.258

Ibraheam, E. H., & Aslan, S. R. (2023). Solar Photovoltaic Water Pumping System Approach for Electricity Generation and Irrigation: Review. *Diagnostyka, 24*(2), 1–7. https://doi.org/10.29354/diag/165849

Ilham, M., Idris, A. R., & Achmad, A. (2024). Design and Development of Solar Pump System for Automatic Watering of Shallots. *Jurnal Teknologi Elekterika, 21*(2), 81–86.

Masthura, M., & Armansyah, A. (2023). Utilization of Solar Panels as a Source of Electrical Energy in Alternating Current (AC) Water Pump. *Jurnal Fisika Flux: Jurnal Ilmiah Fisika FMIPA Universitas Lambung Mangkurat, 20*(1), 38. https://doi.org/10.20527/flux.v20i1.14421

Pambudi, A. S., & Kusumanto, T. (2023). *Water Resources Governance in Indonesia Towards Environmental Sustainability Along with Social and Economic Development* (Issue February, pp. 289–311). Ministry of National Development Planning/National Development Planning Agency of the Republic of Indonesia (Bappenas). https://doi.org/10.1007/978-3-031-15904-6_16

Santosa, F. J., Mustafa, A. K., Widodo, A. R., Padmaningrum, D., Widiyanto, Purwanto, D., & Wardani, R. R. I. K. (2024). The persilan on agroforestry crops system in java production forest. *IOP Conference Series: Earth and Environmental Science, 1315*(1). https://doi.org/10.1088/1755-1315/1315/1/012015

Sigiro, H. A., & Halimi, B. (2024). Design and Implementation of Solar-Powered Pumping System in IKN Nusantara Area. *Andalas Journal of Electrical and Electronic Engineering Technology, 2*(11). https://doi.org/doi.org/10.25077/ajeeet.v4i2.139

Weng, Q. (2025). Rapid Portable Water Purification for Disaster Relief: Developing an Emergency Device to Quickly Purify Contaminated Water Sources to Potable Standards. *International Conference on Materials Chemistry and Environmental Engineering, 0*, 20–35. https://doi.org/10.54254/2755-2721/124/2025.19733

Yadav, A. K., Yadav, V., Malik, H., Khargotra, R., & Singh, T. (2024). Design of novel IoT-based solar powered PV pumping systems for agricultural applications in diverse climatic zones of India. *Results in Engineering, 23*(5). https://doi.org/10.1016/j.rineng.2024.102584