

BASIS (Bank Sampah SIKK): Smart Digitalization Of Circular Economy Education For Empowering Migrant Workers' Children And Achieving The SDGs

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Abstract.

This study validates the business potential and social impact of BASIS (Bank Sampah SIKK), an integrated smart digital platform designed to commercialize organic waste management through circular economy education across Sekolah Indonesia Kota Kinabalu (SIKK) and over 200 Community Learning Centers (CLCs) in Sabah and Sarawak, Malaysia. Previously, Black Soldier Fly (BSF)-based food waste management suffered from severe operational inefficiencies, which were hindered by up to 80% data fragmentation and geographical constraints. Employing a descriptive qualitative method, this study positions BASIS not merely as a monitoring tool, but as a digital transaction platform that converts organic waste into valuable assets. Implementation results demonstrate that the application's transactional design has successfully converted the active participation of Indonesian migrant workers' children into tangible economic benefits through a point-reward system redeemable for educational products. BASIS has proven effective in shifting student behavior from passive consumption to productive social entrepreneurship, establishing a self-sustaining social enterprise model, and visualizing the economic value of waste in real time. In conclusion, BASIS possesses high scalability as an educational social enterprise capable of sustainably integrating ecological sustainability with the economic empowerment of marginalized migrant communities to support the Sustainable Development Goals (SDGs).

Keywords: BASIS, Social Entrepreneurship, Circular Economy, Migrant Workers, Black Soldier Fly and SDGs

I. INTRODUCTION

Sekolah Indonesia Kota Kinabalu (SIKK) serves as the primary educational hub for thousands of Indonesian migrant workers' children across Sabah and Sarawak, Malaysia. Since 2021, SIKK's "Green Practice Project" (GPP) has successfully converted organic waste into Black Soldier Fly (BSF)-based animal feed. This initiative has garnered international acclaim, including the 2025 Green Skills Award in the #ForOurPlanet category from the European Training Foundation (ETF) and European Commission (EC), as well as Gold Awards at the SM Lok Yuk Kota Kinabalu International STEM Festival in 2025 and 2026. Despite these accomplishments, the scalability of this circular economy model remains constrained. The initiative operates conventionally and is geographically fragmented across 283 Community Learning Centers (CLCs), where field observations reveal up to 80% data fragmentation and manual monitoring inefficiencies.

A fundamental barrier to scaling this social venture is the absence of a unified, transactional data ecosystem. Without digital tracking, the exact economic value of processed organic waste remains unquantified, and the collective market potential across hundreds of CLC units remains disconnected. As a result, significant opportunities to monetize organic waste into high-value animal feed and incentivize participants are lost. To address these structural deficiencies, this study introduces the BASIS (*Bank Sampah SIKK*) application: a smart digital platform designed to transition ad-hoc environmental activities into a commercially viable and scalable social enterprise. BASIS integrates organic waste stock monitoring, a dynamic reward-point conversion mechanism, and BSF feed supply chain management into a single digital platform.

While existing literature extensively explores circular economy initiatives in formal urban settings, limited empirical research addresses how smart digital platforms can empower marginalized educational networks. To address this gap and analyze this digital transformation, this study addresses three central research questions:

1. How can fragmented, unquantified organic waste management across SIKK and its network of CLCs be integrated into a scalable digital business ecosystem?
2. How do the transactional features of the BASIS application convert organic waste into digital economic assets (points) to establish a transparent, commercially viable BSF feed supply chain?
3. To what extent does the implementation of BASIS foster circular economy self-reliance and empower Indonesian migrant workers' children to transition from passive participants into active social entrepreneurs?

The implementation of BASIS contributes both empirically and practically by streamlining the organic feed supply chain, thereby reducing waste processing overhead and conventional feed procurement costs. By converting valueless organic waste into digital points redeemable for educational materials, BASIS creates an internal micro-economy that directly supports the educational needs of financially vulnerable migrant children. Furthermore, this digitalized social enterprise offers a ready-to-scale framework that can be replicated in other marginalized communities and educational networks.

Ultimately, BASIS advances the global agenda for sustainable development. By optimizing waste diversion from landfills via BSF processing, the initiative directly supports SDG 12 (Responsible Consumption and Production) and SDG 13 (Climate Action). Simultaneously, by turning environmental stewardship into economic opportunity and skill acquisition for marginalized youth, BASIS fosters quality learning and poverty mitigation, directly advancing SDG 4 (Quality Education) and SDG 8 (Decent Work and Economic Growth). Through this synergy, BASIS demonstrates how digital innovation can elevate grassroots environmental projects into transformative vehicles for social mobility.

II. METHOD

2.1. Research Design

This study employs a descriptive qualitative approach to investigate the implementation and impact of the BASIS (*Bank Sampah SIKK*) application as a smart digital system for circular economy education. A qualitative design is uniquely suited for this research as it facilitates an in-depth, contextual exploration of complex social phenomena, specifically how digital gamification and transactional workflows alter student behaviors, foster social entrepreneurship, and drive environmental stewardship among marginalized migrant children (Creswell & Poth, 2018).

2.2. Research Site and Participants

The study was conducted at Sekolah Indonesia Kota Kinabalu (SIKK) in Sabah, Malaysia, which acts as the central educational institution overseeing 283 Community Learning Centers (CLCs) across Sabah and Sarawak. Participants were selected using purposive sampling based on their direct involvement in the Green Practice Project (GPP) and the BASIS platform ecosystem. The key informants ($n = 22$) comprised:

1. School Administrators and Educators ($n = 5$): Program coordinators and teachers overseeing the GPP and CLC integration.
2. Student Participants ($n = 15$): Indonesian migrant workers' children actively engaged in organic waste collection, Black Soldier Fly (BSF) cultivation, and transaction point redemption.
3. System Developers ($n = 2$): IT specialists responsible for the technical architecture and backend transaction ecosystem of BASIS.

2.3. Data Collection Techniques

Data were gathered through four complementary techniques to capture both socio-behavioral nuances and digital metrics:

1. **Field Observation:** Structured and continuous observations were conducted at SIKK and selected CLC hubs. Researchers observed students' hands-on participation in organic waste sorting, BSF feed production, and their real-time interaction with the BASIS mobile interface during waste-to-point transactions.

2. **Semi-Structured Interviews:** In-depth interviews were carried out with all participant groups. Discussions focused on the transition from manual waste tracking to digital recording, the perceived motivational value of the point-reward system, user interface usability, and changes in students' entrepreneurial mindsets.

3. **Digital Artifact and Document Analysis:** To evaluate system performance and economic outcomes, digital logs generated by the BASIS application were extracted and analyzed alongside institutional documents. Analyzed artifacts included real-time transaction ledgers, organic waste weight logs (kg), point issuance/redemption histories, and GPP award archives.

4. **Triangulation:** To ensure data credibility and trustworthiness, methodological and source triangulation were employed. Findings from field observations were continuously cross-referenced with system transaction logs and verbatim interview transcripts across different informant cohorts (students vs. educators).

2.4. Data Analysis

Collected qualitative data and digital records were analyzed iteratively using the interactive model proposed by Miles, Huberman, and Saldana (2014), consisting of four interconnected stages:

1. **Data Collection:** Gathering qualitative transcripts, field notes, and digital platform transaction records.

2. **Data Condensation:** Filtering, coding, and categorizing raw qualitative data into themes aligned with the research questions (e.g., *data fragmentation before BASIS*, *transactional engagement*, *entrepreneurial shift*, and *SDG alignment*).

3. **Data Display:** Presenting thematic findings through structured tables, flowcharts of the BASIS transaction workflow, and narrative synthesis.

4. **Conclusion Drawing and Verification:** Formulating analytical conclusions regarding system efficacy, which were validated through member checking with school administrators and continuous data comparison.

III. RESULT AND DISCUSSION

3.1 Analysis of Pre-Digitalization GPP Conditions and Operational Challenges

Prior to digital intervention, the Green Practice Project (GPP) at Sekolah Indonesia Kota Kinabalu (SIKK) operated through localized, conventional waste-to-feed initiatives (Figure 1). While operationally functional, data management relied heavily on manual physical logbooks and isolated spreadsheets across the canteen, composting units, and permaculture facilities. This manual approach severely constrained data synchronization, preventing real-time reporting and delaying strategic decision-making.



Fig 1: Waste Processing Activities on SIKK Green Practice Program (GPP)

The scaling of the GPP to 283 Community Learning Centers (CLCs) across Sabah and Sarawak exacerbated these operational bottlenecks. Geographic dispersion created significant monitoring barriers and data standardization challenges. As noted by Mr. Ito, the GPP operational manager:

“We have struggled to verify whether waste management standards at plantation-based CLCs match those at the central hub (SIKK). Reports are often delayed, and we cannot track daily progress because everything still relies on paper records or piles of WhatsApp messages.”

This reliance on unverified, informal communication channels compromised data accuracy, generating systematic discrepancies between the recorded volume of processed organic waste and the distribution of BSF-derived products. Furthermore, manual archival hindered long-term trend analysis. Mr. Dede, co-manager of the GPP, emphasized:

“Our vocational students have done a great job reducing waste by 50%, but if asked for detailed annual totals, we have to dig through archives first. Today’s students need data visualization to grasp that the waste they process holds genuine circular economic value.”

Field findings indicate that pre-digitalization challenges were characterized by three primary barriers: severe data fragmentation (up to 80%), geographical isolation of remote CLCs, and an inability to visualize circular economic values. These findings confirm that transitioning to an integrated smart digital system was an essential step toward preserving environmental data assets and empowering vulnerable migrant children across the diaspora.

3.2 System Architecture, Feature Design, and Transactional Workflow of BASIS

To address structural data fragmentation, the BASIS (Bank Sampah SIKK) platform was initially prototyped via Google Sites and dynamic Google AppSheet databases, before evolving into a dedicated, cross-platform Android mobile application in 2026. The platform’s user interface (UI) incorporates an institutional design identity tailored to resonate with diaspora students (Figure 2 & Figure 3).



Fig 2: User Profile View
(currently still a Google Site)



Fig 3: Home Screen and Key Features

The app architecture organizes complex circular economy workflows into accessible, student-friendly modules, including user authentication, waste deposit entry (Figure 5), user profile tracking (Figure 4), and real-time analytical dashboards (Figure 6).

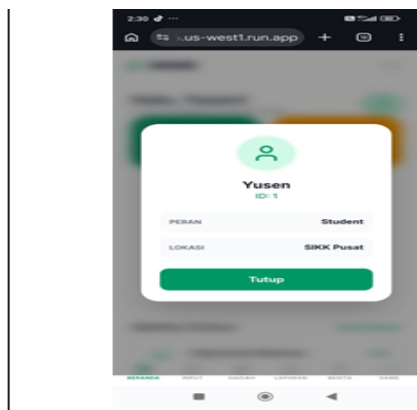


Fig 4: User Profile View After Redesign



Fig 5: Added features, such as a waste data input interface.

A core technological innovation of BASIS is its real-time data aggregation engine. When students input daily organic waste deposits (kg), the system instantly calculates and displays cumulative environmental impacts (e.g., “28 kg waste diverted/month”) on the primary dashboard. This immediate visualization provides instant feedback, converting abstract ecological actions into quantifiable performance metrics.

Furthermore, BASIS embeds a closed-loop transactional mechanism (Figure 7). Deposited organic waste is programmatically converted into an “internal digital currency” (reward points).



Fig 8: Permaculture Farming Activities on SIKK Green Practice Program (GPP)

Students can redeem accumulated points through an in-app catalog offering educational materials and fresh produce harvested from SIKK’s BSF-fertilized permaculture gardens (Figure 8). This digital ledger completes the circular economy workflow: canteen food waste is converted into Black Soldier Fly (BSF) larvae/compost (Figure 9), tracked transparently via BASIS, and returned to students as educational assets and nutritional support.



Fig 9: BSF on SIKK Green Practice Project

3.3 Educational Transformation, Social Entrepreneurship, and SDG Alignment

The deployment of BASIS has fundamentally shifted how migrant workers' children perceive and interact with organic waste (Figure 10).



Fig 10: Siswa terjun langsung berinteraksi dengan pengolahan sampah di SIKK Green Practice Project

Previously viewed as worthless refuse, food waste is now recognized as a high-value input within a digitalized supply chain. As Yusen, a senior high school student at SIKK, reflected:

"I used to throw away food scraps because I thought it was just trash. But after using BASIS, I get excited seeing the waste weight figures go up in the app. I've learned that the waste I collect becomes food for maggots (Black Soldier Fly larvae), which eventually turn into fertilizer for the vegetable garden. Now I understand that in nature, nothing truly goes to waste."

This behavioral transformation extends across geographical divides to plantation-based CLC hubs. Digitalization bridges physical isolation, allowing remote students to participate synchronously in the circular economy network. Siti and Bela, students at a remote plantation CLC, noted that the app's transparent point system provides tangible validation for their daily environmental contributions, turning abstract sustainability concepts into rewarding daily routines.

From a social entrepreneurship perspective, BASIS successfully transitions students from passive environmental participants to proactive social entrepreneurs. By engaging directly with a transactional ledger, students learn basic supply chain economics, asset management, and resource valuation.

SDGs ALIGNMENT THROUGH BASIS	
SDG Target	BASIS System Mechanism & Impact
SDG 4: Quality Education	Gamified experiential learning in circular economy & digital skill acquisition
SDG 8: Decent Work & Econ Growth	Fostering social entrepreneurship mindsets and vocational skills among migrant youth.
SDG 12: Responsible Consumption	Digital waste tracking and closed-loop BSF organic waste diversion from landfills.
SDG 13: Climate Action	Real-time monitoring and reduction of methane emissions from organic waste decomposition.

Fig 7: A Sdgs Alignment Through Basis

As summarized in the matrix above, the platform directly advances global sustainability objectives:

- **SDG 4 (Quality Education):** Enhances environmental literacy and digital competency through interactive, gamified learning interfaces.
- **SDG 8 (Decent Work & Economic Growth):** Equips vulnerable migrant children with market-relevant skills in green technology and digital asset tracking.
- **SDG 12 & 13 (Responsible Consumption & Climate Action):** Systematically diverts organic waste from landfills through quantified BSF larvae processing, mitigating greenhouse gas emissions while creating a self-sustaining social enterprise model.

IV. CONCLUSION

This study validates the transformative potential of BASIS (*Bank Sampah SIKK*) as a smart digital system that addresses severe data fragmentation and geographical barriers in circular economy education across Sekolah Indonesia Kota Kinabalu (SIKK) and its network of Community Learning Centers (CLCs) in Sabah and Sarawak. By transitioning from conventional, manual logbooks to an integrated digital platform, BASIS successfully standardizes organic waste management metrics, converts organic waste into transparent digital assets (reward points), and streamlines the Black Soldier Fly (BSF) supply chain.

Empirically, the implementation of BASIS demonstrates that gamified digital workflows and point-reward systems significantly enhance environmental literacy, behavioral discipline, and social entrepreneurship mindsets among marginalized migrant workers' children. Students are empowered to evolve from passive participants into active social entrepreneurs who directly experience the economic and educational benefits of waste monetization, directly contributing to SDGs 4, 8, 12, and 13.

Practical Implications and Recommendations

Practically, BASIS serves as a ready-to-scale social enterprise framework. Educational authorities and NGOs catering to vulnerable or diaspora communities can replicate this smart digitalization model to foster self-sustaining environmental ecosystems. Integration with local agricultural or educational product catalogs offers a viable blueprint for micro-economic self-reliance within non-formal educational hubs.

Limitations and Future Research

While this study demonstrates strong qualitative and behavioral outcomes, it is limited by its primary focus on a single educational institution network in East Malaysia. Future research should quantitatively-evaluate the long-term economic scalability, analyze system backend scalability with larger user bases, and explore technical integration with physical Internet of Things (IoT) hardware, such as automated smart scales and environmental sensors, to further automate waste data collection across remote learning centers.

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