

Community-Based Total Sanitation (CLTS) As A Strategy To Enhance Environmental Health In Disaster-Prone Villages: A Case Study In Pujiharjo, Malang, Indonesia

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Abstract

Pujiharjo Village in Malang Regency is a coastal area frequently affected by floods, posing significant environmental health challenges. This study aims to analyze the implementation of Community-Based Total Sanitation (CLTS) as a strategy to strengthen environmental health and disaster preparedness in disaster-prone communities. A descriptive case study design was applied using secondary data from the 2024 CLTS monitoring survey in Pujiharjo. A total of 1,369 households were analyzed based on five CLTS pillars. Data collection involved structured household surveys and laboratory water quality testing. Descriptive statistics were used to evaluate the percentage of households meeting CLTS indicators and to identify gaps compared with national and international standards. The study found high achievements in hygiene-related pillars, namely handwashing with soap (86.41%) and food and water management (95.76%), indicating improved household health behavior. However, the low performance in solid (41.12%) and liquid (29.88%) waste management highlights weaknesses in sanitation infrastructure and community participation. These conditions increase environmental contamination risks, especially during floods. Integrating CLTS into disaster preparedness programs is essential to enhance resilience and reduce vulnerability to environmental health hazards. Strengthening community participation, sanitation infrastructure, and intersectoral coordination is crucial to improve environmental health resilience in disaster-prone areas like Pujiharjo Village.

Keyword: community resilience, disaster preparedness, environmental health, sanitation



behavior, waste management.

INTRODUCTION

Pujiharjo Village in Tirtoyudo District is one of the coastal villages repeatedly affected by disasters, particularly the annual flooding that occurs during the heavy rainy season. This condition places the community in a state of vulnerability, both physically, socially, and in terms of health. The flooding in Pujiharjo is caused by the overflow of the Tundo River, which passes through the village area, blocking local access roads and inundating residents' houses. This overflow occurs due to sedimentation that reduces the river flow capacity, thus requiring regular dredging. The impact of these floods not only damages infrastructure and disrupts community activities but also causes environmental health problems such as limited access to clean water, poor sanitation, and increased risk of environment-related diseases.

Within the framework of disaster management, environmental health plays a crucial role in reducing risk impacts on affected communities. The Water, Sanitation, and Hygiene (WASH) theory emphasizes that access to clean water, emergency sanitation, and hygienic behavior are the main factors in maintaining public health during emergency response situations. The Sphere Project (2018) also establishes minimum standards, including the provision of at least 20 liters of clean water per person per day and a toilet ratio of 1:20 in evacuation sites. Failure to meet these standards has been shown to contribute to increased cases of water- and environment-related diseases, such as diarrhea, acute respiratory infections, and vector-borne diseases. According to the WHO (2019) Health Emergency and Disaster Risk Management framework, weak integration of environmental health aspects into disaster management systems can increase disease morbidity and slow community recovery. Rahman et al. (2021) also found in coastal areas of Bangladesh that limited access to clean water and sanitation after disasters led to a rise in communicable diseases and worsened coastal community health conditions.

The situation in Pujiharjo Village reflects similar problems. Preliminary analysis shows that most households still lack access to clean water that meets the Sphere Project standards. Water quality testing also indicated the presence of *E. coli* contamination. On the other hand, the toilet ratio at evacuation points remains far below the minimum standard, with only one toilet available for 65 people, and limited access to handwashing facilities with soap. From a management perspective, village documents show that although an emergency response SOP exists, environmental health aspects are not yet detailed. The last evacuation simulation was conducted in 2021, but it has not been carried out regularly and does not emphasize sanitation or disease prevention aspects.



The field conditions highlight a real gap between disaster preparedness theory and coastal village practices. The Disaster Preparedness Theory proposed by Paton & Johnston (2001) states that community capacity in facing disasters is influenced by three main factors: risk knowledge, emergency response readiness, and the availability of supporting resources. Research in Indonesia shows that although many villages have formal SOPs and Disaster-Resilient Village programs, aspects such as resource mobilization and early warning systems are often still lacking. Without strengthening environmental health aspects, such as sanitation, environmental hygiene, and clean water, community preparedness capacity will remain low even when SOPs exist. Therefore, integrating environmental health aspects into the Disaster-Resilient Village program is not merely an addition but an urgent need to make community preparedness more effective.

This study focuses on analyzing the environmental health conditions and the level of community preparedness in Pujiharjo Village in facing hydrometeorological disaster risks. Through this approach, it aims to describe the relationship between environmental infrastructure limitations and increased community health vulnerability during disasters. In this context, the implementation of the Community-Based Total Sanitation (CLTS) program serves as an important indicator to assess community readiness against environment-related disaster risks. CLTS, with its five pillars; ending open defecation, handwashing with soap, safe water and food management, solid waste management, and domestic wastewater management can play a strategic role in strengthening community-level environmental health systems. Strengthening CLTS implementation in Pujiharjo Village is expected not only to improve clean and healthy living behavior but also to enhance community resilience to coastal disaster impacts such as floods, earthquakes, and tsunamis.

Implicitly, this study departs from the hypothesis that Pujiharjo Village's environmental health conditions do not yet meet the minimum standards of the Sphere Project or WHO, and that low community preparedness related to environmental health contributes to high risk of environment-related diseases during disasters. In this regard, the implementation of CLTS becomes a key factor in reducing such vulnerability through behavior change and community empowerment approaches. The CLTS program functions not only as an environmental health intervention but also as a community-based disaster mitigation and adaptation strategy. By analyzing the relationship between environmental conditions, CLTS implementation, and community preparedness, this study is expected to provide strategic recommendations that strengthen village capacity and support the national framework for disaster management based on environmental health in coastal regions.

METHOD

This study employed a descriptive case study design to analyze the implementation of Community-Based Total Sanitation (CLTS) in Pujiharjo Village, Malang, Indonesia. The approach was chosen to capture the interaction between environmental health conditions and disaster preparedness in a coastal community highly vulnerable to geological hazards. The analysis was grounded in the ecological health perspective, recognizing that limited access to safe water, inadequate sanitation, and poor waste management exacerbate health risks in post-disaster contexts, as highlighted in previous disaster risk reduction literature. This design enabled a comprehensive assessment of how household-level sanitation behaviors, as reflected in the five CLTS pillars, contribute to the resilience of disaster-prone communities.

The study was conducted in Pujiharjo Village, Tirtoyudo Subdistrict, Malang Regency, East Java, Indonesia, a coastal settlement exposed to high seismic and tsunami risk due to its proximity to the Indo-Australian subduction zone. Pujiharjo consists of more than 1,300 households and has been recurrently impacted by natural hazards, including the 1994 and 2021 earthquakes as well as flooding in 2016. The village was purposively selected as a research site based on its disaster vulnerability, coastal geographical setting, and ongoing implementation of the CLTS program at the community level.

The study utilized secondary quantitative data drawn from the 2024 CLTS monitoring survey conducted in Pujiharjo Village. Data were aggregated at the household level and categorized according to the five CLTS pillars: (1) elimination of open defecation, (2) handwashing with soap, (3) household food and drinking water management, (4) household solid waste management, and (5) household liquid waste management. Data collection instruments included structured observation checklists and household surveys administered by local health cadres under the supervision of the Malang District Health Office.

To ensure validity, data triangulation was applied by cross-referencing household survey results with village health records and sanitation reports. Indicators such as the number of households with access to improved latrines, availability of handwashing facilities, and waste disposal methods were systematically tabulated. Water quality testing (pH, turbidity, and *E. coli*) was also conducted by the local health laboratory to complement reported household practices, thus integrating environmental quality parameters into the dataset.

The data were analyzed using descriptive statistics to calculate frequency distributions and percentages of households meeting each CLTS indicator. These results were compared against national CLTS targets and international standards, particularly the Sphere Handbook minimum standards for humanitarian response. The analysis aimed to identify strengths and

gaps across the five pillars, highlighting environmental health vulnerabilities that intersect with disaster preparedness.

Furthermore, a comparative perspective was adopted by reviewing findings from similar studies in disaster-prone regions of Indonesia, such as Aceh and Lombok, to contextualize Pujiharjo's achievements and challenges. Finally, thematic interpretation was conducted to align quantitative results with broader disaster resilience frameworks, emphasizing the role of environmental health in strengthening community capacity

RESULTS AND DISCUSSION

Data Characteristics

This study analyzed 1,369 households in Pujiharjo Village, Malang, based on the five pillars of Community-Led Total Sanitation (CLTS). From the total respondents, all questionnaire data were successfully analyzed with no missing data (missing data = 0%). Therefore, no data imputation or sample exclusion procedures were required.

Distribution of the Five CLTS Pillars

The frequency distribution results for the achievement of each CLTS pillar are presented in Table 1

Table 1 Distribution of the Five CLTS Pillars Achievement in Pujiharjo Village, Malang (N = 1.369)

Pillar	Indicator	Total (Household)	Percentage (%)
Pillar 1 – Ending Open Defecation	Safely managed latrine	368	27,36
	Improve latrine	594	44,16
	Unimprove latrine	184	13,68
	Share latrine	23	1,71
	Closed open defecation	161	11,97
	Open defecation	15	1,12
Pillar 2 – Handwashing with Soap	With handwashing facility	1183	86,41
	Without handwashing facility	186	13,59
Pillar 3 – Household Drinking Water and Food Management	Properly managed	1311	95,76
	Not properly managed	58	4,24

Pillar 4 – Household Solid Waste Management	Practicing waste management	563	41,12
	Not practicing waste management	806	58,88
Pillar 5 – Household Liquid Waste Management	With waste management system	409	29,88
	Without waste management system	960	70,12

Achievement of Hygiene Pillars (Handwashing with Soap and Household Water and Food Management)

For the hygiene pillars, 1,183 households (86.41%) had handwashing facilities with soap, while 186 households (13.59%) did not. Regarding Pillar 3, the majority of households (1,311 or 95.76%) managed their household drinking water and food properly, whereas 58 households (4.24%) did not.

Achievement of Sanitation Pillar (Ending Open Defecation)

A total of 594 households (44.16%) used improved latrines, 368 households (27.36%) used safely managed latrines, while the rest still used unimproved latrines (13.68%), shared latrines (1.71%), closed open defecation (11.97%), and open defecation (1.12%).

Achievement of Solid and Liquid Waste Management Pillars

The analysis results showed that 563 households (41.12%) practiced household solid waste management, while 806 households (58.88%) did not. For Pillar 5, only 409 households (29.88%) had a liquid waste management system, whereas 960 households (70.12%) still discharged wastewater directly into the environment.

Integration of Environmental Health into Community Disaster Resilience

The study findings indicate that the implementation of Community-Led Total Sanitation (CLTS) has significantly contributed to the improvement of environmental health in Pujiharjo Village. The high achievements in the pillars of handwashing with soap (86.41%) and household water and food management (95.76%) are consistent with previous studies emphasizing that household hygiene practices are one of the main protective factors against environment-related diseases in post-disaster situations. These findings support the WASH theoretical framework,

which highlights the importance of clean water, sanitation, and hygienic behavior as key determinants of public health in the context of disaster risk.

Sanitation Infrastructure and Health Implications

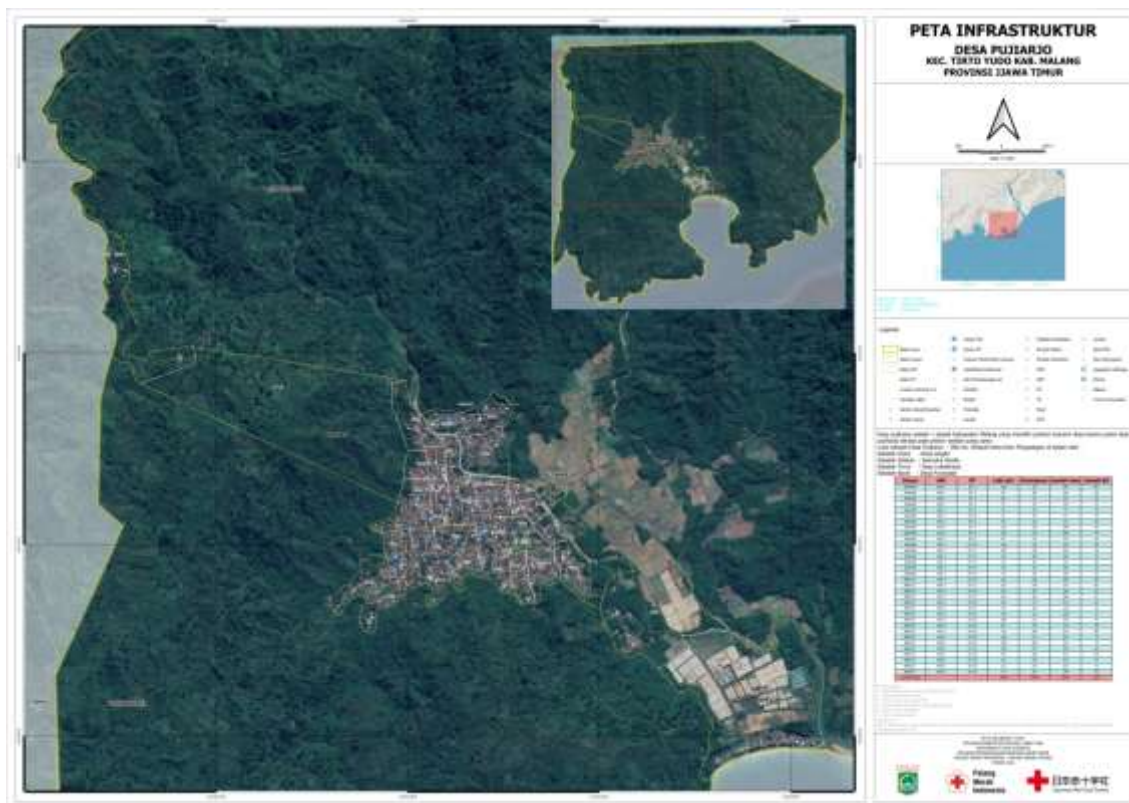


Figure 1. Infrastructure Map of Pujiharjo Village, Tirtoyudo District, Malang Regency

The low achievements in Pillar 4 (41.12%) and Pillar 5 (29.88%) indicate weaknesses in solid and liquid waste management infrastructure. This condition may increase environmental pollution and exacerbate waterborne disease risks, particularly during annual floods that damage sanitation facilities. This finding is consistent with studies on hygiene promotion interventions, which reported increased cases of diarrhea due to limited sanitation and wastewater facilities in evacuation areas. Therefore, strengthening emergency sanitation infrastructure is crucial for achieving disaster-resilient villages.

Challenges of Community Participation in the CLTS Program

Despite progress in hygiene-related pillars, major challenges remain in waste



management (26). The low achievements in solid and liquid waste management reflect that community participation in household waste management is still suboptimal. This condition mirrors challenges observed in many disaster-prone villages across Indonesia, where socioeconomic factors, inadequate facilities, and low environmental awareness hinder the comprehensive implementation of CLTS. Previous studies emphasize that the success of CLTS is highly influenced by community engagement in all stages of intervention from planning to monitoring.

Social, Institutional, and Preparedness Roles

The limited implementation of CLTS in Pujiharjo is also linked to institutional aspects. The last evacuation simulation was conducted in 2021 and did not include comprehensive integration of environmental health protocols. This highlights the need for cross-sectoral coordination among village authorities, health cadres, and disaster management teams. According to the Disaster Preparedness Theory (Paton & Johnston, 2001), community preparedness capacity is not solely determined by the availability of formal SOPs but also by social networks, communication, and collective community practices. Strengthening community communication through groups such as PKK or SIBAT has the potential to improve the effectiveness of environmental health management at the village level(31)(32).

Theoretical and Practical Implications

Theoretically, this study expands the understanding of the relationship between environmental health and community resilience, consistent with the ecosystem-based approach to disaster risk reduction. Practically, the findings emphasize the need for cross-sectoral strategies to strengthen the two weakest CLTS pillars solid and liquid waste management. Strengthening village regulations, allocating environmental health budgets, and involving communities in sanitation monitoring are essential steps to enhance coastal community resilience to disasters.

Research Limitations and Future Directions

This study has limitations due to its use of secondary data and cross-sectional design, which cannot capture the long-term dynamics of sanitation behavior change. Therefore, future research should adopt longitudinal approaches to measure the sustainability of CLTS practices over time. Comparative studies between coastal villages are also needed to examine variations in CLTS achievements under different disaster vulnerability contexts. Moreover, integrating





digital technologies, such as community-based applications for sanitation reporting and water quality monitoring could serve as a focus for future research.

Social and Ethical Implications

This study also carries social and ethical implications, particularly concerning equity in access to sanitation and environmental health services. The persistence of households practicing open defecation and lacking handwashing facilities with soap indicates a gap in fulfilling the basic right to health. Therefore, it is essential to consider social justice, community participation, and the integration of local wisdom in implementing environmental health programs in disaster-prone villages

CONCLUSION

The study concludes that implementing Community-Based Total Sanitation (CLTS) in Pujiharjo Village significantly improves environmental health and disaster preparedness. High achievements in hygiene practices show strong community awareness, while low performance in waste management highlights ongoing infrastructure and behavioral gaps. Strengthening sanitation systems, community participation, and cross-sector coordination is essential to enhance resilience and ensure sustainable environmental health in disaster-prone areas.

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