

Education on the Use of Biopore Infiltration Holes for Flood Prevention at SDN 100 Kendari, Kambu Village, Kambu District, Southeast Sulawesi

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Abstract

Purpose: This program aimed to enhance elementary students' understanding of biopore infiltration holes as a low-cost solution for mitigating waterlogging and addressing inadequate drainage at SDN 100 Kendari.

Method: The intervention combined interactive lectures, live demonstrations, hands-on construction, and guided discussions. Learning outcomes were evaluated using standardized pre-test and post-test instruments.

Practical Applications: The activity enabled students to construct functional biopores that improve groundwater absorption, reduce surface runoff, and facilitate organic waste management, providing a replicable framework for school-based environmental management.

Conclusion: Student comprehension significantly increased from 10–20% to 80–90%. These results demonstrate that participatory environmental education effectively fosters ecological literacy and supports localized flood mitigation in urban school settings.



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Introduction

SDN 100 Kendari is a public elementary school located in the BTN Unhalu residential area, Kambu Village, Kendari City. Established in 1997, the school occupies approximately 10,000 m² of land and holds a B accreditation status. The surrounding Kambu area, where the school is situated, is home to around 5,000 residents grouped into approximately 1,200 households. The relatively dense settlement pattern, combined with a geographical elevation of about 25 meters above sea level, makes this area vulnerable to various environmental challenges, particularly those related to water management and sanitation. The growing number of students and the limited availability of open space have made it increasingly difficult to maintain cleanliness and control water puddles within the school environment. Although the schoolyard has the potential to function as a natural infiltration area, suboptimal drainage conditions often cause rainwater to turn into surface runoff, leading to water accumulation. This situation is exacerbated by the limited green open space and the dominance of impervious surfaces typical of urban areas. These conditions align with Azzahra & Maysithoh (2024), who state that water management in urban regions has become increasingly urgent due to the heightened risk of flooding, while during the dry season communities often face water shortages.

Climate change further intensifies the situation by triggering unpredictable rainfall patterns, rising air temperatures, and increasing sea levels. Such instability directly affects the quality and availability of water resources for local communities (Murdhani, 2024; Rahmayanti & Feryl Ilyasa, 2022). Rapid urbanization in Kendari City, including in Kambu Village, has reduced infiltration areas and increased surface runoff, significantly raising the risk of flooding. The absence of adequate water infiltration systems—such as recharge wells or biopore infiltration holes—extends the time required for rainwater to seep into the ground.

One simple technology recommended as a solution to these challenges is the biopore infiltration hole. This method has been proven effective in improving soil water absorption capacity, reducing the risk of waterlogging, and utilizing organic waste for composting (Khusna et al., 2020; Puspawati et al., 2023). Biopores offer several advantages, including low construction costs, the use of simple tools, and ecological benefits such as improving soil fertility and conserving groundwater (MF & Hanum, 2019). However, public understanding—especially among elementary school students—regarding the functions and benefits of biopores remains limited. Low environmental literacy at an early age can lead to poor attitudes toward cleanliness and inadequate environmental management practices. Therefore, an appropriate educational program is needed to increase awareness and participation among students, teachers, and the broader school community in applying biopore technology as a measure for flood mitigation and climate change adaptation.

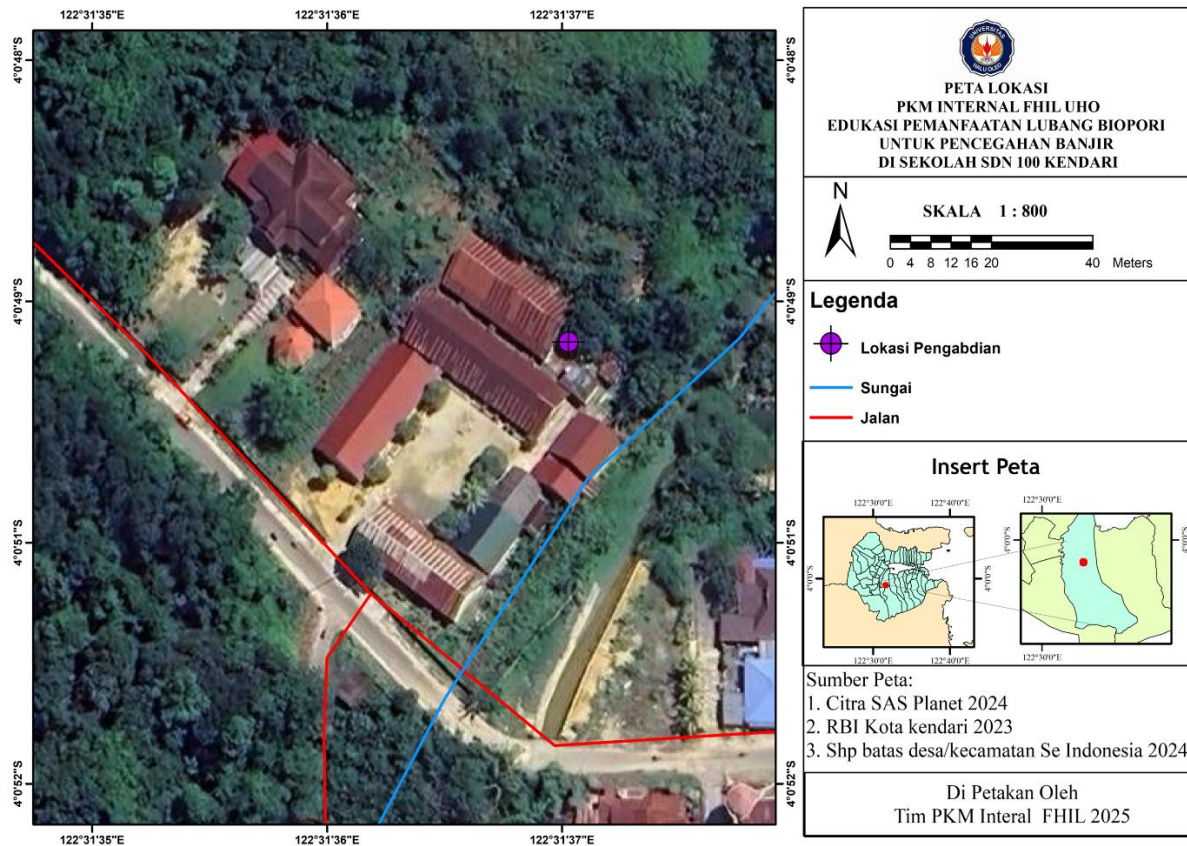
Based on these conditions, the community service program at SDN 100 Kendari is focused on educating students on the use of biopore infiltration holes as a practical and applicable solution to improve water infiltration capacity within the school environment, reduce the risk of water accumulation, and foster environmentally responsible behavior among students from an early age.

Method

The community service activity was carried out at SDN 100 Kendari, targeting fourth-grade students as the primary participants. The program was designed using an educational-participatory approach that combined socialization, demonstrations, and hands-on practice in creating biopore infiltration holes as an effort to improve environmental literacy and mitigate water puddles within the school area.

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Figure 1. Map of the Community Service Location



Source: Private Documentation, 2025.

The implementation method consisted of three main stages: preparation, educational delivery and practice, and program evaluation. The preparation stage included coordination with the school, determining participants, and preparing educational materials and equipment. The implementation stage involved interactive delivery of biopore-related materials and direct practice in creating infiltration holes within the school environment. The final evaluation stage was conducted to measure improvements in students' knowledge, skills, and attitudes after participating in the activity. This stepwise approach was adopted to strengthen conceptual understanding while developing students' skills through experiential learning, enabling them to participate actively and understand the benefits of biopores firsthand.

The community service team conducted initial coordination with the school to determine the schedule, participants, practice location, and necessary supporting facilities. Educational materials, simple modules, and biopore-making tools (soil drill, PVC pipe, biopore cover, and organic waste) were prepared to support the activity.

- a. Socialization and Education. Students were introduced to the concept of biopores, infiltration functions, surface water reduction, and the use of organic waste. Interactive lectures, discussions, and visual aids were used to enhance their understanding.
- b. Demonstration and Practice. The team demonstrated the procedure for making biopores, followed by hands-on practice by students in small groups. Students drilled the soil, installed PVC pipes, and filled the biopore holes with organic waste under the guidance of teachers and the service team.

Evaluation was conducted using both quantitative and qualitative approaches.

- a. Quantitative Evaluation. To assess the effectiveness of the educational activity, pre-test and post-test instruments were used to measure students' improvement. The instruments were designed to evaluate four key aspects: understanding of organic

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waste types and characteristics, basic biopore concepts, technical steps in biopore construction, and knowledge of biopore benefits for water infiltration and puddle prevention. The comparison between pre-test and post-test results provided a quantitative overview of how effectively the program improved students' environmental literacy in water conservation using simple technology. Achievement was measured based on increased post-test scores as an indicator of educational success.

- b. Qualitative Evaluation. Qualitative assessment was conducted through direct observation of student behavior during the activity. Observations focused on students' enthusiasm and active participation during the educational sessions, their collaboration within groups during biopore practice, and their responses to instructions and challenges encountered in the field. Interactions and discussions between teachers and students regarding biopore benefits were also considered important indicators of understanding and engagement. Overall, changes in students' attitudes and environmental behavior during and after the activity served as key indicators of the program's success.

Program success was measured using several indicators reflecting improvements in knowledge, skills, and environmental impact. Quantitatively, the program was considered successful if post-test scores increased by at least 60% compared to pre-test scores. In terms of participation, at least 80% of students were required to actively engage in biopore construction, and a minimum of 70% had to complete the biopore-making steps correctly according to the procedure. Teacher commitment to assisting and maintaining the newly created biopores was also an important indicator for ensuring program sustainability. Ecologically, success was reflected in positive changes in infiltration areas, particularly the reduction of water puddles around the biopore installation sites. These indicators provided a comprehensive overview of the achievement level of the community service program.

Result

The community service activity held on 29 September 2025 was attended by 27 fourth-grade students and accompanying teachers. Observations showed that students demonstrated high enthusiasm during the educational sessions on biopore concepts, organic waste utilization, and the function of biopores in preventing water puddles. The interactive lecture and discussion methods effectively captured students' attention and enhanced their understanding of water conservation within the school environment.

Pre-test and post-test results indicated a substantial improvement across all assessed indicators. Understanding of organic waste increased from 10% to 90%, basic knowledge of biopores improved from 20% to 80%, and technical skills in constructing biopores rose from 20% to 83%. In addition, students' awareness of the role of biopores in flood prevention increased from 20% to 80%. These quantitative outcomes demonstrate that the learning intervention was highly effective.

Field practice was carried out in the back area of the school. Students observed a demonstration of biopore construction and subsequently worked in small groups to create infiltration holes. Despite encountering hard and rocky soil conditions in some areas, students remained highly motivated and were able to complete the construction steps correctly. In locations with softer soil, the process was faster and produced optimal results. Students successfully operated the soil drill, installed the PVC pipes, and filled the holes with organic waste.

The biopores created during the activity produced observable ecological benefits. Several infiltration points displayed improved soil infiltration capacity and reduced puddling after rainfall. Soil surrounding the biopores became more porous, and surface runoff decreased. The use of organic waste as biopore filler also facilitated natural decomposition, contributing to improved soil fertility.

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Students exhibited positive changes in environmental attitudes, demonstrated through active participation, questioning, discussion, and collaborative problem-solving. Group cooperation, responsibility, and environmental awareness increased throughout the activity. Teachers also showed commitment to supporting and maintaining the constructed biopores, strengthening the potential sustainability of the program.

Figure 2. Educational Session on Biopores at SDN 100 Kendari, where the community service team provided interactive explanations to students and teachers regarding organic waste management and the role of biopores in flood prevention.



Source: Private Documentation, 2025.

Program evaluation confirmed that all targeted objectives were achieved. Post-test scores showed marked improvement across all indicators, and field observations validated students' increased competence and engagement. Positive behavioral changes and strengthened teacher involvement served as additional indicators of the program's success.

Discussion

The considerable increase in students' knowledge and technical abilities demonstrates the strong effectiveness of practice-based environmental education. The improvement in understanding—from only 10–20% prior to the activity to 80–90% afterward—highlights the transformative role of experiential learning in shaping environmental literacy at an early age. This shift indicates that when students are given the opportunity to observe, interact with, and directly apply environmental concepts, their cognitive engagement and retention of knowledge increase significantly. Interactive lectures alone may introduce concepts, but it is the combination with concrete, hands-on practice that establishes deeper conceptual grasp and behavioral internalization. These findings reinforce the conclusions of Meiyuntariningsih et al. (2022) and Windraswara & Prihastuti (2017), who demonstrated that practical mentoring and direct community-based involvement significantly enhance competencies in organic waste management. Overall, the learning model implemented in this program provides evidence that early environmental interventions grounded in experience can build foundational understanding that supports long-term ecological awareness.

Students' active involvement in constructing biopores offers strong evidence of the value of project-based learning (PjBL) as a pedagogical approach that integrates psychomotor development with ecological comprehension. Through the structured steps of drilling, installing PVC pipes, and loading organic material, students not only learned *how* biopores are made, but also *why* each step matters in the overall ecological function of the system. This merging of procedural knowledge with conceptual understanding reflects the core principles of PjBL, which emphasize problem-solving, inquiry, creativity, and real-world application. Bell (2010) argues that PjBL enhances student autonomy and engagement, and the biopore activity validated this by fostering independence and confidence among the participants. The infusion

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of eco-literacy principles, as suggested by Orr (1992), further deepened students' environmental consciousness by helping them recognize their roles as active contributors to ecological solutions. In this way, the activity did not merely transfer knowledge—it cultivated an environmentally responsible mindset and agency among young learners.

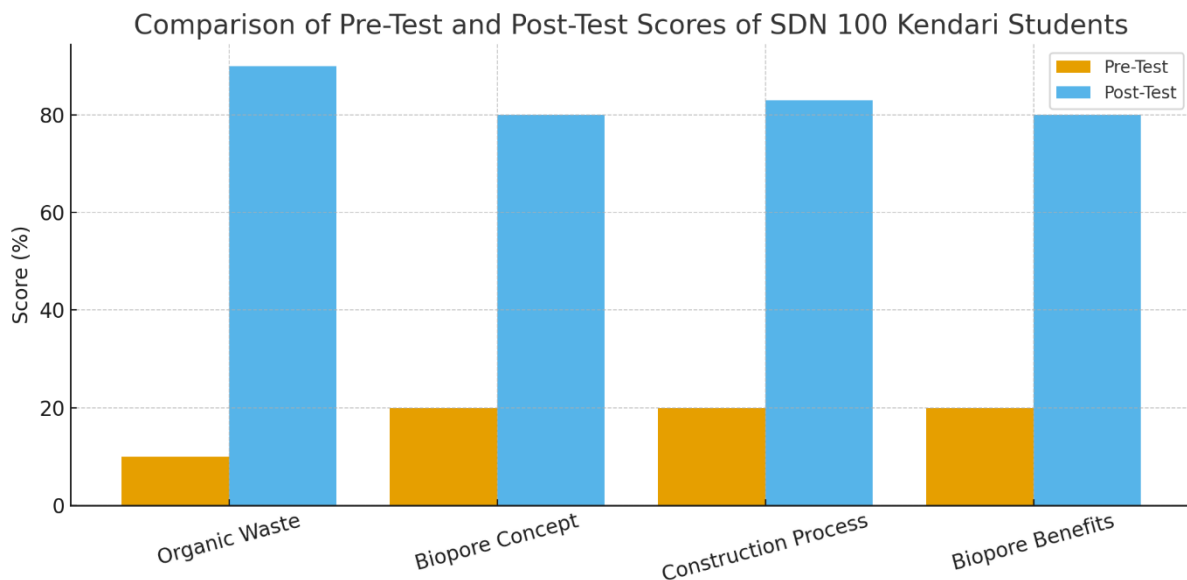
The ecological effects observed during and after the activity provide strong evidence of the functional benefits of biopore technology. Increased soil infiltration capacity and reduced puddling at several points demonstrate the immediate hydrological impact of biopores in enhancing water absorption and decreasing surface runoff. These findings are consistent with Wibowo et al. (2022), who reported that biopores can improve infiltration by up to 30%, offering a practical solution for micro-scale flood mitigation. Furthermore, the organic waste inserted into the biopores aided natural decomposition, resulting in the formation of nutrient-rich humus that improved soil structure, porosity, and biological activity. Over time, this process supports root growth, enhances soil biodiversity, and increases water-holding capacity. Thus, biopores provide dual ecological benefits—water conservation and soil fertility enhancement—making them a suitable and sustainable nature-based solution for school environments with limited green space.

The social and behavioral outcomes of the program underline the importance of integrating environmental activities within the school curriculum. Students' increased participation, enthusiasm, and willingness to collaborate show that hands-on environmental education fosters positive attitudes toward nature and strengthens pro-environmental behavior. These behavioral shifts illustrate the early formation of ecological character, supporting Ramadhan & Wulandari's (2021) assertion that environmental character education during childhood contributes to long-term environmental responsibility. The involvement of teachers further reinforces program sustainability; their commitment to supervising and maintaining the biopores ensures that the initiative extends beyond a one-time activity and becomes part of routine school management. This teacher–student synergy is essential for establishing a culture of environmental stewardship within the school community. In addition, the program supports broader school-based environmental initiatives such as Adiwiyata and green school programs, aligning educational practice with national environmental sustainability goals.

The integrated evaluation—combining cognitive improvement, psychomotor skill development, ecological change, and behavioral transformation—demonstrates that the program effectively achieved its intended outcomes. Significant increases in post-test scores confirm its educational impact, while improved field performance and changes in attitudes highlight the program's broader social and environmental influence. These results align with MF & Hanum (2019), who emphasize that proper monitoring and evaluation are crucial for ensuring the effectiveness of biopore-based interventions for flood mitigation. The consistency between this program and previous studies strengthens the validity of biopore technology as a practical, scalable, and community-friendly solution. Moreover, the alignment of findings suggests that school-based biopore education can serve as a replicable model for other educational institutions aiming to enhance environmental literacy and resilience against climate-related risks.

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Figure 4. Comparison of pre-test and post-test scores of SDN 100 Kendari students across four indicators: organic waste understanding, biopore concepts, biopore construction processes, and biopore benefits. The graph shows significant improvement in all indicators following the educational and field practice activities.



Source: Author's Work, 2025.

Conclusion

The community service program involving education and hands-on biopore construction at SDN 100 Kendari successfully improved students' and teachers' understanding, skills, and environmental awareness. The pre-test and post-test results showed a significant increase in knowledge related to organic waste, biopore concepts, construction processes, and the benefits of biopores for mitigating water puddles and small-scale flooding within the school environment. The field practice effectively developed students' technical abilities, with the majority able to construct biopore infiltration holes independently and correctly. In addition, the implementation of biopores had a positive impact on the physical condition of the school grounds by enhancing water infiltration capacity. The program provided not only ecological benefits but also strengthened students' environmental character and ecological literacy culture, aligning with the goals of the Adiwiyata school program. The collaboration between the university and the elementary school was well established, creating opportunities for replication and sustainability of simple community-based conservation initiatives. With this success, SDN 100 Kendari can serve as a model for biopore technology implementation in other schools across Kendari City.

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