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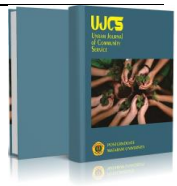

Implementation of Tree Planting and Biopore Infiltration Systems for Flood Mitigation among Junior High School Students in Pekanbaru

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Abstract: Flooding remains one of the most common hydrometeorological disasters in Indonesia, primarily caused by reduced soil infiltration capacity, vegetation degradation, and low environmental awareness. Addressing this problem requires an integrative mitigation strategy that combines technical solutions with community-based education. This study presents a community service program aimed at improving students' environmental awareness and practical skills in flood prevention through tree planting and biopore infiltration holes at SMPN 25 Pekanbaru. The program adopted a participatory approach, including educational sessions, demonstrations, and hands-on activities. The results showed a significant increase in student knowledge, with the average score increasing from 43.6% in the pre-test to 88.4% in the post-test, representing a relative increase of 105.6%. The highest increase was observed in understanding the concept of biopores, which increased by 148.6%. Furthermore, students demonstrated increased engagement and active participation in environmental conservation practices.The uniqueness of this study lies in the integration of a simple ecotechnological solution, a biopore infiltration system, with experiential learning at the junior high school level, providing both immediate educational outcomes and long-term environmental benefits. This approach not only increases infiltration capacity and reduces surface runoff but also supports sustainable organic waste management and ecological awareness. Therefore, the proposed model can serve as an effective and applicable strategy for flood mitigation education in school-based community programs.

Keywords: Flooding, Biopore Infiltration Holes, Tree Planting, Environmental Education.

Introduction

Flooding is one of the most dominant hydrometeorological disasters in Indonesia, causing significant impacts on economic, social, and environmental sectors. The frequency and intensity of flood events have increased in recent years due to changes in rainfall patterns, environmental degradation, and inadequate spatial planning management. Data from the Badan Nasional Penanggulangan Bencana indicate that floods consistently rank as the most frequent disaster in Indonesia. These conditions are influenced by both natural and anthropogenic factors, including high rainfall intensity, poor drainage systems, reduced water infiltration areas, and uncontrolled land-use changes (BPPN, 2023) (Andung et al., 2019).

One of the primary factors contributing to increased flood risk is the reduction of vegetation cover due to deforestation without adequate reforestation efforts. From a hydrological perspective, vegetation plays a critical role in enhancing soil infiltration capacity and reducing surface runoff. When vegetation decreases, the soil's ability to absorb rainwater declines significantly, resulting in increased surface runoff that may lead to flooding (Asdak, 1995). Furthermore, low

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public awareness regarding environmental conservation, including simple actions such as planting and maintaining trees, exacerbates the problem.

Ecologically, vegetation and green open spaces contribute to improving soil structure through root systems that enhance soil porosity and infiltration capacity. This allows rainwater to be absorbed more effectively into the ground and supports the balance of the hydrological cycle. According to the Kementerian Lingkungan Hidup dan Kehutanan, increasing vegetation cover is an effective ecosystem-based approach for flood risk reduction and sustainable water resource management (KLHK, 2020).

In addition to vegetative approaches, simple and applicable technologies are required to enhance soil water absorption capacity, particularly in school and residential environments. One such method is the construction of biopore infiltration holes, introduced by Kamir R. Brata. Biopores are an effective, low-cost, and easy-to-implement soil and water conservation technique. These infiltration holes function by increasing the rate of water absorption into the soil through biological activity, thereby reducing surface runoff. Additionally, biopores serve as a medium for processing organic waste into compost, contributing to improved soil fertility and sustainable waste management (Ganjarsari, 2024). Therefore, biopore technology not only mitigates flood risk but also supports integrated environmental management.

Flood mitigation efforts cannot rely solely on large-scale infrastructure development; they also require active community participation through educational and participatory approaches. Environmental education at an early age, particularly at the junior high school level, is a strategic effort to develop environmentally responsible behavior and awareness of disaster prevention. Therefore, community service activities focusing on the implementation of tree planting and biopore infiltration holes for students at SMPN 25 Pekanbaru are highly relevant.

In practice, environmental conservation activities within the school environment have not yet become a collective culture. Student participation in tree planting, maintenance, and the application of simple environmental technologies such as biopores remains relatively low. This condition highlights the need for systematic and continuous educational interventions. Through this program, students are expected not only to understand the causes and prevention of flooding but also to actively implement practical solutions through tree planting and the construction of biopore infiltration holes as sustainable flood mitigation measures.

Method

This community service activity uses a participatory outreach method with an educational and demonstrative approach to increase student knowledge and engagement in flood prevention. A participatory approach is effective in environmental education because it encourages active engagement and experiential learning (Sari et al., 2024).

The implementation included:

- Interactive lectures to explain flood causes, impacts, and the importance of infiltration areas.
- Discussion sessions to enhance student participation and understanding (Sari et al., 2024).
- Demonstration and hands-on practice in constructing biopore infiltration holes and planting trees. Practical learning improves environmental awareness and skill development.
- Pre-test and post-test evaluation to measure knowledge improvement and program effectiveness.

Five Implementation Stages:

- Stage 1: Preparation and Coordination Coordination with SMPN 25 Pekanbaru was conducted to determine the schedule, location, and technical requirements. Educational materials and evaluation instruments were prepared. Proper planning is crucial for an effective community-based program (Lolo et al., 2023).
- Stage 2: Observation and Needs Assessment Initial observations were conducted to identify environmental conditions, areas potentially prone to flooding, and students' basic understanding. The needs assessment ensured that interventions were context-specific and effective (Dewi & Ahmad Mughofar, 2024).
- Stage 3: Educational Outreach Educational sessions included: Causes and impacts of flooding, importance of water infiltration areas, role of trees in environmental balance, concept and benefits of biopore infiltration holes. This stage emphasized interactive learning to strengthen environmental awareness (Dewi & Ahmad Mughofar, 2024).
- Stage 4: Demonstration and Practical Implementation Students participated in: Construction of biopore infiltration holes, tree planting activities. Bioporite technology is recognized as an effective ecological drainage solution that increases infiltration capacity and reduces runoff in urban areas (Hutabarat & Simanjuntak, 2022). This technology also contributes to organic waste management and soil improvement (Hendrawan et al., 2021), (Fathurrohman et al., 2023).
- Stage 5: Evaluation and Follow-up A post-test evaluation was conducted to assess knowledge gains. Follow-up guidance on maintaining the biopores and

planted trees was provided to ensure sustainability (Mansida et al., 2025).

Method Flow Diagram

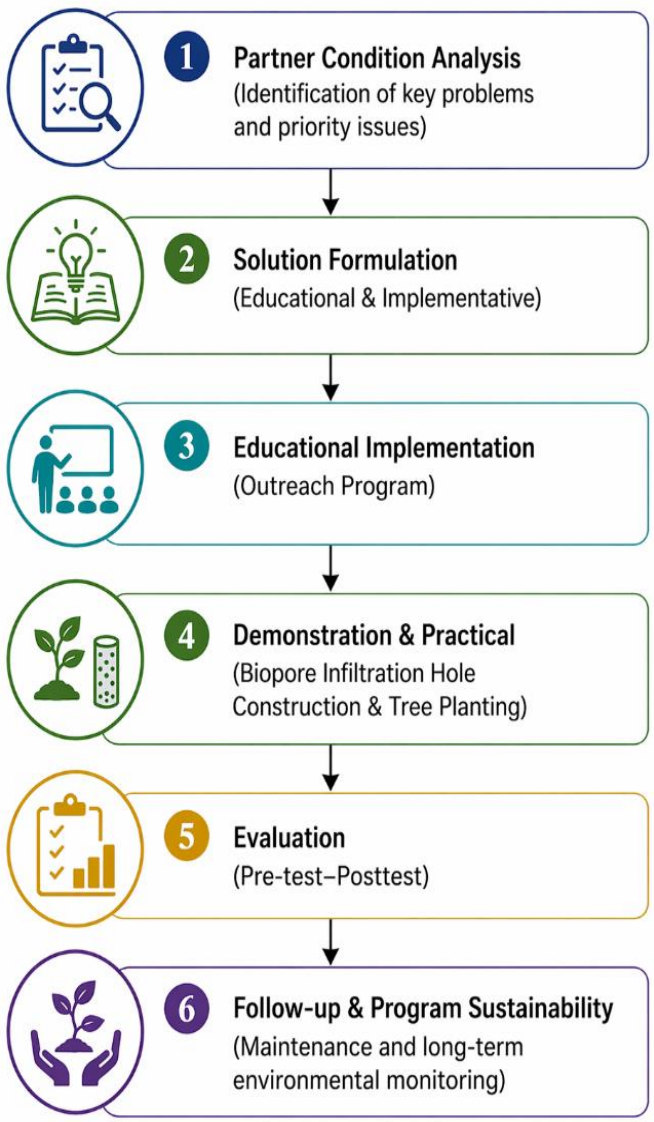

Figure. 1. Community empowerment program process.

Result and Discussion

The implementation of community service activities at SMPN 25 Pekanbaru showed a significant improvement in students' understanding of flood prevention concepts, particularly related to tree planting and biopore infiltration holes.

1. Pre-test and Post-test Results

Evaluation was conducted using pre-test and post-test instruments involving 30 students. The results indicate a substantial increase in students' knowledge.

Table 1. Comparison of Pre-test and Post-test Results

No	Indicator	Pre-test (%)	Post-test (%)	Increase (%)
1	Understanding of flood causes	45	88	96
2	Awareness of infiltration areas	40	85	113
3	Knowledge of tree function	48	90	88
4	Understanding of biopore concept	35	87	149
5	Environmental awareness behavior	50	92	84
Average		44	88	106

Interpretation:

- The average knowledge increased from 43.6% to 88.4%, representing a relative improvement of 105.6%.
- The highest improvement was observed in biopore understanding (148.6%).
- All indicators showed a significant increase of more than 80%, indicating strong effectiveness of the program.

This result confirms that participatory and practical approaches are effective in improving environmental knowledge and awareness.

Figure 2. Educational and Counseling Session

2. Impact of Practical Activities

The practical implementation of biopore construction and tree planting significantly improved students' engagement.

Key outcomes:

- 55 biopore holes successfully constructed
- 10 trees planted within the school environment
- Increased student participation during field activities

The hands-on approach strengthened students' understanding of:

- Water infiltration mechanisms
- Reduction of surface runoff
- Environmental conservation practices

Figure 3. Biopore Hole Construction Practice

Figure 4. Tree planting

Conclusion

Based on the results and discussion of this study, the following conclusions can be drawn:

1. The implementation of a combined educational and practical approach through counseling, demonstration, and hands-on activities has been proven effective in improving students' environmental awareness and understanding of flood prevention.
2. The significant increase in post-test results indicates that students not only gained theoretical knowledge but were also able to apply it in practical activities, particularly in tree planting and the construction of biopore infiltration holes.
3. The application of biopore technology contributes to: Increasing soil infiltration capacity, Reducing surface runoff, Supporting organic waste management
4. Tree planting activities provide long-term environmental benefits by improving soil structure, enhancing water absorption, and maintaining ecological balance.
5. This community-based and participatory model can be recommended as an effective and sustainable strategy for flood mitigation education, particularly for implementation in school environments.

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