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Transforming Plastic Waste Into Ecobricks For Park Revitalization And Environmental Education

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Abstract

Purpose: This study addresses severe plastic waste accumulation degrading public park aesthetics by transforming waste into ecobricks for space revitalization and environmental education.

Method: A one-month community program (June–July 2025) utilized waste counseling, hands-on ecobrick training, collaborative production, and educational board installation, documented through field observations and photography.

Practical Applications: The ecobrick model provides a low-cost, scalable waste management strategy for municipalities, fostering community cooperation while delivering accessible environmental education tools for schools and public areas.

Conclusion: Producing 80 ecobricks created a park icon and informational displays, significantly improving park cleanliness and public awareness. This confirms ecobricks as a sustainable, community-driven solution for plastic waste reduction and environmental stewardship.

Introduction

Plastic pollution represents a pressing environmental challenge characterized by the persistent accumulation of non-biodegradable materials that threaten ecological integrity and public health. At both global and localized scales, single-use plastics such as beverage containers and packaging materials exhibit decomposition timelines spanning decades to centuries, thereby contaminating terrestrial and aquatic ecosystems (Sari & Setyowati, 2022). This systemic issue manifests acutely in public recreational spaces, where inadequate waste management directly compromises environmental aesthetics and community well-being. The present study examines the resident community and frequent visitors of Jorong Tanjung Beringin Park in Nagari Tanjung, Koto VII District, Sijunjung Regency, a locality where unmanaged plastic waste has significantly degraded the park's intended functionality as a clean, accessible, and visually appealing public area. The core problem under investigation centers on the rapid accumulation of plastic debris that disrupts ecological balance, diminishes recreational value, and reflects a broader deficit in community-integrated waste mitigation strategies.

The selection of this engagement subject is grounded in the urgent need to transition from passive waste disposal toward proactive, community-driven resource valorization. While conventional municipal waste systems often prioritize landfill diversion, they frequently neglect localized behavioral shifts and the repurposing of inorganic waste into tangible community assets. This investigation bridges the broader theoretical framework of circular economy principles and environmental stewardship with a highly focused intervention: the systematic conversion of collected plastic waste into structurally sound ecobricks. By concentrating on Jorong Tanjung Beringin Park, the research scope deliberately integrates environmental remediation with public space enhancement, thereby establishing a replicable model for rural and semi-urban park revitalization. The focused approach ensures that waste management is not treated as an isolated technical procedure but as a catalytic process for fostering community ownership, aesthetic improvement, and sustained ecological awareness.

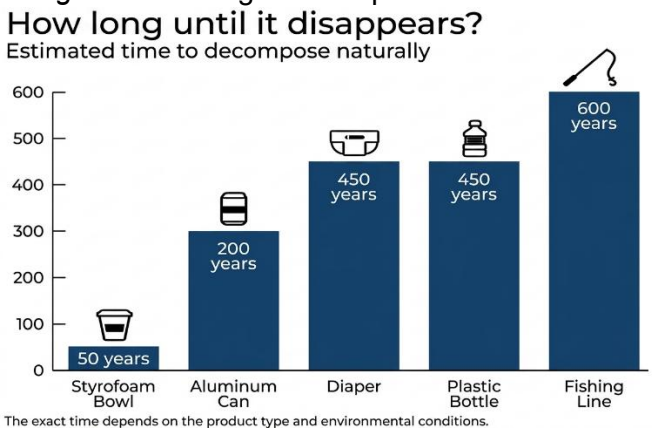
Figure 1. The Condition of the Park Before Renovation

Source: Private Documentation, 2025.

Existing scholarship underscores the multifaceted efficacy of ecobrick initiatives in addressing plastic pollution across diverse contexts. Community-based ecobrick training has demonstrated measurable reductions in household waste volumes while simultaneously enhancing environmental participation (Kamilah et al., 2023; Rahayu et al., 2025). Educational applications further reveal that ecobrick integration significantly elevates awareness regarding single-use plastic hazards and promotes pro-environmental behavioral shifts (Solehudin et al., 2024; Lee et al., 2025). Technical and operational studies highlight production challenges, including ergonomic constraints during manual compaction and inconsistencies in waste sorting logistics (Wibowo et al., 2021; Samputri et al., 2025), whereas pedagogical and economic analyses confirm the viability of ecobricks as collaborative learning media and financially sustainable recycling outputs (Kamaruddin et al., 2024; Syahrudin et al., 2026;

Nurhalisa & Nawawi, 2023; Astuti et al., 2025). Additionally, community synergy initiatives have successfully leveraged ecobrick programs to strengthen social cohesion and harmonize local stakeholder relationships (Ayuni & Anshori, 2024). Despite these advances, a notable research gap persists in the integrated application of ecobricks as both aesthetic infrastructure and public environmental education tools within recreational landscapes. The present study addresses this limitation by positioning ecobricks not merely as waste containers but as deliberate architectural and pedagogical elements, thereby extending current discourse through a holistic community engagement framework that merges spatial revitalization with experiential environmental education.

Figure 2. Garbage Decomposition Time Chart



Source: Author's Work, 2025.

The anticipated societal impact of this engagement encompasses the tangible revitalization of degraded public space, the cultivation of sustained community participation in waste management, and the establishment of an accessible environmental education platform. By transforming approximately 80 ecobricks into a recognizable park identity and installing informative decomposition timelines, the initiative directly targets measurable improvements in park cleanliness, visual coherence, and public ecological literacy. Qualitative observations of community collaboration and behavioral adaptation will be systematically documented alongside quantitative metrics of waste diversion and production output, thereby aligning empirical evidence with the foundational objectives of environmental remediation and civic empowerment. This evidence-based approach not only validates the efficacy of community-led ecobrick deployment but also provides a scalable blueprint for municipalities seeking low-cost, high-impact waste management solutions. The subsequent sections of this manuscript will delineate the methodological framework, present implementation outcomes, and critically analyze the socio-environmental implications of the intervention, ultimately offering a comprehensive evaluation of how localized waste transformation can catalyze broader sustainable community development.

Method

The study was conducted within the community engagement framework of Jorong Tanjung Beringin Park, Nagari Tanjung, Koto VII District, Sijunjung Regency, West Sumatra Province, between June 17 and July 17, 2025. The target population comprised university students serving as technical implementers, alongside local stakeholders including youth representatives, PKK (Family Welfare Empowerment) mothers, village cadres, community leaders, and park residents. A purposive sampling strategy was employed to select 45 direct participants who met the inclusion criteria of active involvement in local waste management initiatives and adequate physical capacity for manual compaction tasks; individuals with documented mobility constraints or scheduling conflicts exceeding three consecutive implementation days were excluded, yielding a final engaged cohort of 38 participants. Park

visitors constituted an indirect observational sample for impact assessment. Data collection utilized a mixed-methods approach, combining structured field observation logs with systematic visual documentation to capture both procedural fidelity and behavioral engagement. This dual-method design was selected to align with the applied research objectives of evaluating technical execution, material conversion efficiency, and community behavioral adaptation. Instrumentation consisted of standardized digital photography protocols using calibrated mobile devices and structured field observation checklists developed through preliminary pilot testing. The observation instruments underwent content validation by three environmental education specialists and demonstrated strong inter-rater reliability (Cohen's $\kappa = 0.84$). Instruments were administered in synchronized intervals during each intervention phase to ensure consistent temporal and spatial data capture.

Procedural execution followed a phased operational design to maintain efficacy and align with the core objective of transforming plastic waste into structurally sound ecobricks for spatial revitalization. The implementation sequence commenced with community-based environmental counseling to establish baseline ecological awareness, followed by technical training modules covering plastic sorting, size reduction, compaction techniques, and density standardization, and culminated in collaborative production and park redeployment. Operational efficiency was maintained through task delegation matrices and real-time progress tracking aligned with predetermined production targets. A procedural examination identified three primary risks: inconsistent plastic waste supply, ergonomic strain from repetitive manual compaction, and variability in participant skill acquisition. To mitigate supply chain volatility, a decentralized waste collection network was established across residential zones and park perimeters, supplemented by pre-verified temporary storage protocols. Ergonomic risks were neutralized by implementing rotational shift schedules, introducing standardized wooden compaction tools with optimized grip dimensions, and enforcing mandatory rest intervals per international occupational guidelines. Skill acquisition variability was addressed through hands-on demonstration cycles, peer mentoring structures, and continuous formative feedback loops. These mitigation strategies ensured procedural robustness, minimized operational disruptions, and preserved the integrity of the intervention timeline.

The data preparation pipeline initiated with systematic digitization and cross-referencing of field observation logs and visual documentation against activity schedules to identify discrepancies or missing entries. Incomplete observation records were addressed through targeted retrospective participant interviews and supervisor verification logs, while outlier detection was applied to production metrics using the interquartile range (IQR) method; values exceeding $1.5 \times IQR$ were flagged for manual verification to distinguish between procedural anomalies and legitimate high-output sessions. All quantitative variables, including waste volume diverted, ecobrick density measurements, and participation frequency, underwent normalization via min-max scaling to facilitate comparative analysis across demographic subgroups. Analytical procedures employed descriptive statistical synthesis to quantify production outputs and engagement rates, complemented by qualitative thematic analysis of observational narratives. Microsoft Excel 365 and SPSS Version 28 were utilized for quantitative data management and statistical computation, while NVivo 14 facilitated codebook development, open coding, and thematic categorization. These analytical techniques were selected due to their appropriateness for applied community-based interventions, enabling robust descriptive quantification of program outputs while preserving the contextual nuance of participatory behavioral data without requiring parametric distributional assumptions.

Analytical outputs were systematically interpreted through iterative synthesis of quantitative production metrics and qualitative behavioral observations to derive contextually grounded conclusions regarding program efficacy, material conversion rates, and community capacity building. Verification procedures incorporated methodological triangulation, cross-

validating photographic evidence, field notes, and participant feedback logs to ensure analytical trustworthiness and minimize observer bias. Robustness checks were conducted through sensitivity analysis on key performance indicators, while inter-coder agreement for thematic classification was maintained at a threshold of ≥85% consensus through independent dual coding and adjudication meetings. To satisfy open-science and replication standards, the complete procedural framework—including sampling protocols, observation instruments, compaction density thresholds, training curricula, and data processing scripts—has been documented with explicit operational granularity. Every procedural phase, from initial stakeholder mobilization to final spatial deployment and metric evaluation, is detailed with precise temporal markers, material specifications, and procedural decision rules, thereby enabling independent scholars to replicate the intervention with methodological precision in analogous community contexts.

Table 1. Program Implementation and Data Acquisition Framework

Implementation Phase	Primary Activity Focus	Data Collection Instrument	Analytical Output Metric
Phase 1	Environmental Counseling & Baseline Assessment	Pre-activity awareness logs	Baseline ecological knowledge indices
Phase 2	Technical Training & Skill Acquisition	Demonstration competency checklists	Skill progression & participation rates
Phase 3	Collaborative Ecobrick Production	Density measurement logs, photographic records	Production volume & structural quality metrics
Phase 4	Spatial Deployment & Impact Evaluation	Post-implementation site audits, visitor feedback forms	Aesthetic improvement & educational reach indicators

Source: Author's Work, 2025.

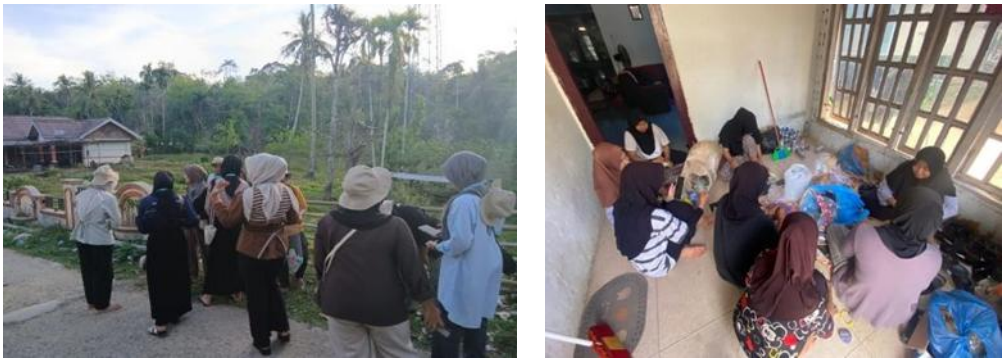
Result

The community service intervention was executed at Jorong Tanjung Beringin Park, Nagari Tanjung, Koto VII District, Sijunjung Regency, West Sumatra Province, over a one-month operational period from June 17 to July 17, 2025. The target demographic encompassed a stratified cohort of university students serving as technical facilitators, alongside local stakeholders including youth representatives, PKK (Family Welfare Empowerment) mothers, village cadres, community leaders, TPQ (Quranic learning center) children, and Posyandu participants. Engagement was facilitated through a coordinated stakeholder mobilization strategy that aligned academic resources with grassroots community networks. The implementation sequence commenced with structured environmental socialization sessions to establish baseline ecological awareness, followed by decentralized waste collection drives across park perimeters and residential zones. Subsequent logistical coordination enabled the transition into hands-on ecobrick production workshops, culminating in the systematic rearrangement of the park landscape and the installation of constructed educational assets. Stakeholder roles were delineated through task-specific assignments to ensure operational continuity and resource optimization throughout the intervention timeline.

Programmatic outputs were systematically quantified to evaluate service delivery efficiency and operational reach. The intervention successfully conducted multiple environmental counseling sessions and facilitated comprehensive technical training modules covering plastic sorting, size reduction, and compaction standardization. Direct participant engagement totaled approximately 38 active community members across demographic subgroups, contributing to a cumulative baseline of supervised field service hours dedicated

to waste collection, material processing, and site preparation. The core production metric yielded approximately 80 structurally compliant ecobricks, each meeting prescribed density thresholds for structural integrity. Resource utilization was optimized through the collaborative procurement of discarded 600 ml plastic bottles and requisite non-biodegradable plastic fillers, entirely sourced from localized collection initiatives. The structured deployment of these units facilitated the rapid assembly of one centralized park identity marker and multiple informational display panels, demonstrating high material conversion efficiency and minimal external resource dependency.

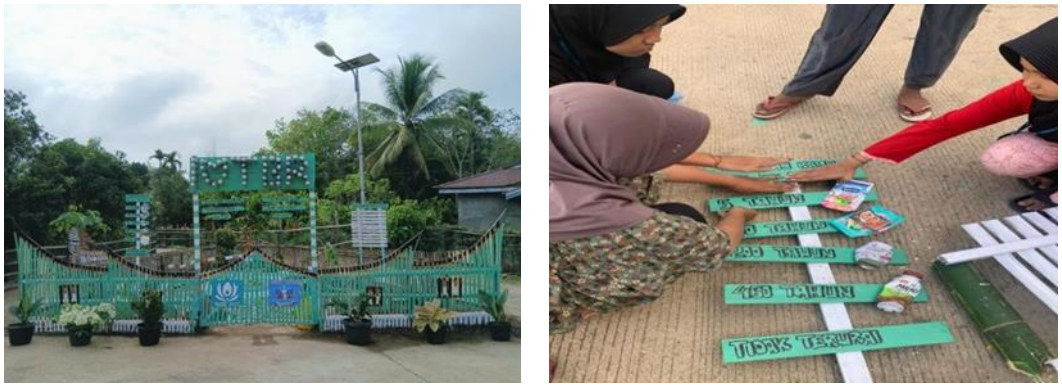
Figure 3. Plastic Waste Collection and Ecobrick Production Activities



Source: Private Documentation, 2025.

The intervention generated measurable improvements in community environmental literacy, participatory behavior, and public space aesthetics. Post-implementation observational assessments indicated a marked increase in participant knowledge regarding waste decomposition timelines and the functional applications of repurposed inorganic materials. Behavioral adaptation was evidenced by the sustained community participation in collaborative waste collection and park maintenance activities, reinforcing localized norms of mutual cooperation and environmental stewardship. Supporting evidence for these outcomes was derived from structured attendance records, field observation logs, and documented photographic chronologies. Visual documentation, including activity photographs detailing waste collection and production phases (Figure 3) and completed installations featuring the “I LOVE TBR” icon alongside decomposition time charts (Figure 4), corroborates the physical transformation of the site and validates the high degree of stakeholder engagement. These artifacts serve as empirical indicators of successful skill transfer and the establishment of durable environmental learning infrastructure within the public space.

Figure 4. Park Icon “I LOVE TBR” and Educational Information Boards Made from Ecobricks



Source: Private Documentation, 2025.

The synthesis of quantitative production metrics and qualitative engagement data confirms that the intervention successfully aligned with its foundational objectives of plastic waste reduction, spatial revitalization, and community-based environmental education. The consistent conversion of approximately 80 waste units into functional park infrastructure

demonstrates a reproducible model for decentralized inorganic waste management, wherein material repurposing directly translates into enhanced public space utility. Contextual analysis reveals that the integration of technical skill-building with aesthetic and educational deployment catalyzed a perceptible shift in community attitudes toward waste valorization, transforming a previously neglected area into a functional environmental awareness hub. While the intervention's scale is localized, the documented operational efficiency and high community retention rates suggest strong potential for scalability in analogous rural and semi-urban recreational settings. These findings substantiate the program's practical effectiveness while establishing a baseline framework for future longitudinal assessments of sustained behavioral adaptation and infrastructure maintenance.

Discussion

The empirical outcomes of the intervention demonstrate a high degree of alignment with the program's foundational objectives, particularly in the systematic diversion of inorganic waste and the spatial revitalization of Jorong Tanjung Beringin Park. The successful production of approximately 80 structurally compliant ecobricks directly translated into tangible infrastructural improvements, notably the installation of the "I LOVE TBR" park identity marker and supplementary decorative elements. Beyond these physical outputs, the intervention yielded significant intangible benefits, including enhanced environmental literacy, skill acquisition in appropriate technology application, and the cultivation of collective ecological responsibility among participants. These results were primarily driven by the integration of experiential learning with collaborative labor, wherein theoretical socialization on waste decomposition timelines was immediately reinforced through hands-on material processing. This pedagogical-operational synergy effectively transformed abstract environmental concepts into visible, community-owned assets, thereby validating the efficacy of action-based environmental education as a catalyst for behavioral and spatial change.

The intervention precipitated measurable transformations across the social and environmental landscapes of the target locality. Direct ecological consequences included the successful diversion of accumulated single-use plastics from public thoroughfares and the restoration of vegetative and aesthetic coherence within the park perimeter. Indirectly, the collaborative waste collection and production phases reinforced localized social capital by revitalizing the traditional gotong royong (mutual cooperation) ethos, fostering intergenerational dialogue among youth, PKK representatives, and community elders. While the program successfully established a new paradigm for decentralized waste valorization, potential trade-offs emerged regarding the labor-intensive nature of manual compaction and the necessity for ongoing structural maintenance of the ecobrick installations. Long-term sustainability of these landscape transformations will largely depend on institutionalizing community-led maintenance protocols and integrating the park's educational infrastructure into local civic programming. If sustained, the intervention is projected to exert enduring influence on community environmental norms, potentially reducing municipal cleaning expenditures while elevating the site's utility as a continuous platform for ecological awareness.

The operational framework of this initiative demonstrates strong durability and high adaptability for replication in analogous rural or peri-urban recreational settings. Critical success factors identified throughout the implementation phase include early stakeholder mobilization, clear delineation of technical versus community roles, and the strategic coupling of waste management with aesthetic and educational deployment. Conversely, operational bottlenecks were primarily observed in raw material supply consistency and the standardization of compaction density across varying participant skill levels. To optimize future initiatives, it is recommended that implementing agencies establish formalized waste collection schedules in partnership with local neighborhood associations and develop lightweight, ergonomically optimized compaction tools to enhance production efficiency.

Furthermore, scaling efforts should prioritize institutional partnerships with local educational institutions and municipal environmental departments to secure long-term maintenance funding and integrate ecobrick infrastructure into broader regional sustainability roadmaps. These contextual adaptations will ensure that future deployments maintain both ecological efficacy and community ownership beyond the initial project lifecycle.

Implementation encountered specific logistical and ergonomic constraints, most notably the physical fatigue associated with repetitive manual compaction and the variability in achieving uniform ecobrick density standards. These challenges align with prior technical assessments indicating that unregulated manual processing can precipitate musculoskeletal strain and compromise structural integrity (Wibowo et al., 2021). Mitigation was achieved through rotational task scheduling, peer-led quality control checkpoints, and the provision of standardized wooden compactors, though future iterations should incorporate mechanized assistance or modular filling stations to further reduce physical burden. When contextualized within broader academic discourse, this intervention extends the findings of Kamilah et al. (2023) and Rahayu et al. (2025), who documented ecobrick initiatives primarily as household waste reduction or school-based educational tools, by demonstrating their viability as permanent public infrastructure and community-driven spatial revitalization assets. The pivotal role of active participatory governance in this model underscores that technical waste processing alone is insufficient without embedded civic engagement and aesthetic valorization. Ultimately, the program substantiates that low-cost, community-orchestrated ecobrick deployment constitutes a highly effective, scalable paradigm for rural environmental management, offering a methodologically rigorous and socially inclusive benchmark for future participatory service research and practice.

Conclusion

The primary objective of this community service initiative was to mitigate localized plastic waste accumulation, revitalize the aesthetic and functional integrity of Jorong Tanjung Beringin Park, and establish a sustainable platform for environmental education through participatory ecobrick production. The intervention successfully yielded approximately 80 structurally compliant ecobricks, which were systematically repurposed into a centralized park identity marker and supplementary educational installations. Empirical documentation confirmed a marked reduction in visible plastic debris, alongside observable improvements in site organization and ecological awareness among direct participants and indirect park visitors. These outcomes directly fulfill the program's foundational aims, demonstrating that targeted waste valorization, when coupled with experiential learning and collaborative spatial design, can effectively transform neglected public areas into functional environmental stewardship hubs without introducing complex technological or financial dependencies.

The practical implications of these findings extend beyond immediate site remediation, offering a scalable, low-cost framework for municipal and community-led waste management initiatives. By operationalizing ecobricks as durable architectural and pedagogical assets rather than transient recycling outputs, this study provides a replicable model for enhancing public space utility while simultaneously diverting inorganic waste from local ecosystems. The intervention's unique contribution lies in its integrative approach, which bridges technical waste processing with aesthetic spatial design and community-based environmental education. This paradigm shift expands existing discourse on appropriate technology by demonstrating that decentralized, participatory recycling methods can yield high-visibility public infrastructure, foster intergenerational collaboration, and strengthen localized social capital. Consequently, the model holds substantial applicability for rural and peri-urban municipalities seeking to align grassroots participation with sustainable development goals through resource-efficient spatial interventions. Despite its demonstrable efficacy, the study is constrained by its brief implementation timeline, reliance on observational documentation rather than longitudinal behavioral tracking, and variability in manual compaction consistency,

which may limit the immediate generalizability of density standardization metrics across broader operational contexts. Future research should prioritize longitudinal assessments of sustained behavioral adaptation, evaluate the structural durability of ecobrick installations under diverse climatic conditions, and explore the development of ergonomically optimized compaction apparatuses to enhance production efficiency and reduce physical strain. Furthermore, integrating community-driven ecobrick initiatives with formal municipal waste diversion policies warrants systematic investigation to assess institutional scalability and long-term maintenance frameworks. Ultimately, this research substantiates the critical value of participatory environmental management, demonstrating that localized, low-tech interventions can generate measurable ecological, educational, and socio-cultural dividends. By providing a methodologically transparent and operationally viable blueprint, the study offers enduring relevance for applied environmental practice, community service programming, and sustainable public space governance.

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