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Groundwater Identification Using the Resistivity Method to Improve Community Livelihoods in Bernung Village, Gedong Tataan District, Pesawaran, Lampung

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Abstract

Background: Water availability is a critical factor influencing the sustainability of community-based economic activities, particularly in fisheries and plantation sectors. In Bernung Village, Gedong Tataan District, Pesawaran Regency, limited water supply during the dry season has restricted the optimal utilization of fish ponds and plantation land, thereby affecting local economic productivity.

Objectives: This study aims to describe a community service program integrating geoelectrical groundwater identification with community-based economic empowerment to support sustainable local business development.

Methods: The program applied a Participatory Rural Appraisal (PRA) approach involving community participation throughout field surveys, groundwater-source identification, site selection, mentoring, and evaluation stages. Groundwater investigation was conducted using 1D geoelectrical sounding with a Schlumberger configuration at two observation points. The acquired data were interpreted to identify aquifer characteristics and to support groundwater utilization planning.

Results: The geoelectrical survey identified potential aquifer zones at depths of 33.4–81.9 m at Point 1 and 21.5–82.8 m at Point 2, providing a technical basis for groundwater utilization planning. The program further supported the development of plantation land and fish-farming activities while improving community understanding of water-resource management and business development.

Conclusion: The findings demonstrate that geoelectrical investigation serves not only as an effective groundwater exploration tool but also as a practical decision-support approach for strengthening community livelihoods and promoting more sustainable fisheries and plantation-based economic activities.

A. Introduction

Water availability is a critical factor influencing the sustainability of community-based economic activities, particularly in rural areas that depend on agriculture, plantations, and fisheries (Triningsih., 2020; Sutrisno & Hamdani, 2020; Parahita et al., 2022). Limited access to reliable water sources may constrain productivity and hinder the development of local enterprises (Fajar et al., 2021). Therefore, proper

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identification and management of water resources are essential to support community empowerment and improve livelihoods.

Bernung Village, located in Gedong Tataan district, Pesawaran Regency, has considerable potential for the development of fisheries and plantation-based activities. However, field observations and discussions with local partners revealed several key challenges, including limited water availability for fish ponds, suboptimal utilization of mountain water and groundwater, the absence of water distribution channels to business locations, inadequate water storage facilities, and limited community knowledge in identifying groundwater depth. These conditions indicate a gap between the existing local resource potential and the community's technical capacity to utilize it effectively.

Previous studies have demonstrated that geoelectrical methods are widely applied to identify subsurface structures and estimate aquifer potential (Damayanti et al., 2020; Jusmi & Bakri, 2020; Fitrianto & Supriyadi, 2020; Masudi, 2021; Silvia & Malik, 2021; Kamur, 2022; Rolia et al., 2022; Chandrasasi et al., 2023; Saily et al., 2023; Rahmadani & Afdal, 2023). However, these studies generally focus on the technical aspects of aquifer detection and subsurface characterization, with limited attention to how geophysical findings can be translated into practical strategies for community-based economic development. Meanwhile, previous community service programs have utilized mountain water to support productive activities (Dewanto et al., 2022; 2023), yet the integration of scientific groundwater identification with structured community empowerment efforts remains limited.

Based on this gap, this study proposes an integrated approach that combines geoelectrical surveys for groundwater identification with community-based utilization strategies. The integration is implemented by using subsurface resistivity interpretations to determine potential groundwater locations, which then serve as a basis for supporting community business activities, such as fish pond development and water utilization for plantation needs. This approach is expected to improve the accuracy of water resource utilization while strengthening community capacity in sustainable water management. Therefore, this study aims to (1) identify potential groundwater zones using the geoelectrical method, (2) support the optimization of mountain water and groundwater utilization, and (3) enhance community economic activities through the development of fisheries and plantation sectors.

B. Methods

The community service program was carried out in Bernung Village, Gedong Tataan district, Pesawaran Regency, over a period of six months in 2025. The target participants of the program were farmers and livestock groups as well as community members directly involved in fisheries and plantation-based businesses. The program adopted a Participatory Rural Appraisal (PRA) approach, positioning the community not only as beneficiaries but also as active participants throughout problem identification, implementation, and evaluation stages (Firmansyah et al., 2024). The PRA approach was implemented through participatory surveys, field observations, group discussions, and collaborative decision-making involving community partners. During the initial stage, the community service team and local partners jointly identified the major problems related to water availability, fishpond development, and plantation expansion. Community members actively participated in identifying mountain water sources, assessing storage facilities, determining suitable land for fishponds and plantation development, and selecting feasible locations for groundwater exploration and waterway construction. The partner groups also acted as local pioneers and demonstration units to facilitate wider community participation and ensure sustainability of the program outcomes (Gozali et al., 2021). This participatory process was considered essential because the problems faced by the community required not only technical solutions but also strong local involvement to ensure long-term implementation and management.

The stages of the community service program were designed based on the community's initial conditions, the proposed solutions, and the expected conditions after program implementation. This methodological sequence and evaluation framework are presented in Table 1.

Table 1. Methods, stages and evaluation of service

Initial conditions before the activity is carried out	Solutions offered	Expected conditions after the Service activity
Lack of knowledge of groundwater and mountain water utilization.	Utilize groundwater and mountains by making waterway designs.	It is more profitable if it uses groundwater and mountains.
The knowledge of designing aqueducts is not yet understood.	Designing waterways to the place of business.	Facilitates the maintenance of farm animals and plant care.
Lack of knowledge of waterway design to the place of business.	Providing insight and knowledge in the manufacture of livestock and plant areas and the design of waterways.	Maintaining plant fertility and livestock health, so as to increase economic business results.
Knowledge is still lacking about business management, marketing systems, finance.	Provide training on business management, systems and marketing, and finance.	Facilitate marketing and benefit the farming and livestock community, so as to obtain good business results.
Lack of knowledge of groundwater depth determination.	Providing training on Geoelectric tools.	The community, farmer and breeder groups can determine the depth of groundwater.
There has been no continuous cooperation between Unila and the community	It is necessary to form cooperation to provide training, development.	Ability to increase, so it is expected to increase income.
Initial evaluation was carried out	Process evaluation is carried out	Final evaluation is carried out

In the initial stage, the community service team conducted a field survey together with community partners to identify the condition of mountain water sources, storage tanks, water distribution pathways, fishpond locations, and land with potential for plantation development. This preliminary survey also aimed to recognize environmental and technical constraints associated with water accessibility and agricultural activities. The preliminary survey activity is shown in Figure 1. The findings from this survey served as the basis for formulating more effective water utilization strategy in accordance with the needs and conditions of the community partners.

Figure 1. Condition of the Community Service Location

The main instruments used for groundwater identification were a one-dimensional (1D) Vertical Electrical Sounding (VES) geoelectrical survey employing a Schlumberger configuration (Antosia et al., 2022). Data acquisition was carried out using a Naniura resistivity meter at two observation locations, namely Point 1 (T-01) and Point 2 (T-02), on 6 July 2025. Documentation of the geoelectrical instrument and field measurement process is presented in Figure 4. The Schlumberger configuration was selected because of its capability to identify vertical variations in subsurface resistivity and delineate potential aquifer-bearing layers. The measurements were conducted by progressively expanding the electrode spacing, with AB/2 distances ranging from 1.5 to 150 m and MN/2 distances ranging from 0.5 to 10 m, allowing deeper subsurface penetration and improved resolution of vertical lithological variations. Apparent resistivity values were obtained from field measurements of injected electrical current and potential differences using the Schlumberger geometric factor. The acquired geoelectrical data were subsequently processed and inverted using IPI2Win software to obtain true resistivity models and subsurface layer geometry (Tso et al., 2021; Rahmaniah et al., 2021).

Figure 2. Full set of 1D resistivity method measurement tools

Operationally, the program was implemented through several stages. Firstly, preliminary surveys and participatory discussions were conducted to determine environmental conditions and community needs. Secondly, the service team and community partners collaboratively selected the locations for geo-electrical measurements. Thirdly, geoelectrical data acquisition was carried out at two observation points. Fourthly, the measurement results were processed and interpreted to determine the depth and position of aquifer zones. Fifthly, the groundwater identification results were used as the basis for formulating recommendations for water utilization and designing water-distribution channels to business locations (Saputro et al., 2022). Sixthly, the team provided assistance for fishpond and plantation development, conducted training on business management and marketing, and carried out participatory evaluation of the program outcomes together with the community.

C. Results and Discussion

1. Results

The results of the community service program demonstrated that the primary challenges faced by partners in Bernung Village were closely associated with limited water availability and the absence of an organized water-utilization system to support productive economic activities. During the initial stage, the community service team conducted a field survey to assess mountain water sources, storage tanks, and existing water-channel directions leading to business locations, as shown in Figure 3. The preliminary survey findings served as the basis for determining an intervention strategy integrating mountain-water utilization and groundwater identification. This integrated approach was considered necessary because water availability constitutes a key factor affecting the sustainability of fisheries, plantation activities, and livestock production (Koniyo, 2020; Pagoray et al., 2021). The field assessment further revealed that the community possessed land resources with considerable potential for plantation and fish-farming development, although these resources had not yet been optimally managed. The inspection of land suitable for plantation and fish-farming development is presented in Figure 4, while the condition of the fish ponds that served as supporting infrastructure for community-based businesses is shown in Figure 3. These observations indicate that the principal limitation faced by the community was not merely land availability but rather inadequate water accessibility and limited technical capacity for water-resource management.

Figure 3. Evaluation of highland water control to reservoirs in Gedong Tataan Village

Figure 4. Evaluation of land that can be made for plantations and fish farms

From the technical perspective, the core activity of the community service program was groundwater identification using the geoelectric method. Measurements were carried out using the Schlumberger configuration at two points, namely Point 1 (T-01) at UTM coordinates X: 517394 and Y: 9406261 in Zone 48S, and Point 2 (T-02) at UTM coordinates X: 517369 and Y: 9406266 in Zone 48S. The geoelectric measurement model for Point 1 is presented in Figure 5, while the geoelectric measurement data for Point 2 are presented in Figure 7.

The geoelectrical investigation provided important technical information regarding groundwater potential in the study area (Nurfaika, 2021). Based on the 1D modeling results at Point 1 (Figure 6), four relatively distinct subsurface layers were identified. According to the regional geological map, the site is located within the Qhv formation, dominated by andesite, breccia, and tuff deposits. Layer 1, extending from 0 to 0.759 m depth, represents topsoil or overburden material. Layer 2, located between 0.759 and 1.84 m, also consists of topsoil characterized by relatively higher resistivity responses. Layer 3, extending from 1.84 to 33.4 m, is interpreted as a breccia layer with moderately low resistivity characteristics. Layer 4, occurring at depths between 33.4 and 81.9 m, is interpreted as a groundwater-bearing zone dominated by breccia and sandstone materials deposited through fluvial processes.

Figure 5. resistivity measurement documentation Point 1

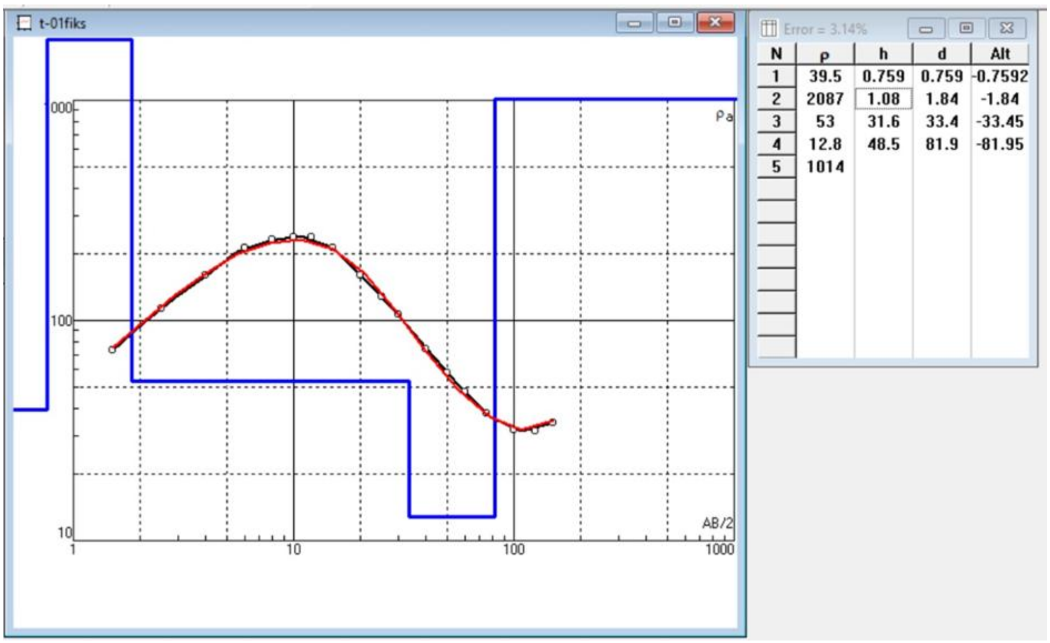

Figure 6. 1D model of resistivity measurement Point 1

Figure 7. Resistivity measurement documentation Point 2

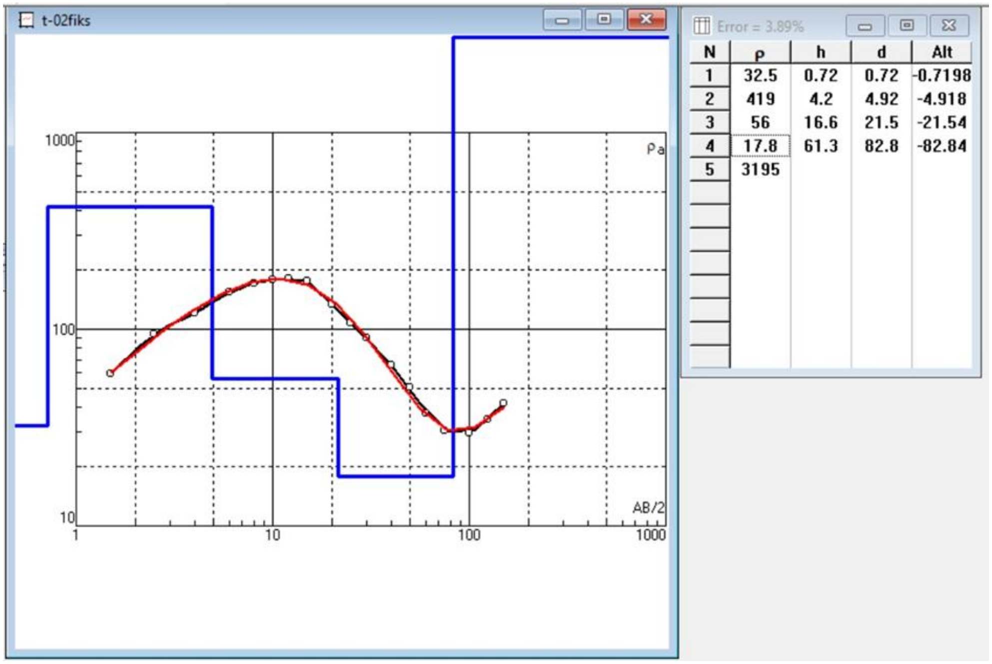

Figure 8. 1D model of resistivity measurement Point 2

The interpretation of Layer 4 as an aquifer was not based solely on depth distribution but also on its geoelectrical and geological characteristics. In geoelectrical investigations, aquifer zones commonly exhibit moderate resistivity values associated with porous and permeable materials capable of storing and transmitting groundwater (Ammar et al., 2021). Volcaniclastic deposits such as fractured breccia and sandstone may function as productive aquifers due to the presence of intergranular porosity and secondary permeability generated by fractures and weathering processes. The interpretation obtained in this study is consistent with previous groundwater investigations employing geoelectrical methods, which reported that groundwater-bearing layers are frequently associated with moderate resistivity responses within permeable volcanic and sedimentary units. Therefore, the identified layer at Point 1 was considered to represent a potential aquifer zone suitable for groundwater extraction. Based on the interpreted groundwater distribution, deep groundwater drilling at Point 1 may be conducted within the depth range of approximately 33.4–81.9 m. Furthermore, groundwater indications may still persist below this interval to approximately 100 m depth, considering the proximity of the area to natural water sources and the hydrogeological setting of the site.

Similarly, the 1D modeling results at Point 2 (Figure 8) identified four relatively distinct subsurface layers within the Qhv formation. Layer 1, extending from 0 to 0.72 m depth, consists of topsoil or overburden material, while Layer 2, occurring between 0.72 and 4.92 m depth, is also interpreted as topsoil characterized by relatively higher resistivity values. Layer 3, located between 4.92 and 21.5 m depth, represents breccia deposits with moderately low resistivity characteristics. Layer 4, occurring between 21.5 and 82.8 m, is interpreted as an aquifer layer composed predominantly of breccia and sandstone transported through fluvial depositional processes. The hydrogeological interpretation at Point 2 demonstrates characteristics similar to those observed at Point 1, where permeable volcaniclastic materials provide favorable conditions for groundwater accumulation (Amri, 2021). Such materials commonly possess sufficient porosity and permeability to support groundwater storage and movement. Consequently, deep groundwater drilling at Point 2 is recommended within the depth interval of 21.5–82.8 m, while groundwater indications may still extend to depths approaching 100 m.

The technical results obtained from the geoelectrical survey were subsequently integrated into community empowerment activities. In the fisheries, livestock, and plantation sectors, the community successfully improved and developed fish ponds and plantation areas that had previously been underutilized. The results of livestock-development and plantation-supporting activities are shown in Figures 9 and 10. These developments demonstrate that groundwater identification and water-resource planning provided not only technical information but also practical guidance for strengthening local economic activities. During the final evaluation stage, the community service team revisited the site to assess plantation activities, fish farming, and groundwater utilization. Moreover, the program contributed to the diversification of local livelihoods and encouraged more sustainable resource management practices.

Figure 9. Fish, poultry and goats farming of the Bernung Village community

Figure 10. Plantation of the Bernung Village community

From an economic perspective, the program contributed to the diversification of community livelihoods and business activities. Prior to the implementation of the community service program, partners' income mainly depended on plantation products, resulting in relatively limited and less diversified sources of revenue. Following the program, additional productive activities developed through vegetable cultivation, fruit production, and fish farming, as presented in Tables 2 and 3. Although the economic outcomes require longer observation to demonstrate long-term impacts comprehensively, the emergence of multiple income-generating activities indicates that improved water accessibility and technical assistance supported broader community business development (Zahra et al., 2021). Therefore, the economic benefit of the program should be understood not only in terms of monetary income but also through enhanced livelihood diversification, improved resource utilization, and strengthened local productive capacity.

Table 2. Partner's earnings per week before the Service Team arrives

Before the Service Team Arrives	**Earnings/Week**
Selling garden produce: bananas, durians, duku, waluh and cassava	IDR 900,000,-

Table 3. Partner's earnings per Sunday after the Service Team arrives

After the Service Team Comes	**After 3 months (implemented)**	**After 6 months (approximately)**	**After 10 months (approximately)**
		Per Week	
1. Selling garden produce (Vegetables): chayote, chili, spinach, pete, cassava leaves	IDR 200,000	IDR 300,000	IDR 500,000
2. Selling garden products (fruits): bananas, waluh, duku, durian, sawo	IDR 200,000	IDR 400,000	IDR 600,000
3. Selling fish products: tilapia	IDR 300,000	IDR 500,000	Rp. 800.000

2. Discussion

The results of this community service program indicate that groundwater identification using the geoelectric method can provide a strong technical foundation for community business development. The 1D geoelectric modeling results at Points 1 and 2 show that Bernung Village has aquifer potential that is feasible to utilize as a reserve water source, particularly during the dry season. This finding is highly important because one of the main constraints faced by the community is the limited water supply, which has so far hindered the development of fish ponds and plantation land. With the availability of information on aquifer depth, water supply planning can be carried out more accurately (Rubiantoro & Bisri, 2022). These findings are consistent with various previous studies showing that the geoelectric method is effective for estimating the presence of aquifers and supporting groundwater provision for community needs (Damayanti et al., 2020; Irawan et al., 2022; Chandrasasi et al., 2023).

However, the contribution of this community service program does not stop at groundwater identification alone. The geoelectric results were directly linked to the actual needs of the community, namely the development of fisheries and plantation-based businesses. Thus, the 1D geoelectric modeling was translated into an applicable solution within the context of community empowerment in Bernung Village. The development of plantation land and the improvement of fish farming activities demonstrate that water support, both from mountain water sources and from the planned utilization of groundwater, can strengthen the community's business activities (Susanti et al., 2022).

The participatory approach used in this program was also an important factor in its success. The community did not merely act as beneficiaries, but was actively involved in the preliminary survey, problem identification, development of business facilities, and final evaluation of the program. It was this community involvement that made the outcomes of the program more likely to continue after its completion. From an economic perspective, the development of income showed a positive trend. Before the community service program, the partners' income was still limited and depended mainly on plantation products. After the program was implemented, income sources became more diverse through the production of vegetables, fruits, and fish farming.

2.1 Implications

The practical implication of this program is the availability of a basis for the community and local stakeholders to plan water utilization more effectively. The 1D geoelectric modeling results shown in Figures 6 and 8 can serve as an initial reference for determining well locations and depths, while the business development presented in Figures 9 and 10 provides evidence that better water utilization can support the strengthening of community businesses.

2.2 Research Contribution

The main contribution of this article is that the geoelectric method can be directly integrated into community service programs as a tool for technical decision-making. This article also demonstrates that the results of geophysical research are not only relevant in a scientific context, but can also be applied as a strategy for strengthening community businesses based on local resources.

2.3 Limitations

The limitation of this program lies in the geoelectric measurements, which were conducted at only two points; therefore, the interpretation results do not yet represent the entire village area. In addition, the evaluation of the increase in community income still requires long-term monitoring in order to demonstrate the economic impact more comprehensively and convincingly.

2.4 Suggestions

Follow-up activities need to be directed toward increasing the number of geoelectric measurement points so that aquifer mapping can be carried out in greater detail. In addition, further assistance is needed for the implementation of well drilling, the organization of water distribution systems, the strengthening of business management, and the regular monitoring of the community's economic conditions so that the impact of the community service program can develop in a more sustainable manner.

D. Conclusion

The community service program in Bernung Village shows that groundwater identification using the resistivity method can serve as a scientific basis for supporting community business development. The geoelectric measurement results at two points indicate the presence of potential aquifer zones that can be recommended for groundwater supply, particularly as an anticipatory measure during the dry season. The use of these identification results, combined with the utilization of mountain water and assistance in the development of fish ponds and plantations, was able to enhance the capacity of community businesses. Thus, this program demonstrates that the integration of geophysical technology and community empowerment can be an effective strategy for increasing productivity and the income potential of rural communities.

E. Acknowledgment

The undersigned are the authors of the community service journal article:

Title: Groundwater Identification Using the Resisitvity Method to Improve Community Livelihoods in Bernung Village, Gedong Tataan District, Pesawaran, Lampung

Authors: Ordas Dewanto, Akhmad Dzakwan, Ilham Dani, Nasir Muhammad

Hereby declare that this article is our original work, is not plagiarized, and has never been published in any journal.

Thank you.

Sincerely,

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F. Author Contribution Statement

OD was responsible for the implementation of the community service program, conducted the preliminary survey and data collection, and carried out the data analysis to determine the position and depth of groundwater. AD designed the water distribution channels and business facilities. ID processed the geoelectric data and interpreted the results to determine the position and depth of groundwater. NM helped with language editing, manuscript proofreading, and enhancing the calibre of scientific writing.

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