

DIGITAL SOCIAL INNOVATION FOR CIRCULAR WASTE COOKING OIL MANAGEMENT: EVIDENCE FROM AN INDONESIAN COMMUNITY

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Abstract

The increasing volume of waste cooking oil (WCO) generated by households and small food businesses presents significant environmental challenges while simultaneously offering opportunities for circular economy implementation. However, community-based WCO collection initiatives in developing countries remain constrained by manual administration, fragmented data management, and limited public participation. This study aims to develop and implement the Jelantah Point web-based platform as a Digital Social Innovation to improve the management of community-based waste cooking oil collection. The research employed a combination of Participatory Action Research (PAR) and Design Science Research (DSR), involving the Jejak Jelantah Community throughout the processes of problem identification, system design, prototype development, implementation, monitoring, and evaluation. The resulting platform integrates digital deposit recording, an automated point-based incentive system, user contribution rankings, environmental education, and drop-point information into a single web-based application. The implementation demonstrates that the platform improves transparency, accuracy of collection records, accessibility of information, and operational efficiency while strengthening community participation through digital incentives and real-time monitoring. Furthermore, the integration of environmental education and contribution-based rewards encourages pro-environmental behavior and supports sustainable waste management practices. This study contributes to the growing literature on Digital Social Innovation by proposing an integrated web-based model that combines digital participation, incentive mechanisms, and community engagement to strengthen circular economy initiatives. The proposed model provides a scalable and replicable framework for sustainable community-based waste cooking oil management in developing countries.

Keywords: Digital Social Innovation; Waste Cooking Oil; Circular Economy; Community-Based Waste Management; Web-Based Information System

INTRODUCTION

The rise in cooking oil consumption in various countries has led to a rise in the volume of used cooking oil (WCO), which is a significant challenge in environmental management and sustainable development (Awogbemi & Kallon, 2024). The International Energy Agency has identified used cooking oil as one of the most potential raw materials for bioenergy development because it can reduce dependence on fossil fuels while utilizing waste that has not been optimally managed (Monika et al., 2023). However, in many developing countries, including Indonesia, most used cooking oil from households and culinary businesses is still not managed through an organized collection system. As a result, used cooking oil is often disposed of in drainage channels, water bodies, or soil, or even reused as cooking oil, thus negatively impacting environmental quality and public health (Hartini et al., 2023).

From an environmental perspective, the indiscriminate disposal of used cooking oil leads to blocked drainage systems, water pollution, soil degradation, and increased urban wastewater treatment costs (Awogbemi & Kallon, 2024). Meanwhile, repeated use of cooking oil for consumption can produce degradation products such as aldehydes, free radicals, and carcinogenic compounds, which can potentially increase the risk of various degenerative diseases (Scianò et al.,

2025). In fact, used cooking oil is a secondary resource with high economic value because it can be processed into biodiesel, soap, wax, biolubricants, and various other industrial products (Beghetto, 2025). Therefore, used cooking oil management is no longer viewed as a mere waste management activity, but rather an important part of implementing the circular economy concept, which focuses on resource reuse to create economic value while reducing environmental impact (Geissdoerfer et al., 2023).

One emerging approach to used cooking oil management is a community-based collection system (Baskaran et al., 2026). This approach positions the community as the primary actor in the waste collection process, thereby increasing environmental awareness and strengthening the community economy. Various studies have shown that community involvement contributes to increased waste management effectiveness, environmental awareness, and the successful implementation of a circular economy at the local level (Loizides et al., 2019); (Lee et al., 2023). However, most used cooking oil management communities still carry out administrative activities manually, from recording deposits and calculating incentives to preparing reports. This condition results in fragmented data, which is difficult to trace, prone to recording errors, and less supportive of data-driven decision-making (Aberger et al., 2025).

The development of digital technology has given rise to the concept of Digital Social Innovation (DSI), which is the use of digital technology to generate innovative solutions to various social and environmental problems through collaboration between communities, organizations, and other stakeholders (Dionisio et al., 2024). In the context of environmental management, web-based digital platforms have been shown to increase transparency, strengthen community participation, provide real-time data, and support evidence-based decision-making (Rodrigo et al., 2022). Furthermore, various studies have shown that the implementation of digital incentive mechanisms, such as point systems, awards, and leaderboards, can increase community motivation, engagement, and pro-environmental behavior by providing measurable appreciation for each user's contribution (Singh et al., 2026); (Riar et al., 2022).

However, previous research has been dominated by studies on the use of used cooking oil as a biodiesel feedstock (Monika et al., 2023), supply chain optimization (Zhang & Jiang, 2017), life cycle analysis (Foteinis et al., 2020), life cycle analysis (Khodadadi et al., 2020). and waste treatment technologies (Khodadadi et al., 2020). On the other hand, research on the digitalization of waste management generally focuses on urban waste monitoring systems or organizational operational efficiency (Gianmarco Bressanelli et al., 2022). (Kristoffersen, 2020). There is still very limited research integrating community-based used cooking oil management, digital social innovation, digital incentive systems, environmental education, and circular economy principles into a single, integrated web-based platform, particularly in the context of a developing country like Indonesia. Thus, there remains a research gap regarding how digital technology can be used not only to improve administrative efficiency but also to strengthen community participation, raise environmental awareness, and support the sustainable implementation of a circular economy.

Based on these gaps, this study developed the "Jelantah Point" Website, a web-based platform designed as a digital social innovation to support community-based used cooking oil management. Different from existing used cooking oil management systems, the "Jelantah Point" Website integrates five main functions in one platform, namely (1) digital recording of used cooking oil deposits, (2) an automatic points-based incentive system, (3) user contribution ranking (leaderboard), (4) environmental education media, and (5) drop point location information. The integration of these various features is expected to increase management transparency, strengthen community participation, build pro-environmental behavior, and provide an accurate database to support the development of a community-based circular economy.

Therefore, this study aims to develop and implement the "Jelantah Point" website as a digital social innovation platform for community-based used cooking oil management, evaluate the system's implementation towards increasing management transparency and community

participation, and explain the platform's contribution in supporting the implementation of a circular economy at the community level. The results of this study are expected to contribute to the development of literature on Digital Social Innovation, community-based waste management, and the circular economy, as well as become a model that can be replicated by used cooking oil management communities in various regions.

LITERATURE REVIEW AND HYPOTHESIS FORMULATION

Waste Cooking Oil Management from a Circular Economy Perspective

Used cooking oil is a type of waste generated in households and the food service sector, the volume of which continues to increase in line with the growth of cooking oil consumption in various countries (Teixeira et al., 2018). If not managed properly, used cooking oil has the potential to cause various environmental problems, such as blocked drainage systems, soil and water pollution, and increased pollutant loads in wastewater treatment plants (Awogbemi & Kallon, 2024). Furthermore, the practice of reusing used cooking oil for consumption also poses health risks because it can produce toxic and carcinogenic compounds from thermal degradation (Scianò et al., 2025). Therefore, the management of used cooking oil is a crucial issue in sustainable development, requiring an integrated approach from environmental, social, and economic perspectives.

From a circular economy perspective, used cooking oil is no longer viewed as waste to be disposed of, but rather as a secondary resource (Orjuela & Clark, 2020) that has economic value and can be reused as a raw material for various products, such as biodiesel (Monika et al., 2023), soap and candles (Baskaran et al., 2026), lubricants (Joshi et al., 2023), and other chemical industry raw materials. The circular economy approach emphasizes efforts to maintain material value for as long as possible through reuse, recovery, and recycling strategies, thereby reducing natural resource exploitation while reducing waste generation (Loizides et al., 2019). In this context, used cooking oil has strategic potential as part of the renewable energy supply chain because it can be converted into biodiesel, which is more environmentally friendly than fossil-based fuels (Foteinis et al., 2020).

Despite its high economic potential, the implementation of used cooking oil management at the community level still faces various challenges. Several studies have shown that low levels of community participation, limited collection facilities, weak administrative systems, and the lack of incentive mechanisms are the main factors causing low levels of used cooking oil collection (Feo et al., 2020). (Lee et al., 2023) In some communities, collection activities are still carried out manually, so data on the number of depositors, the volume of oil collected, and the resulting environmental impacts have not been systematically documented (Xirogiannopoulou, 2026). This condition makes the evaluation process, decision-making, and program development less effective.

As digital transformation advances, various studies have begun to emphasize the importance of utilizing information technology to support the implementation of a circular economy. Digitalization enables more accurate, transparent, and real-time recording, monitoring, and traceability of material flows, thereby improving resource management efficiency (Kristoffersen, 2020). In addition to improving governance, digital systems also have the potential to strengthen community participation through the provision of transparent information, technology-based incentives, and increased trust in waste management organizations (Bressanelli, 2018). Therefore, integrating digital technology with community-based used cooking oil management is becoming an increasingly relevant approach to supporting the implementation of a circular economy and achieving sustainable development goals.

Digital Social Innovation

Digital Social Innovation (DSI) is an innovation approach that utilizes digital technology to generate solutions to various social and environmental problems through collaboration, community participation, and the creation of shared value (Triantafyllidou & Zabaniotou, 2022,) (Suwandari, Indyastuti, & Dewi, 2021) Unlike technological innovation, which focuses on business

efficiency, DSI positions society as the primary actor in the creation, use, and development of innovation, enabling technology to function as a facilitator of social change (Cangiano et al., 2017). In recent years, the DSI concept has been increasingly applied to various sustainable development sectors, including waste management (Gustavo et al., 2025), the circular economy, environmental conservation, and community-based empowerment (Fahmi & Arifianto, 2022).

The development of information technology has opened up opportunities for community organizations to manage resources in a more transparent, participatory, and data-driven manner. Various studies have shown that digital platforms can improve administrative efficiency, strengthen information transparency, accelerate communication between stakeholders, and support evidence-based decision-making processes (G Bressanelli, 2018). (Kristoffersen, 2020). (Triantafyllidou & Zabaniotou, 2022). Furthermore, digitalization enables traceability of resource flows, allowing for real-time documentation of every waste collection, distribution, and utilization activity. This capability is a crucial factor in supporting the implementation of a circular economy because it increases accountability for material management throughout the supply chain.

In the context of community-based waste management, digital technology serves not only as an administrative tool but also as an instrument for increasing community participation. According to digital participation theory, the provision of easily accessible information, transparency of individual contributions, and online interactions can increase community involvement in various social and environmental activities (Sharma et al., 2022). Therefore, various organizations have begun developing digital platforms that allow communities to directly monitor their contributions, obtain feedback, and build a sense of ownership of the programs they implement (Triantafyllidou & Zabaniotou, 2022).

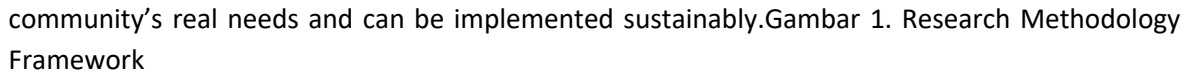
Previous research has also shown that integrating digital incentive mechanisms into web-based platforms can increase public motivation to participate in environmental activities (Mihale et al., 2024). Reward systems in the form of points, leaderboards, and other forms of gamification have proven effective in encouraging sustainable behavior change because they provide measurable appreciation for user contributions (Riar et al., 2022). In addition to increasing intrinsic and extrinsic motivation, these mechanisms also strengthen organizational transparency because all user activities are automatically documented in the system (Koivisto & Hamari, 2019).

Based on these findings, this study developed "Jelantah Point," a web-based platform that integrates digital recording, traceability of used cooking oil deposits, a points-based incentive system, a leaderboard, and educational information within a single digital ecosystem. Unlike previous research, which generally focused on the partial digitization of administration or waste management, this study integrates the principles of Digital Social Innovation with digital incentive mechanisms to strengthen public participation in community-based used cooking oil management as part of the implementation of a circular economy.

METHODS

Research Design

This study employs a Participatory Action Research (PAR) approach combined with Design Science Research (DSR). The PAR approach is a research method that positions the community or partners as subjects who actively participate in the entire research process, from problem identification and solution design through to implementation and evaluation of results (De Oliveira, 2023). This approach aims to bring about social change through collaboration between researchers and the community, so that the solutions developed are truly tailored to the needs on the ground (Snapp et al., 2023). (De Oliveira, 2024). In this study, the Jejak Jelantah Community acted as the main partner, playing an active role at every stage of the development of the Jelantah Point System.

Meanwhile, the Design Science Research (DSR) approach was adopted because this study focuses on the processes of design, development, implementation and evaluation of a technological artefact in the form of a web-based information system. According to (Zeng et al., 2025), DSR is a research paradigm aimed at producing innovative artefacts to solve real-world problems through a systematic design process and an evaluation of the effectiveness of the solutions developed. This approach is supported by (Trigo, 2026) who explains that DSR comprises the stages of problem identification, defining solution objectives, artefact design and development, demonstration, evaluation, and communication of research results. Therefore, the combination of PAR and DSR is considered appropriate as it not only produces technological innovation in the form of the 'Jelantah Point' system, but also ensures that the system is developed based on the community's real needs and can be implemented sustainably. 

Problem Identification

The initial phase involved field observations, in-depth interviews with the Jejak Jelantah Community administrators, and a documentation study of the ongoing used cooking oil collection administration process. This phase aimed to identify various operational challenges, such as manual record-keeping, administrative irregularities, low information transparency, and the absence of a digital incentive mechanism for community members. Based on the identified problems, a system requirements analysis was conducted to determine the functional and non-functional requirements of the application. The analysis included user characteristics, the used cooking oil collection business flow, the information needs of administrators and members, and the digital points award mechanism as a form of participation incentive. This aligns with a study (Karnowati et al., 2021), which showed that incentives have been shown to increase community participation in social and environmental programs.

System Development

The next stage was the development of a conceptual system design, which included application architecture, database design, process flow diagrams, and user interface design in mock-up form. The design was conducted based on the needs analysis results to ensure the system was tailored to the operational characteristics of the Jejak Jelantah Community. The Jelantah Point System prototype was then developed as a web-based application accessible via computer or smartphone. The system was built using a multi-user concept that differentiates access rights between administrators and community members. Key features developed include user registration, recording used cooking oil deposits, automatic point conversion, leaderboards, monitoring dashboards, drop point management, point exchange, and digital reporting.

Implementation

The completed prototype was then introduced to the managers and members of the Jejak Jelantah Community through outreach and training activities. The training materials covered the use of all application features, digital administration, and education on the importance of used cooking oil management in supporting a circular economy and environmental conservation. Prior to full implementation, the system was tested on a limited scale with a number of community members. This phase aimed to evaluate usability, interface clarity, and the completeness of the system's functions, as well as identifying any technical challenges that arose during initial use. User feedback was used as the basis for system improvements.

After refinements were made, the Used Cooking Oil Point System was implemented in the operational activities of the Jejak Jelantah Community. All used cooking oil deposit transactions began to be recorded through a web-based system, allowing for digital and integrated administration, point management, and reporting. Monitoring was conducted throughout the implementation period by observing system usage, the number of members using the application, the frequency of used cooking oil deposits, the accumulation of digital points, and various other operational indicators. Furthermore, observations were made on changes in the administrative process and the level of community participation following the system's implementation.

Evaluation

The final stage of the research involved evaluating the implementation of the Jelantah Point System by comparing conditions before and after digitalization. The evaluation was conducted descriptively based on field observations, interviews with community managers, system documentation, and operational data generated by the application. The evaluation results were used to assess the system's contribution to improving administrative transparency, management efficiency, community participation, and strengthening community-based circular economy practices.

The resulting Jelantah Point System is a web-based application accessible from a computer or smartphone. The system offers two types of access: administrator and community member. Key features include user registration, digital recording of used cooking oil deposits, automatic point conversion, a monitoring dashboard, a leaderboard, drop point location management, point exchange, educational articles, and regular reporting of used cooking oil collections. All data is stored in a centralized database, supporting more accurate, transparent, and real-time information management.

RESULTS AND DISCUSSION

4.1 Existing Conditions Before Implementation of the Jelantah Point System

Prior to the implementation of the web-based Used Cooking Oil Point System, the entire administrative process for collecting used cooking oil in the Jejak Jelantah Community was still carried out manually, using transaction notes and written records. Based on field observations and interviews with community managers, the administrative system used was not yet capable of supporting accurate, fast, and integrated data management. This resulted in low operational efficiency, limited information transparency, and increased potential for errors in recording and reporting.

Tabel 1. Results of Identification of Existing Conditions Before System Implementation

Aspect	Conditions Before Implementation	Impact
Member registration	Name writing is still manual	Identity errors and data input delays
Transaction	Calculations are done manually	Potential for payment miscalculation
Volume of used cooking oil	Member and operator data are not always the same	Reduces reporting accuracy
Price information	Delivered via WhatsApp	Information is not always real-time

Database	Not yet integrated	Difficult monitoring and evaluation
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Source: Table source

Observations revealed several key issues in the used cooking oil collection administration process. First, errors were still found in member identification on payment receipts, complicating the verification process and slowing down data input into the community administration. Second, manual transaction calculations led to errors in the sum of payment amounts and the volume of used cooking oil received. Third, discrepancies in the weight of used cooking oil between partner member records and operational records were observed, potentially leading to inconsistencies in reporting and reducing member trust in the administration system.

Furthermore, information delivery to members is still carried out conventionally through personal communication or text messages. Information regarding changes in used cooking oil prices, deposit history, and incentive entitlements is still not directly accessible to members, resulting in information often not being up-to-date (real-time). This situation limits members' ability to monitor their contributions and the benefits they receive from used cooking oil collection activities.

This problem is further exacerbated by the lack of an integrated database. Transaction data is scattered across various manual documents, complicating the process of recapitulating, monitoring, and periodically evaluating community performance. This data fragmentation reduces organizational operational efficiency, increases the risk of data loss, and limits managers' ability to compile reports and make data-driven decisions. This situation aligns with findings (Hera et al., 2024) that information systems that still rely on manual recording tend to result in information delays, data inconsistencies, and poor organizational decision-making quality.

Overall, the identification results indicate that the problems faced by the Jejak Jelantah Community are not only related to administrative aspects, but also encompass information governance and services to members. Therefore, a digital system is needed that can integrate transaction recording, member data management, information delivery, and incentive mechanisms in a transparent and centralized manner. Digitization through the Jelantah Point System is expected to be a solution to improve operational effectiveness while strengthening community participation in community-based used cooking oil management.

4.2 Development of the Point Wastewater Treatment System

The Jelantah Point system was developed as a digital solution to integrate the entire used cooking oil collection process, from member registration and deposit recording, verification, incentive management, and reporting. This web-based system is accessible in real time by both members and community administrators. The system was developed with the operational needs of the Jejak Jelantah Community in mind, addressing various challenges that have arisen from the use of manual administration systems. The Jelantah Point system architecture is shown in Figure 1.

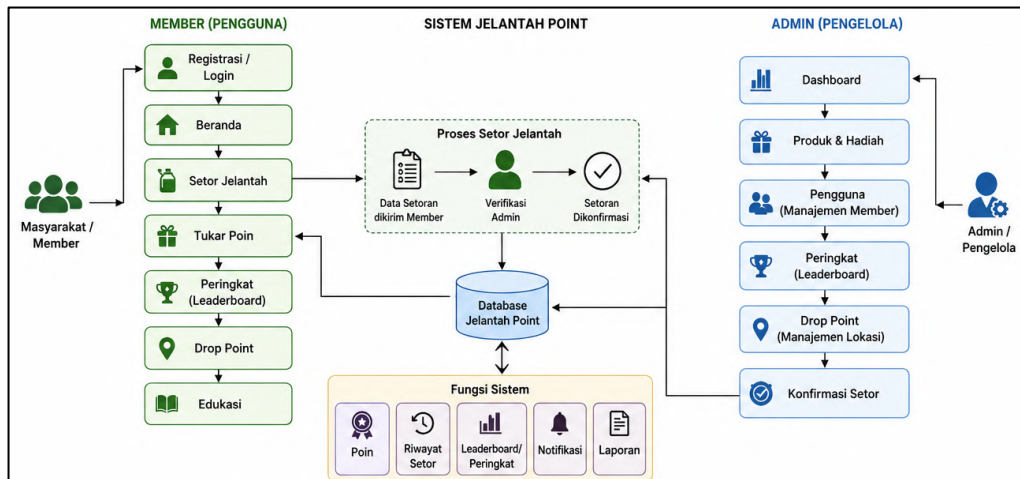


Figure 1. Point Wastewater Treatment System Architecture

Figure 1 shows the architecture of the Used Cooking Oil Point System, which consists of three main components: the member interface, the system module, and the admin interface. Members begin the process by registering or logging in, then depositing used cooking oil through the “Deposit” feature. The submitted deposit data will be verified by the admin through the “Deposit Confirmation” feature. Once the deposit is confirmed, the system automatically saves the data to the database and adds points based on the volume of used cooking oil deposited. This information can then be accessed through the “Deposit History,” “Exchange Points,” and “Ranking” features. Meanwhile, the admin uses the dashboard and management module to monitor program performance, manage rewards, set drop points, and generate reports. This architecture ensures an integrated and transparent data flow and supports real-time, data-driven decision-making. This aligns with a study by xx, which states that integrated and transparent data can support accelerated organizational decision-making (Yang & Khalid, 2025).

4.2.1 User Module (Member Interface)

The user module is designed as a means of interaction between the public and the Jejak Jelantah Community. Users who wish to become members are required to register through the website by providing personal information. Once the registration process is complete, users can log in to the system using their created account, so that all used cooking oil deposit activity is automatically recorded in the system database.

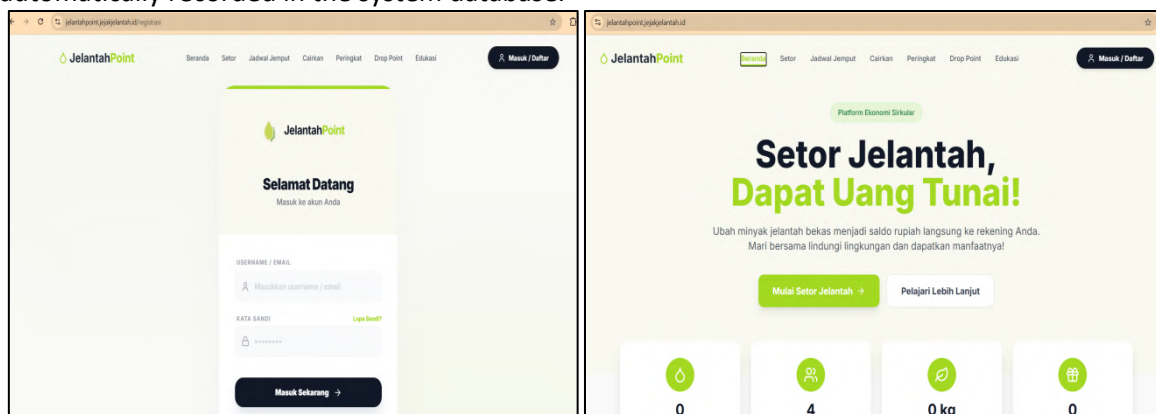


Figure 2. User Login Registration and Home View

After successfully logging into the system, users are directed to the "Home" page, which contains information about the Jelantah Point Program, system usage procedures, and various available service menus. The homepage aims to facilitate navigation while also enhancing user understanding of the digital used cooking oil collection mechanism.

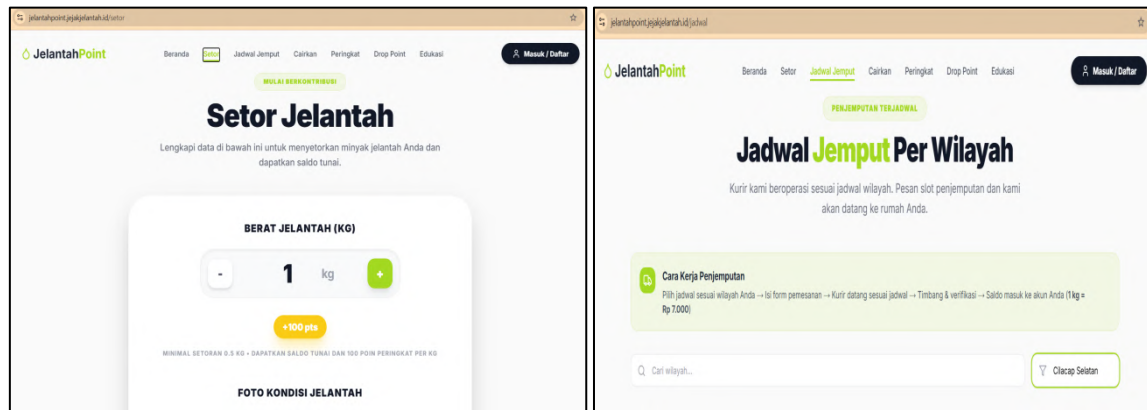


Figure 3. Display of Deposit and Pickup Schedule Features

The main feature provided to users is the "Deposit" menu, which is a facility for recording used cooking oil deposits. In this menu, users enter the volume of used cooking oil to be deposited and choose a collection method, namely via courier pickup service (pick-up service) or handing it directly to a predetermined drop point location. If the user chooses the pickup service, the system will ask for the complete address for the pickup location. Conversely, if the drop point is selected, the system will display a list of available collection points. In addition to deposit and pickup facilities, the system also provides a "Cirkan" feature that allows users to withdraw the balance directly to a bank account.

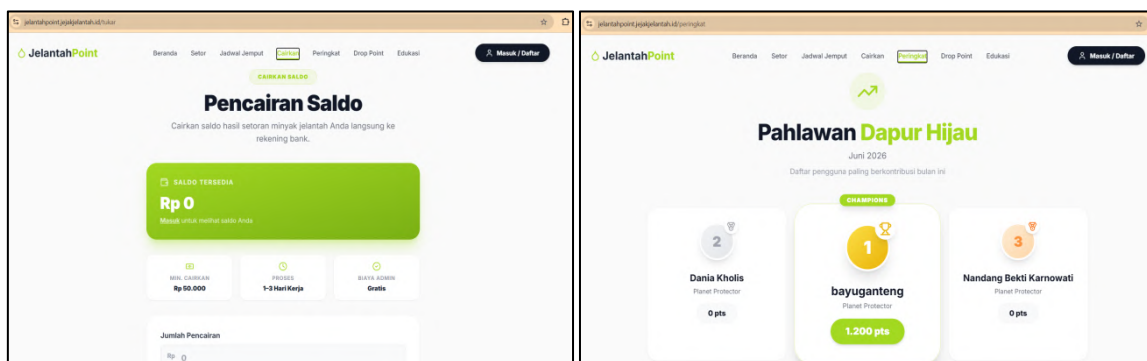


Figure 4. Display of Liquidation and Rating Features

To increase participation motivation, the system also features a "Leaderboard" feature that displays the ranking of users based on the accumulated volume of used cooking oil they have deposited. This information presentation is expected to encourage positive competition while strengthening community involvement in used cooking oil collection activities.

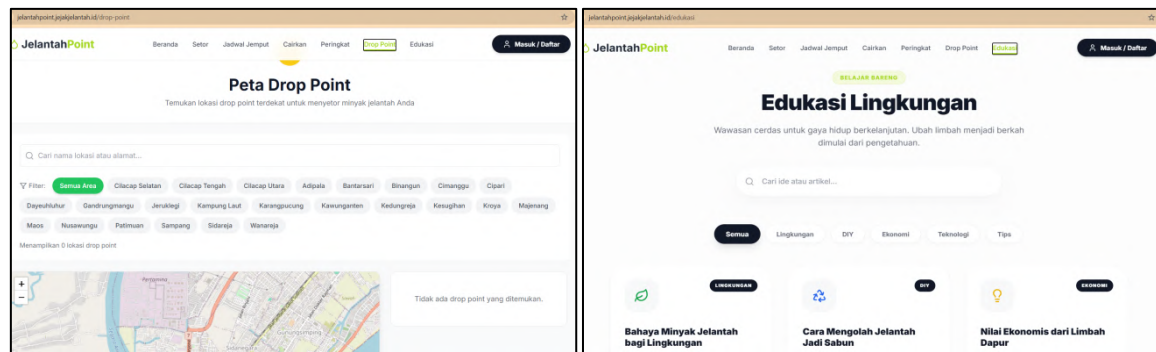


Figure 5. Display of Drop Point and Education Features

Furthermore, the Drop Point feature provides information on used cooking oil collection locations, which users can select based on their proximity. The system also offers an Education feature containing scientific articles, environmental information, and various educational materials on used cooking oil management and the implementation of a circular economy. This feature demonstrates that the Used Cooking Oil Point System serves not only as a transaction medium but also as a means of increasing environmental literacy among the public.

4.2.3 Modul Administrator (Admin Interface)

In addition to the user interface, the system also provides an administrator module to support the operational management of the community. This module begins with a dashboard that provides concise information on the number of registered users, the accumulated used cooking oil collected, and the number of products or prizes available for point exchange. This dashboard serves as a crucial tool for managers in monitoring program performance in real time.

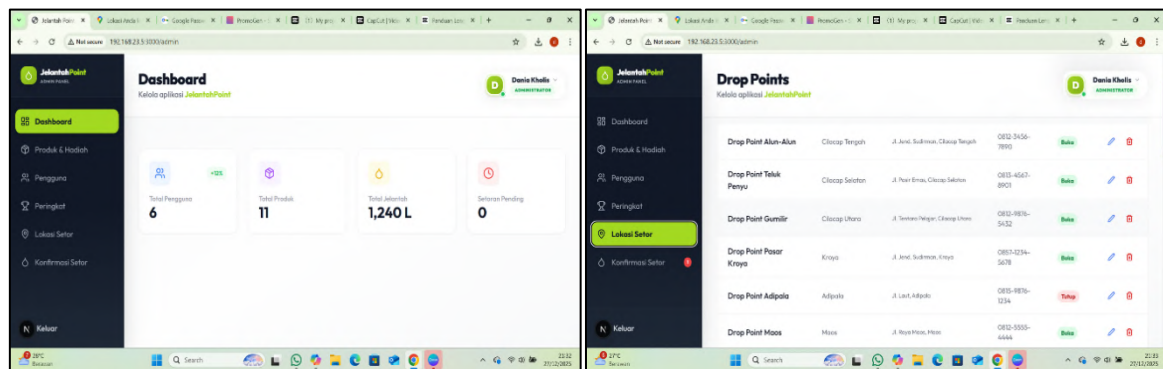


Figure 6. Dashboard Admin Interface

Furthermore, administrators have access to the Products and Rewards menu to manage the stock of rewards available on the system, the Users menu to monitor member data along with the number of points they have, the Ranking menu to view the contributions of all members, and the Drop Point menu to set the location and operational schedule of each collection point.

The most important feature in the administrator module is Deposit Confirmation, a facility used to verify the receipt of used cooking oil. After the confirmation process is complete, the system automatically calculates the number of points earned by the user based on the volume of used cooking oil deposited. This automated mechanism eliminates manual calculations that previously had the potential to lead to administrative errors and increases transparency in the provision of incentives to the community.

4.2.4 System Contribution to Management Improvement

The development of the Jelantah Point System fundamentally changes the governance of used cooking oil collection within the Jejak Jelantah Community. The integration of user and administrator modules creates an information system capable of centrally connecting all business processes, from member registration and deposit recording to incentive management and reporting. This minimizes data fragmentation, a major obstacle, while significantly improving recording accuracy, information transparency, and community operational efficiency. In addition to serving as an administrative tool, the system also serves as an educational and community empowerment tool to support circular economy-based used cooking oil management.

4.3 Digital Incentives and Community Participation

The implementation of incentive mechanisms has been recognized as an effective strategy for increasing community participation in various environmental programs (Karnowati & Jayanti, 2021). Both economic and non-economic incentives can increase individual motivation to participate in pro-environmental behavior by strengthening the perception of benefits received and reducing barriers to participation (Karnowati & Yuwono, 2023). In the context of community-based waste management, incentive systems also play a role in building commitment, increasing loyalty, and maintaining long-term community involvement (Mihale et al., 2024). Based on this concept, the Jelantah Poin Program adopts a digital incentive mechanism as a form of appreciation for the community's contribution in collecting used cooking oil. Every customer who deposits used cooking oil through the system will receive 1 point for every 1 kilogram of used cooking oil, with a conversion value of IDR 100 for each point. Accumulated points can be exchanged for various forms of rewards, either in the form of products or balances in rupiah. This incentive is not only intended as economic compensation, but also as a form of recognition for the community's contribution in supporting environmental conservation through responsible waste management (Kristoffersen, 2020).

The incentive mechanism is integrated into the Jelantah Poin website, allowing each user to transparently monitor the entire process of recording deposits, accumulating points, and even transaction history. This digital technology integration aligns with the concept of digital participation, which utilizes information technology to increase community involvement by providing easier, more transparent, and more interactive access to information (Al-Emran, 2023).

Through this system, customers can monitor their contributions in real time, while community managers obtain accurate data for monitoring and evaluation purposes. This information transparency is expected to increase public trust in the Jejak Jelantah community and strengthen the relationship between managers and customers. In addition to economic incentives, the system also features a customer ranking feature (leaderboard) based on the accumulated volume of used cooking oil deposited over a period. This feature is designed to foster positive competition while encouraging customers to be more active in educating their families, neighbors, and the surrounding community about the importance of proper used cooking oil management.

As a form of social recognition, the three customers with the largest contributions each period are awarded the title of "Best Customer," with an award given at the end of the collection period, which is held every June. This combination of financial incentives and social rewards is expected to create stronger motivation than relying solely on one form of incentive. From a circular economy perspective, this mechanism not only increases the volume of used cooking oil collections but also strengthens community involvement as key actors in maintaining the resource cycle. The more used cooking oil that is successfully collected and reused as industrial raw material, the greater the community's contribution to reducing environmental pollution, increasing resource efficiency, and supporting the implementation of circular economy principles that emphasize the reuse of waste as an economically valuable resource (Velenturf, 2021). (Gianmarco Bressanelli et al., 2022). Thus, the Jelantah Poin Program functions not only as a digital reward system but also as

a community empowerment instrument that integrates digital technology, behavioral change, and environmental sustainability within a single community-based used cooking oil management ecosystem.

4.4 Implications for the Circular Economy

The implementation of the Used Cooking Oil Point System significantly contributes to the implementation of circular economy principles by strengthening community-based waste cooking oil collection governance. Within the circular economy concept, waste is no longer viewed as a residue to be discarded, but rather as a resource with economic value and can be reused in the production cycle (Foteinis et al., 2020). Therefore, the success of a circular economy is determined not only by the ability to process waste downstream but also by the effectiveness of the collection, recording, and traceability systems for raw materials upstream.

Through the Jelantah Point System, every used cooking oil deposit is digitally documented based on the depositor's identity, collection location, deposit volume, transaction time, and user contribution history. This digitization creates an integrated database that allows for more accurate source tracing of used cooking oil compared to manual recording systems. The availability of accurate data not only increases transparency and accountability in community management but also strengthens trust between the community, as raw material providers, and the community managers.

In addition to improving internal governance, this system also strengthens the relationship between the Used Cooking Oil Trail Community and the downstream used cooking oil processing industry. Digital data on supply volume, collection continuity, and distribution in used cooking oil producing areas provides more reliable information for industry partners in planning raw material needs sustainably. Thus, the Used Cooking Oil Point System serves not only as an administrative tool but also as a digital infrastructure that supports the formation of a more efficient, transparent, and sustainable circular economy supply chain. This finding aligns with research (Kristoffersen, 2020) (Kristoffersen, 2020) which states that digitalization plays a crucial role in improving material flow efficiency, information transparency, and collaboration between actors in implementing a circular economy.

4.5 Alignment with Sustainable Development Goals

The implementation of the Used Cooking Oil Point System is closely linked to the achievement of several Sustainable Development Goals. First, the program supports SDG 11 (Sustainable Cities and Communities) by strengthening community-based waste management services. Digitizing the used cooking oil collection process expands public access to more organized, transparent, and accessible waste management services, contributing to the creation of cleaner and more sustainable urban areas (United Nations, 2015).

Second, this program contributes to SDG 12 (Responsible Consumption and Production) by encouraging more responsible consumption and production practices through the reuse of used cooking oil as an industrial raw material. The digital system enables communities to actively participate in reducing waste generation while supporting the reuse of previously worthless resources into products with economic value. This approach aligns with the principles of a circular economy, which emphasizes efficient resource use and waste reduction throughout a product's life cycle (Loizides et al., 2019).

Third, this program supports SDG 13 (Climate Action) by reducing the practice of indiscriminate disposal of used cooking oil that has the potential to pollute the environment and by increasing the use of used cooking oil as a raw material for renewable energy, such as biodiesel. More systematic management of used cooking oil contributes to reducing environmental impacts while supporting climate change mitigation efforts through the development of more sustainable alternative energy sources (Loizides et al., 2019).

Thus, the Jelantah Point Program not only produces innovation at the community level, but also contributes to the global development agenda that positions digital technology as an enabler in achieving sustainability goals.

4.6 Practical Implications

The results of this study provide several practical implications for various stakeholders. For the used cooking oil management community, the Point System can serve as a model for digitalized management that improves administrative efficiency, record-keeping accuracy, incentive transparency, and the quality of data-driven decision-making. For local governments, this system can be utilized as a supporting instrument for community-based waste management integrated with household waste reduction programs and the development of a circular economy at the local level. Meanwhile, for the used cooking oil processing industry, the availability of digitally documented data increases the certainty of raw material supply, thus supporting the sustainability of the supply chain for the biodiesel industry and other derivative products.

From an academic perspective, this research demonstrates that the integration of digitalization, gamification-based incentive mechanisms, and community-based waste management can form a digital social innovation model that has the potential to be replicated in various types of waste management. The Jelantah Point model demonstrates that digital transformation not only improves organizational operational efficiency but also fosters behavioral change in communities through a combination of economic incentives, social rewards, and information transparency. Therefore, this model has the potential to be adopted by communities, local governments, and non-governmental organizations as a strategy to accelerate the implementation of a circular economy in Indonesia.

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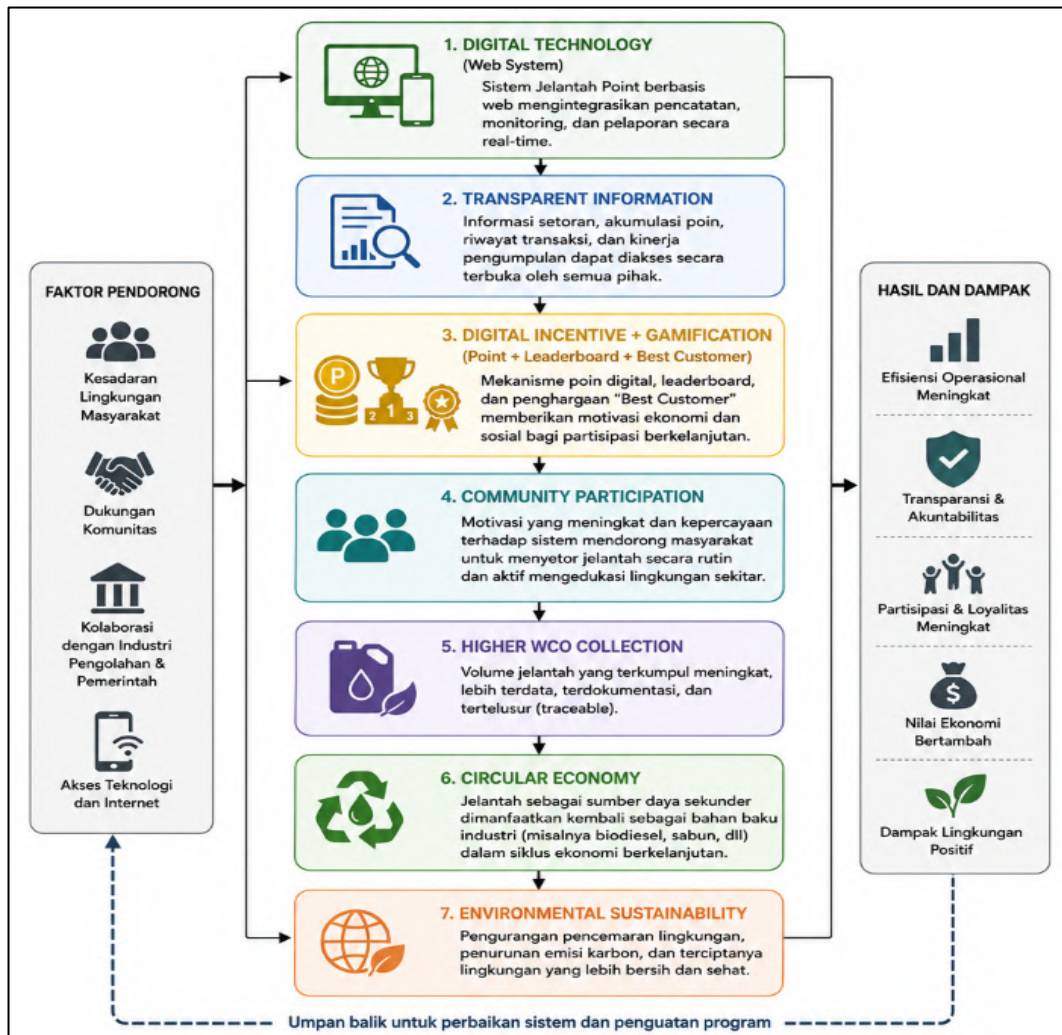


Figure 7. Conceptual Model of Digital Social Innovation in Community-Based Waste Cooking Oil Management

The conceptual model in Figure 7 shows how the integration of digital technology, gamification-based incentive mechanisms, and community participation form a sustainable digital social innovation cycle in used cooking oil management. The use of a web system allows for transparent and real-time information, thereby increasing public trust. Digital points, leaderboards, and "best customer" awards serve as both economic and social incentives, fostering intrinsic and extrinsic motivation to continue participating. Increased participation results in an increase in the volume of recorded and traceable used cooking oil collection, which then becomes an economically valuable raw material for the processing industry. This process closes the economic cycle by converting waste into a reusable resource, in line with circular economy principles. Ultimately, this model has a dual impact: increasing economic value for the community and improving environmental quality. Feedback from the system is used for continuous improvement so that the program can be strengthened and replicated in other community contexts. Thus, this model offers a digital social innovation framework that can serve as a basis for developing similar waste management strategies in other regions.

CONCLUSION

This research demonstrates that the development of the Used Cooking Oil Point System is a form of digital social innovation capable of addressing various challenges in community-based used cooking oil management, particularly in the areas of recording, transparency, incentives, and data management. The transformation from a manual administration system to a web-based system has resulted in more effective, accurate, and integrated used cooking oil collection governance, improving the quality of public service while supporting data-driven decision-making.

Beyond simply digitizing administration, the Jelantah Point System integrates digital incentive mechanisms and social rewards that encourage sustainable community participation in used cooking oil collection. This integration strengthens the relationship between communities, society, and the processing industry, creating a more transparent, collaborative, and sustainability-oriented waste management ecosystem.

The main contribution of this research lies in the development of a Digital Social Innovation for Community-Based Circular Economy model, a model that integrates digital technology, behavioral incentives, and community empowerment in the management of used cooking oil. This model not only provides practical benefits for improving the effectiveness of waste management but also enriches the literature on digital transformation in the implementation of a community-based circular economy. Future research can quantitatively test the effectiveness of this model in increasing community participation, used cooking oil collection volume, user trust, and its impact on economic and environmental performance at a broader regional scale.

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