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Empowering rural communities through hydrothermal diaper waste processing: A CSR initiative by Pertamina Patra Niaga in South Sulawesi

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ABSTRACT

Improper management of disposable diaper waste remains a persistent environmental concern, especially in rural areas where public awareness and infrastructure are limited. Previous studies have often overlooked community-based educational interventions focused on diaper waste processing. This study aims to improve community knowledge on waste separation and disposable diaper waste management through a targeted empowerment program in Kelurahan Tamalabba, South Sulawesi. Conducted as part of the CSR initiative of PT Pertamina Patra Niaga IT Makassar, the program involved 20 residents of RW 4 and employed a combination of socialization, interactive discussions, and hands-on training. Baseline data revealed only 20% of participants had good knowledge of diaper waste handling. Following the intervention, this figure increased to 75%, indicating a substantial improvement. This study demonstrates the effectiveness of hydrothermal technology as a feasible solution for diaper waste processing in rural settings, while simultaneously emphasizing the role of participatory education in fostering environmental responsibility. These findings highlight the potential of localized CSR-supported programs to enhance public health outcomes by addressing unmanaged sanitary waste in underserved areas.

ABSTRAK

Pengelolaan sampah popok sekali pakai yang tidak tepat masih menjadi masalah lingkungan yang terus berlanjut, terutama di daerah pedesaan di mana kesadaran masyarakat dan infrastruktur masih terbatas. Penelitian-penelitian sebelumnya sering kali mengabaikan intervensi edukasi berbasis masyarakat yang berfokus pada pengolahan sampah popok. Penelitian ini bertujuan untuk meningkatkan pengetahuan masyarakat tentang pemilahan sampah dan pengelolaan sampah popok sekali pakai melalui program pemberdayaan yang ditargetkan di Kelurahan Tamalabba, Sulawesi Selatan. Dilaksanakan sebagai bagian dari inisiatif CSR PT Pertamina Patra Niaga IT Makassar, program ini melibatkan 20 warga RW 4 dan menggunakan kombinasi sosialisasi, diskusi interaktif, dan pelatihan langsung. Data awal menunjukkan bahwa hanya 20% peserta yang memiliki pengetahuan yang baik tentang penanganan sampah popok. Setelah intervensi, angka ini meningkat menjadi 75%, yang menunjukkan peningkatan yang substansial. Penelitian ini menunjukkan efektivitas teknologi hidrotermal sebagai solusi yang layak untuk pengolahan sampah popok di daerah pedesaan, sekaligus menekankan peran pendidikan partisipatif dalam menumbuhkan tanggung jawab terhadap lingkungan. Temuan ini menyoroti potensi program-program yang didukung oleh CSR lokal untuk meningkatkan hasil kesehatan masyarakat dengan menangani limbah sanitasi yang tidak dikelola di daerah-daerah yang kurang terlayani.

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INTRODUCTION

The Makassar, one of the major metropolitan areas in Indonesia, reported a population of 1,168,258 in 2024. This urban growth has coincided with a substantial increase in municipal solid waste, reaching 387,470.80 tons in 2024, up from 365,924.29 tons in 2022 and 376,707.41 tons in 2023 (Sistem Informasi Pengolahan Sampah Nasional, 2024). The majority of this waste is transported to the Tamangapa landfill, posing escalating environmental and public health challenges. Waste management in densely populated urban regions of developing countries like Indonesia remains complex, involving processes from collection and transportation to final disposal. Effective and integrated waste management strategies are thus essential to safeguard environmental sustainability and community well-being.

A significant portion of unmanaged urban waste includes disposable baby diapers, which, when improperly discarded into rivers, drainage channels, or buried in soil, can severely pollute the environment. The lack of public awareness—particularly among young mothers—about the environmental and health hazards of diaper waste exacerbates the issue. These diapers contain synthetic materials and chemicals such as polyacrylate granules, hydrocarbon-based plastics, and polychlorinated dibenzodioxins, which can take 450 to 500 years to decompose (Norgitasari & Qurniyawati, 2017). The persistence of these materials in the ecosystem calls for urgent interventions focused on household-level waste reduction and behavioral change.

High levels of disposable diaper waste in urban neighborhoods are closely linked to limited public knowledge and the absence of structured education programs on waste management. A previous study indicated that households unaware of the chemical hazards and reutilization potential of disposable diapers contributed disproportionately to diaper waste volumes (Nasrokhatun, 2020). This underscores the need for integrated public education and training interventions, supported by community participation and practical technologies such as hydrothermal treatment, to mitigate environmental risks.

Various studies have emphasized the efficacy of community-based interventions in improving waste management outcomes in urban settings. Educational and training programs that incorporate participatory methods have been shown to significantly increase environmental awareness and shift household behaviors towards sustainable waste practices. For example, community engagement in sorting and recycling initiatives has led to measurable reductions in landfill contributions and improved sanitation standards in several low-income regions (Rahmawati et al., 2021; Haris et al., 2022).

Moreover, technological innovations such as hydrothermal treatment have emerged as viable solutions for processing non-biodegradable waste like disposable diapers. This method not only reduces diaper waste volume but also facilitates the conversion of waste materials into reusable products such as paving blocks or fuel pellets. The integration of technical solutions with community empowerment strategies enhances the sustainability and scalability of such interventions (Pratama et al., 2023; Yuliani & Hidayat, 2021).

Despite the growing body of evidence supporting integrated waste management strategies, there remains a notable gap in applying these interventions at the household level in urban Indonesia, particularly for the treatment of disposable diaper waste. Most municipal waste programs fail to address specific waste streams such as diapers, and very few initiatives incorporate both behavioral and technological solutions tailored for communities with limited access to infrastructure.

This study addresses this gap by implementing a structured community empowerment program in RW 4 of Kelurahan Tamalabba, Makassar, focusing on both education and hydrothermal diaper processing. The novelty of this initiative lies in its dual approach—enhancing public knowledge while introducing sustainable waste processing technology. The objectives of this study are to (1) improve household knowledge on waste sorting and (2) raise awareness and skills in processing disposable diaper waste at the community level.

METHODS

This study utilized a quantitative pre-experimental design involving a one-group pre-test and post-test approach to evaluate the effectiveness of educational interventions on household waste sorting and diaper waste processing. The community empowerment activity was conducted in RW 4, Kelurahan Tamalabba, Kecamatan Ujung Tanah, Makassar, as part of a CSR program initiated by PT Pertamina Patra Niaga IT Makassar.

The study was implemented in 2024 and involved 20 local residents as participants. The inclusion criteria were residents aged 18 years and older who were willing to attend the full duration of the training and educational sessions. Convenience sampling was employed to recruit the participants from the local neighborhood.

The intervention comprised a combination of structured training and interactive education. It began with a socialization session focused on the importance of waste separation and the responsible use of disposable diapers. Subsequently, participants were guided through a practical demonstration on converting used diapers into paving blocks using hydrothermal technology. The sessions concluded with a discussion and Q&A to reinforce understanding and clarify community concerns.

To assess changes in knowledge and willingness to participate in waste processing, both pre-tests and post-tests were administered using a standardized questionnaire. Each test consisted of 10 multiple-choice items related to waste sorting practices and attitudes toward diaper waste processing. Correct answers were scored as 1 and incorrect answers as 0, yielding a maximum possible score of 10. Based on the total scores, participants' knowledge levels were categorized as poor, fair, or good.

The evaluation design of this study involved administering pre-tests and post-tests using structured knowledge-based questionnaires to assess participants' understanding of waste sorting and their willingness to engage in diaper waste processing. The pre-test was conducted prior to the educational and training sessions, while the post-test was administered immediately afterward, with each session allocated 20 minutes for completion. The evaluation criteria focused on measuring participants' knowledge related to household waste sorting and their readiness to adopt sustainable waste practices at home. Target indicators included observable improvements in post-test scores, indicating an increase in knowledge, and a higher number of participants expressing willingness to participate in waste management activities, particularly in processing disposable diapers using hydrothermal techniques (see Figure 1).

Data were analyzed using descriptive statistics to summarize pre- and post-test results, and comparative analysis was applied to measure the intervention's impact. All participants provided informed consent before participating in the study.

Figure 1
Educational activity process

Table 1
Pre test and post test education

Criteria Knowledge Level	Pre Test	Percentage	Post Test	Percentage
Good	4	20	15	75
Simply	9	45	3	15
Less	7	35	2	10

RESULTS AND DISCUSSION

Educational interventions were conducted through a structured training session, including pre-test and post-test assessments to evaluate community knowledge on waste sorting. Based on Table 1, the pre-test results indicated that only 4 respondents (20%) demonstrated a good level of knowledge, 9 respondents (45%) had moderate knowledge, and 7 respondents (35%) showed poor understanding. Post-test assessments showed a significant improvement, with 15 respondents (75%) categorized under good knowledge, 3 (15%) with moderate, and only 2 (10%) still exhibiting poor knowledge. This suggests a substantial positive shift in community awareness and understanding after the educational sessions.

These results align with findings from previous studies demonstrating the effectiveness of structured educational programs in increasing knowledge and changing waste-related behaviors (Nurhayati & Nurhayati, 2023; Musiana et al., 2024). The participatory method used in this study—combining socialization, discussion, and demonstration—was critical to this improvement. Compared to top-down campaigns, this community-based approach provided more engagement, thereby fostering better knowledge retention and behavioral commitment. Furthermore, this initiative shows that even short-duration training can lead to significant cognitive improvements if implemented with active facilitation.

This finding underscores the crucial role of education in bridging knowledge gaps regarding household waste management. In contexts like Kelurahan Tamalabba, where awareness about the consequences of improper diaper waste disposal remains low, such targeted interventions can prevent environmental pollution and support broader urban sanitation goals. Improved knowledge is a necessary precursor for behavioral change and is foundational to sustainable community-led waste initiatives.

The evaluation data also captured community readiness to engage in waste processing following the training. Initially, willingness to participate in diaper processing was low due to lack of knowledge and perceived difficulty. However, post-intervention discussions and demonstrations significantly changed attitudes, with a marked increase in participant interest and self-reported intention to practice waste sorting and diaper processing at home using hydrothermal techniques. The community showed curiosity about producing paving blocks from diapers, indicating not only cognitive but also practical empowerment.

These findings support the assertion that behavioral change is influenced by interactive and demonstrative education methods (Pratama et al., 2021; Naldi, 2023). In comparison to passive educational tools, hands-on practice enhances understanding and demystifies technological processes, especially in communities with low baseline literacy on waste technology. The local adaptation of hydrothermal treatment also demonstrates an advantage by linking education directly with visible environmental and economic outcomes, such as paving block production.

The observed change in attitudes represents an important transition toward community-led solutions in waste management. Beyond awareness, equipping residents with the ability and confidence to implement solutions independently is key to sustainability. These results highlight the feasibility of CSR-supported models in achieving both educational and environmental objectives, suggesting replicability in other urban-rural transition zones.

The initiative also revealed latent community potential for organized participation. Discussions post-training showed that participants were eager to explore additional waste-to-product innovations and expressed the need for institutional support. The success of this initiative has sparked conversations

about the formalization of neighborhood-based waste teams and local regulations that could encourage waste sorting compliance.

This aligns with prior research indicating that sustained community engagement requires both education and systemic reinforcement (Schenck et al., 2023; Khotimah et al., 2023). The combination of CSR involvement, local leadership, and visible environmental gains provides a compelling model. Unlike many initiatives that remain isolated, this one has potential for scalability through structured community systems, such as waste banks or cooperatives.

The emerging enthusiasm for organized community roles in waste management indicates a readiness for more structured interventions. By capitalizing on the momentum generated by this initiative, stakeholders can establish community-based monitoring and incentive systems that institutionalize responsible waste behavior. This reinforces the importance of integrating social, technological, and institutional dimensions in sustainable CSR programs.

CONCLUSION

The training and educational activities conducted in this study successfully enhanced community knowledge regarding waste sorting, with particular emphasis on the management of disposable diaper waste. Participants not only acquired a better understanding of proper waste segregation practices but also gained practical skills in processing diaper waste into paving blocks using hydrothermal technology. This knowledge improvement was evident in the pre- and post-test results, with the proportion of respondents categorized as having good knowledge increasing significantly from 20% to 75%.

These findings affirm the effectiveness of community-based education and empowerment interventions in addressing localized waste challenges. However, the sustainability of household-level waste management remains dependent on the availability of supportive infrastructure and robust government policies that promote responsible waste handling. Future initiatives should focus on strengthening institutional support, expanding access to waste processing technologies, and integrating these efforts into formal waste management systems. Further research is encouraged to explore long-term behavioral impacts and the scalability of such programs in other urban and peri-urban areas.

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