



# Environmental education and community empowerment for local fish conservation in Pasuruan, Indonesia

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## ABSTRACT

*Pusat Konservasi Iwak Kali (PAKWALI)* in Bakalan village, Pasuruan, holds significant potential for freshwater biodiversity conservation, but faces major challenges from environmental pollution, exploitation of native fish species, and limited infrastructure support. This community services program aimed to strengthen conservation efforts through community empowerment, education, and facility support. The main objectives were to raise awareness of local fish conservation, improve water quality management, and build capacity through participatory training. The program was implemented through several stages, including site assessment, installation of basic facilities such as fish nursery ponds and water quality monitoring tools, community education workshops, and post-activity evaluation. Pre- and post-test analysis showed improvements in cognitive, affective, and psychomotor dimensions. Affective scores increased from 4.25 to 4.62 ( $p = 0.023$ ), indicating a statistically significant improvement in participants' conservation attitudes. Results showed increased community understanding of freshwater ecosystems, greater awareness of the importance of native fish species, and growing motivation among participants to adopt sustainable fish farming practices. Additionally, the use of standardized recording formats and expanded partnerships with academic and environmental institutions supported the long-term sustainability of the program. The initiative demonstrates the effectiveness of local based conservation efforts in integrating ecological education with practical community-based action.

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## 1. INTRODUCTION

Freshwater biodiversity represents one of the most critically endangered ecosystem components globally (Kumar & Afaq, 2022). Reports from various international environmental agencies indicate that the rate of population decline in freshwater organisms is significantly higher than that observed in terrestrial and marine ecosystems. This trend is primarily driven by habitat degradation, pollution, overexploitation, and a general lack of public conservation awareness (Mafiana et al., 2022). While local and endemic freshwater fish play a vital role in maintaining ecological equilibrium and supporting community food security and economies, their existence is increasingly jeopardized by unsustainable anthropogenic activities (Dudgeon et al., 2006).

In Indonesia, the management and protection of aquatic quality and fish biodiversity are governed by several regulatory frameworks, including Government Regulation No. 22 of 2021 concerning the Implementation of Environmental Protection and Management, as well as fish resource conservation policies that emphasize sustainable and participatory approaches (Effendi et al., 2021). Adherence to water quality standards is a fundamental prerequisite for the survival of freshwater fish; deviations in physical and chemical parameters from established benchmarks can directly impair fish health and destabilize aquatic ecosystems.

The *Pusat Konservasi Iwak Kali* (PAKWALI), situated in Bakalan Village, Pasuruan Regency, is a community-based initiative focused on freshwater fish conservation through aquaculture and environmental education (Prasetyo et al., 2026). Geographically, this area possesses significant biodiversity potential and functions as a critical buffer for the surrounding river ecosystems (Andriyono & Fitriani, 2021). Consequently, PAKWALI serves as a strategic conservation node and an educational space for community-led aquatic resource management.

Based on initial assessments and discussions with PAKWALI management, the community consists of approximately 40 registered members; however, active participation in training activities remains relatively limited. Water quality management within the aquaculture ponds is currently conducted using conventional methods, lacking routine monitoring and documentation of critical parameters such as temperature and pH. Furthermore, structured educational initiatives regarding local fish conservation and the ecological functions of aquatic ecosystems are infrequently implemented. In this community service program, 16 participants were actively involved throughout the entire series of training and evaluation sessions.

The results of the preliminary assessment and interviews with PAKWALI administrators reveal that primary activities are dominated by the cultivation of consumption fish, specifically catfish (*Clarias sp.*) and tilapia (*Oreochromis niloticus*), selected for their economic value and ease of maintenance. Nevertheless, water quality management remains rudimentary, data recording is not standardized, and conservation education for local and endemic species is still restricted. Additionally, public understanding concerning the ecological roles of indigenous fish and the impacts of pollution on aquatic ecosystems is relatively low.

These conditions potentially lead to various adverse impacts, including the degradation of aquatic habitats, the decline of local and endemic fish populations, and an increased reliance on introduced species and unsustainable aquaculture systems (Supiyana & Ratnasari, 2024). In the long term, such circumstances may jeopardize river ecosystem resilience, diminish the ecological value of the area, and hinder PAKWALI's role as a center for conservation and environmental education. While various freshwater fish conservation programs in Indonesia generally emphasize technical approaches such as fish restocking, habitat restoration, and the implementation of aquaculture technology that initiatives remain fragmented. These programs often lack integration between educational aspects, community empowerment, and the strengthening of supporting facilities, which frequently results in suboptimal program sustainability.

Based on field assessments and prior studies, a significant gap remains between research and conservation practice, particularly concerning the implementation of environmental education integrated with community empowerment and the strengthening of local-based conservation facilities (Jarvis et al., 2020; Mihók et al., 2015). To date, community service studies that systematically measure changes in the affective, cognitive, and psychomotor domains of the community within the context of local fish conservation while simultaneously linking these aspects to water quality management and community-level conservation governance remain limited.

The novelty of this initiative lies in the application of a community-based conservation approach that integrates environmental education, participatory training, the provision of fundamental conservation facilities, and the use of validated and reliable evaluation instruments. This program focuses not only on knowledge enhancement but also on fostering attitudes, practical skills, and support systems oriented toward long-term sustainability at PAKWALI. This community service program aims to increase public awareness and capacity regarding local freshwater fish conservation through environmental education, community empowerment, and the strengthening of water quality management and conservation infrastructure at the *Pusat Konservasi Iwak Kali* (PAKWALI).

These activities are expected to provide substantial contributions by improving community understanding and technical skills in local fish conservation, reinforcing PAKWALI's role as a community-based education and conservation hub, and serving as a replicable community service model for other freshwater regions. Furthermore, the outcomes of this project contribute to the development of sustainable freshwater fish conservation studies based on education and community empowerment. This community service initiative is designed to elevate community consciousness and capability in local freshwater fish conservation through an integrated approach involving environmental education, community empowerment, and the enhancement of water quality management and conservation facilities at PAKWALI.

## **2. METHODS**

### **Location and Subject of the Activity**

This community service project was conducted at PAKWALI (*Pusat Konservasi Iwak Lokal*), located in Sukun Hamlet, Bakalan Village, Purwosari District, Pasuruan Regency, East Java, during August 2025. This site was selected due to its function as a center for education, conservation, and socialization of local and endemic freshwater fish, as well as its active role in hosting community-based visits and outreach programs.

The participants of this activity consisted of 16 individuals, including community members and local residents with an interest in freshwater fish conservation and aquatic quality management. Participants were selected through purposive sampling based on the following criteria: (1) Willingness to participate in the entire series of activities; (2) Active involvement in discussion and practical sessions; and (3) No prior formal training in similar programs.

### **Implementation Stage**

The community service program was designed using a participatory learning approach, integrating interactive lectures, discussions, demonstrations, and hands-on practice (Agusta et al., 2025). The activities were conducted across six sessions. The first session focused on program introduction, the implementation team, project objectives, and a general overview of the importance of local and endemic freshwater fish conservation. During this stage, a pre-test was administered to measure the participants' initial levels of knowledge, attitudes, and skills. The second session discussed fundamental concepts of freshwater fish biodiversity, threats to local and endemic species, and the role of the community in conservation efforts. These activities were carried out through interactive discussions and simple case studies relevant to local conditions.

The third session emphasized the basic principles of freshwater quality, simple physico-chemical parameters, and their correlation with fish survival. Participants were encouraged to understand the relationship between anthropogenic activities and aquatic habitat degradation. Subsequently, the fourth

session focused on the introduction of simple technologies supporting aquatic management, including the concept of nanobubble technology as an innovation for water quality enhancement. At this stage, participants were introduced to the working principles and potential applications of the technology through conceptual explanations and basic demonstrations, without the permanent installation of a nanobubble system at the project site.



**Figure 1.** Observation practice using the nanobubble system by participants

The fifth session was directed toward practical activities and simulations, where participants engaged directly in observing aquatic conditions, problem-solving discussions, and applying local fish conservation concepts within real-world scenarios. Finally, the sixth session served as a reflection and evaluation stage, encompassing discussions on activity outcomes, reinforcement of conservation messages, and the administration of a post-test to measure changes in the participants' cognitive, affective, and psychomotor domains.

As part of the community capacity-building effort, the program also provided fundamental facilities to support conservation activities, including small-scale fish breeding ponds and basic water quality monitoring tools, such as thermometers and pH meters. Participants received brief training on tool utilization and the documentation of water quality parameters using the standardized logsheet formats provided during the program.

### **Evaluation Instruments and Techniques**

The effectiveness of the activities was evaluated using a structured questionnaire designed to measure three primary learning domains. The validity of the instrument was tested using Pearson correlation, yielding significant results ( $p < 0,05$ ) for all items (Hammer & Harper, 2024). Consequently, the instrument was deemed valid and appropriate for evaluating cognitive, affective, and psychomotor learning outcomes (Hoque, 2016).

### **Instrument and Indicators**

The evaluation instrument was developed as a structured questionnaire utilizing a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). The questionnaire comprises three primary domains: cognitive, affective, and psychomotor. The cognitive domain consists of 8 items measuring participants' understanding of freshwater fish conservation concepts, aquatic biodiversity, and fundamental water

quality management principles. The affective domain includes 7 items assessing participants' attitudes and concerns toward conservation, including indicators of commitment to local fish preservation, sensitivity to aquatic environmental quality, and the intention to engage in community-based conservation activities. Lastly, the psychomotor domain comprises 5 items evaluating basic conservation skills, such as the ability to observe aquatic conditions, perform basic water quality parameter measurements, and complete environmental monitoring logsheets. The score for each domain was calculated as the mean value of all items within that specific domain.

### **Ethical Procedures**

This community service project was conducted with the formal approval of the PAKWALI management as the collaborating partner. All involved participants received comprehensive explanations regarding the program objectives, implementation processes, and the utilization of evaluation data for program development and scientific publication. Participation was voluntary, and all collected data were kept confidential and utilized exclusively for academic analysis purposes.

### **Data Analysis**

Data obtained from pre-tests and post-tests were analyzed quantitatively. Data normality was assessed descriptively, followed by a comparison of pre-test and post-test scores for each aspect using a dependent t-test. In addition to parametric t-tests, the analysis was reinforced with parametric confidence intervals, bootstrap confidence intervals, and Monte Carlo permutation tests to enhance the reliability of result interpretation, considering the relatively limited sample size (Baltosser, 1996). All statistical analyses were performed using PAST software with a significance level of  $\alpha = 0,05$  (Hammer & Harper, 2024).

The analysis results are presented as mean values, confidence intervals, and p-values, and are interpreted descriptively to assess trends in changes to participants' knowledge, attitudes, and skills following the community service activities.

## **3. RESULTS AND DISCUSSION**

### **Results**

The community service program, titled "Environmental Education and Community Empowerment for Local Fish Conservation at PAKWALI," was conducted at the *Pusat Konservasi Iwak Kali* (PAKWALI) in Sukun Hamlet, Bakalan Village, Purwosari District, Pasuruan Regency. This activity involved 16 participants, consisting of local residents and the PAKWALI management team. The number of participants involved in the evaluation was relatively limited as the activities focused specifically on community members actively engaged in PAKWALI management. Consequently, the findings represent the program's impact on this specific partner community and are not intended to be generalized to a broader population.

### **Implementation of community service activities**

Two primary training sessions were conducted with 16 active participants from the 40 registered members of PAKWALI. The majority of these participants were residents of Sukun Hamlet. The training materials encompassed the conservation of local and endemic freshwater fish species of East Java.



Figure 2. Local fish conservation training activities in PAKWALI

### Changes in partner conditions before and after the program

The effectiveness of the community service program was evaluated through a comparative analysis of pre-test and post-test scores using paired t-tests across three learning domains: cognitive, affective, and psychomotor. This analysis focused on 16 participants who completed the entire series of outreach and training sessions, which addressed two primary themes: local fish conservation and the introduction of nanobubble technology.

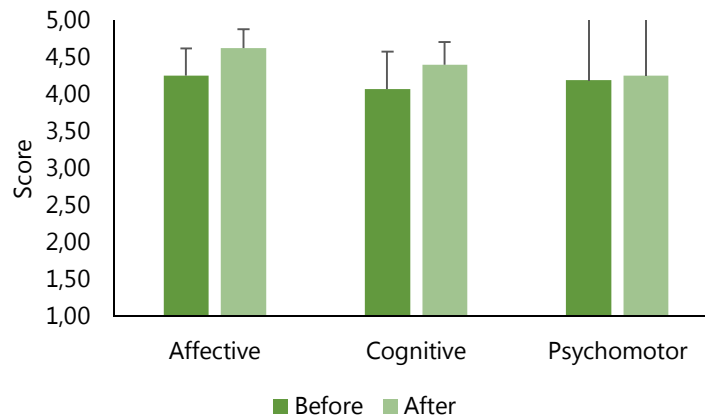


Figure 3. Changes in pre- and post-activity cognitive, affective, and psychomotor scores

Based on Figure 3, in contrast to the cognitive domain, the affective domain demonstrated a statistically significant increase. The mean score rose from 4.25 to 4.62, with a mean difference of 0.37. Paired t-test results indicated a significant difference ( $t = -2,54$ ;  $p = 0,023$ ). This significant improvement in the affective dimension suggests that participatory environmental education activities effectively strengthen participants' awareness and concern regarding local fish conservation. Such attitudinal shifts represent a critical initial stage in the process of behavioral change toward aquatic resource management.

Furthermore, within the cognitive domain, participants' mean scores increased from 4.06 in the pre-test to 4.39 in the post-test, representing a mean difference of 0.33. The paired t-test results showed that this increase was not statistically significant ( $p > 0,05$ ), with a 95% confidence interval that included zero. These findings suggest a trend toward improved understanding, although it was not statistically

robust within the limited sample size. Similarly, in the psychomotor domain, the mean score showed a relatively minor increase from 4.19 to 4.25, with a mean difference of 0.06. Paired t-test results indicated that this difference was not statistically significant ( $t = -0,56$ ;  $p = 0,580$ ), characterized by a wide 95% confidence interval that spanned zero (-0.173 to 0.298).

The lack of significant improvement in the cognitive and psychomotor dimensions was likely influenced by the relatively short duration of the activities and the limited number of participants. In the context of community service programs, changes in knowledge and practical skills often require more prolonged mentoring processes to yield measurable significance. These results are consistent with non-parametric tests and Bayesian analysis, which provided substantial evidence for the similarity between pre- and post-test values, indicating that changes in participants' practical skills remained limited within the brief duration of the intervention.

### **Partner capacity changes**

Based on initial observations and discussions with PAKWALI management, conservation management practices prior to the program were relatively rudimentary. Water quality monitoring was not conducted routinely, and a standardized recording system for environmental parameters was absent. Furthermore, educational initiatives regarding local fish conservation were carried out sporadically and lacked structured training materials.

**Table 1.** Partner capacity changes

<b>Aspect</b>	<b>Before Program</b>	<b>After Program</b>
Water quality monitoring	Was not conducted routinely	Participants understand basic parameters (pH, temperature, DO)
Recording system	There was no standardized documentation format yet	Introduction of environmental monitoring logsheets
Conservation education	Activities were conducted on an informal basis	Utilization of local fish conservation training modules
Knowledge of water management technology	Lack of innovative conservation technologies	Participants are introduced to the concept of nanobubble technology

Following the implementation of the community service program, several initial changes became apparent within the partner community. Participants were introduced to basic water quality monitoring procedures and the use of logsheets to document environmental parameters. Furthermore, educational activities regarding local fish conservation began to be conducted in a more structured manner through the utilization of the training modules developed in this program.

### **Supporting facilities and technology**

In addition to training and educational activities, this community service program provided fundamental facility support to bolster conservation efforts at PAKWALI. The facilities introduced included basic water quality monitoring devices, such as water thermometers and pH meters, used to observe aquatic environmental conditions. During the training sessions, participants were also introduced to the concept of nanobubble technology as an innovation in water quality management. Demonstrations of this technology were conducted on a limited basis as part of the educational process to broaden

participants' horizons regarding eco-friendly technological alternatives applicable to aquaculture systems. This approach aimed to enhance the community's technical capacity to understand the relationship between water quality and the sustainability of local fish conservation.

### Program materials

The materials for this community service program were developed based on research findings previously conducted by the implementation team, particularly regarding local freshwater fish conservation and aquatic quality management. Additionally, the content was adapted from academic teaching materials and synthesized from various scientific references and similar community service initiatives. The development of these materials took into account the specific characteristics of the partner community and field conditions to ensure the content remained applicable and easily understood by participants.

The program focused on two primary themes: the conservation of local and endemic freshwater fish species and the introduction of nanobubble technology as an innovation in water quality management. Material adjustments were made based on initial discussions between the implementation team and the partners, considering the participants' prior knowledge, available facilities, and the program's timeline. In practice, the activities were carried out over several sessions, combining interactive lectures, discussions, and hands-on field practice.

**Table 2.** Activity schedule and materials

Session	Activity	Goals
1	<ul style="list-style-type: none"> <li>- Introduction of the implementation team and participants</li> <li>- Explanation of objectives, methods, and guidelines</li> <li>- General introduction to local freshwater fish conservation</li> </ul>	<ul style="list-style-type: none"> <li>- To align perceptions between the team and participants</li> <li>- To provide an initial understanding of the importance of local fish conservation</li> </ul>
2	<ul style="list-style-type: none"> <li>- Presentation on local and endemic fish diversity</li> <li>- Discussion on threats and challenges in freshwater ecosystems</li> </ul>	<ul style="list-style-type: none"> <li>- To increase participants' knowledge regarding local fish species</li> <li>- To foster concern for the sustainability of aquatic resources</li> </ul>
3	<ul style="list-style-type: none"> <li>- Explanation of water quality parameters (pH, temperature, DO)</li> <li>- Discussion on the relationship between water quality and fish health</li> </ul>	<ul style="list-style-type: none"> <li>- To provide an understanding of environmental factors affecting fish</li> <li>- To link water quality management with conservation practices</li> </ul>
4	<ul style="list-style-type: none"> <li>- Introduction to the concepts and principles of nanobubble technology</li> <li>- Introduction to devices and application examples</li> </ul>	<ul style="list-style-type: none"> <li>- To provide insights into eco-friendly technological innovations</li> <li>- To broaden alternative solutions for water quality management</li> </ul>
5	<ul style="list-style-type: none"> <li>- Demonstration of nanobubble technology usage</li> <li>- Field practice and observation of aquatic conditions</li> </ul>	<ul style="list-style-type: none"> <li>- To enhance participants' practical skills</li> <li>- To integrate theoretical knowledge with field application</li> </ul>
6	<ul style="list-style-type: none"> <li>- Post-test administration</li> <li>- Reflective discussion and program evaluation</li> <li>- Participant feedback collection</li> </ul>	<ul style="list-style-type: none"> <li>- To evaluate the overall effectiveness of the activities</li> <li>- To identify opportunities for future program development</li> </ul>

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The community service activities commenced in the first session with the introduction of the implementation team and an explanation of the program methodology. This stage served as the initial foundation to build a mutual understanding between the team and participants regarding the program's objectives, implementation flow, and the significance of local freshwater fish conservation. This preliminary explanation was also intended to foster a participatory atmosphere, ensuring that participants remained actively engaged throughout every phase of the project.

In the second session, the focus shifted toward enhancing participants' knowledge of local and endemic fish biodiversity, as well as the various threats affecting their existence. Interactive discussions were held by linking the material to the aquatic conditions surrounding the partner's location. This approach helped participants realize that conservation challenges are not abstract issues but are directly related to the environment they encounter daily.

The third session addressed the technical aspects of water quality management as a key factor in the sustainability of freshwater fish. Materials regarding water quality parameters were presented in a simple and applicable manner, accompanied by discussions on their impact on fish health. This stage aimed to strengthen participants' understanding that fish conservation efforts are inseparable from sound aquatic environmental management.

The fourth session introduced participants to nanobubble technology as an innovation in water quality management. This introduction emphasized its working principles and practical benefits, providing participants with new insights into eco-friendly alternative solutions that have the potential for implementation within local aquatic systems.

The fifth session focused on field practice, where participants were directly involved in demonstrations and the application of nanobubble technology. The implementation team provided intensive mentoring to ensure that participants understood every stage of the practice. This activity played a crucial role in enhancing the participants' psychomotor skills and strengthening the link between theory and practice.

In the sixth session, a program evaluation was conducted through a post-test and reflective discussion. This stage aimed to assess the program's effectiveness while gathering experiences and feedback from the participants. The reflective discussion provided an overview of the program's benefits and identified potential for more sustainable community service development in the future.

## **Discussion**

### **Community empowerment through environmental education based on local fish conservation**

In general, the results of the pre-test and post-test evaluations indicate that the community service program had a positive impact on increasing participant capacity, particularly within the affective dimension, as reflected by the strengthening of attitudes and awareness regarding the importance of local and endemic freshwater fish conservation. Improvements in the cognitive aspect also showed a consistent and practically meaningful trend, although not fully detected as statistically significant, while changes in the psychomotor aspect remained relatively limited.

These findings suggest that conservation-based environmental education, designed in a participatory and contextual manner, is effective in building initial understanding and positive community attitudes. Nevertheless, the limited duration of the intervention and the small number of participants are thought to have constrained the observable quantitative changes in skills. This pattern aligns with the characteristics of community service programs, where shifts in attitude and awareness generally emerge earlier than changes in behavior or technical skills, which require more long-term mentoring processes (Monroe et al., 2019).

These findings align with various studies on community-based environmental education, which indicate that changes in attitudes and ecological awareness typically emerge earlier than changes in behavior or technical skills within the community (Monroe et al., 2019). Other studies also show that contextual learning approaches that link materials with local experiences can increase participants' emotional engagement and strengthen commitment to conservation practices (Fraser et al., 2015).

The implementation of community service activities at PAKWALI demonstrates that an environmental education approach integrated with community empowerment is a relevant strategy for supporting local freshwater fish conservation (Wiyono et al., 2023). The activities began with a field condition assessment and participatory dialogue with the management, which served as an essential foundation in ensuring the program's alignment with the community's actual needs. This approach is consistent with the principles of community service that position partners as active subjects rather than mere program recipients, as emphasized in various community-based service studies.

Pre-test and post-test evaluation results show a consistent upward trend across cognitive, affective, and psychomotor aspects, although they are not yet statistically significant. These findings can be interpreted as an indication that changes in community knowledge and attitudes toward local fish conservation are gradual processes that may not always be detected instantaneously, particularly in service activities with limited duration and a relatively small number of participants. Similar conditions have also been reported in several community service programs in the field of environmental education, where increased awareness and conservative attitudes appear before significant behavioral changes can be quantitatively measured.

The stronger increase in the affective dimension was likely influenced by a participatory learning approach that directly placed participants within the context of conservation issues in their own environment. Discussions regarding local aquatic conditions, field experiences, and direct interaction with conservation practices at PAKWALI can trigger emotional engagement with the issues they face daily. In environmental education, such contextual experiences are known to play a vital role in forming ecological awareness and conservation attitudes before more complex behavioral changes occur. Conversely, the statistically non-significant increases in the cognitive and psychomotor dimensions were likely influenced by the relatively short duration of the program and limited field practice time. Mastering technical knowledge regarding fish conservation and water quality management generally requires repetitive learning processes and more intensive mentoring to develop into quantitatively measurable skills.

Specifically, the score increases in the cognitive and affective aspects indicate that the materials on local fish conservation and aquatic ecology delivered through participatory methods were able to broaden understanding and build positive attitudes toward the importance of maintaining freshwater ecosystem sustainability. This supports the view that environmental education serves not only as a transfer of knowledge but also as a means of forming community ecological values and concern (Fraser et al., 2015; Uralovich et al., 2023).

From a practical standpoint, the identified increase in participants' conservation awareness and attitudes can serve as an initial asset for developing community-based conservation systems at PAKWALI. This awareness has the potential to be translated into more structured environmental management practices, such as routine water quality monitoring, documentation of environmental parameters, and collective management of local fish habitats. Strengthening community institutions and developing collaborative networks with universities, local governments, and conservation agencies are also critical factors to ensure program sustainability and expand its impact on local aquatic resource management.

### **Effectiveness of participatory modules and practices in strengthening community capacity**

The development and use of the module “Conservation Strategies for Local and Endemic Freshwater Fish” played a vital role in supporting the effectiveness of the outreach activities. The module, designed based on field needs and equipped with technical guidelines and practical exercises, allowed participants to link conservation concepts with the daily fish farming practices they already perform. This approach aligns with findings from various community service activities emphasizing that contextual and applicable materials are more easily accepted and internalized by the community (Corneasari, 2025).

Hands-on methods and direct mentoring also contributed to the improvement of participants’ psychomotor aspects, although the increase was relatively small. This is understandable given that practical skills in water quality management and fish conservation require time and repetition to develop optimally. Nevertheless, the direct involvement of participants in field practice serves as an important initial step in encouraging the adoption of more sustainable aquaculture and conservation practices within PAKWALI.

### **Impact, contribution, and potential for program development**

Overall, this community service activity has had a positive impact on increasing community awareness regarding the importance of local freshwater fish conservation and water quality management. Strengthening community capacity, providing basic conservation facilities, and developing partnerships with academic institutions serve as the initial assets for program sustainability at PAKWALI. The community-based conservation approach applied here demonstrates the potential to be replicated in other freshwater areas with similar characteristics.

Nevertheless, the evaluation results also indicate areas for improvement, particularly concerning the duration of mentoring, the intensity of practice, and the expansion of participant numbers. The development of follow-up programs with a sustainable approach is expected to produce more tangible and measurable behavioral changes, as well as strengthen PAKWALI’s role as a community-based center for conservation and environmental education.

From a practical standpoint, the identified increase in participants’ conservation awareness and attitudes can serve as a foundation for developing community-based conservation systems at PAKWALI. This awareness has the potential to be translated into more structured environmental management practices, such as routine water quality monitoring, documentation of environmental parameters, and collective management of local fish habitats. Strengthening community institutions and developing collaborative networks with universities, local governments, and conservation agencies are also critical factors to ensure program sustainability and expand its impact on local aquatic resource management.

In conclusion, this community service initiative contributes not only to local capacity building but also demonstrates that community-based environmental education approaches can be an effective strategy in strengthening conservation awareness and the participatory management of local aquatic resources.

## **4. CONCLUSION AND RECOMMENDATIONS**

Community service activities based on environmental education and local freshwater fish conservation at PAKWALI demonstrated a positive impact on increasing participant capacity. Pre-test and post-test evaluations indicated improvements across cognitive, affective, and psychomotor aspects,

although not all were statistically significant. The most prominent increase occurred in the affective aspect, reflecting the growth of participants' attitudes, concern, and awareness regarding the importance of local and endemic freshwater fish conservation. The cognitive aspect also showed a consistent and practically meaningful upward trend, while changes in the psychomotor aspect remained relatively limited. These findings suggest that participatory and contextual learning approaches are effective in building initial community understanding and attitudes, even though strengthening practical skills requires more sustainable time and mentoring. The strongest impact occurred in the affective domain ( $p = 0.023$ ), indicating that this environmental education program is effective in shaping conservation attitudes within the local community.

Based on the results, it is recommended that future service programs be implemented with longer mentoring durations and increased field practice intensity to strengthen participants' psychomotor aspects. Practical activities could focus on routine water quality monitoring training, the use of basic measurement tools, and the implementation of environmental recording systems using monitoring logsheets. Increasing the number of participants and strengthening cross-sector partnerships are also necessary to enhance program impact and sustainability. Furthermore, improvements in the cognitive aspect should be supported by developing more systematic training modules regarding local fish identification, aquatic habitat management, and community-based conservation practices. Strengthening the PAKWALI community institution is also essential through the establishment of a community-based environmental monitoring system and the development of collaborations with universities, conservation agencies, and local governments to support the sustainability of the conservation program.

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