Ish Pandey, 2026, 14:4
ISSN (Online): 2348-4098
ISSN (Print): 2395-4752

International Journal of Science, Engineering and Technology
An Open Access Journal

WasteWise: An Incentive-Based Digital Platform for Circular Economy-Driven Waste Management and Upcycled Product Ecosystems

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Abstract- The emergence of more paper, plastic, floral, and reusable wastes presents substantial environmental problems that call for new approaches to solving them. In view of the above, this paper will examine the WasteWise platform as a potential innovation aimed at transforming the management of waste using the principles of circular economy. The application will allow citizens to donate recyclable waste products such as paper, flowers, and plastics, earning digital incentives in return for donating their waste products. The incentives earned will enable the donors to buy sustainable products on the online marketplace of the application. The distinguishing feature of WasteWise is the circular approach applied, whereby the donated waste will be converted into sustainable products. The process will make sure that the products obtained from the conversion will enter the consumer market via the WasteWise platform. It will be noted that by integrating waste collection, incentives, upcycling, and eco-commerce into a single system, the above model of the waste management process minimises waste generation, promoting responsible consumption and supporting zero-waste initiatives. The research paper will focus on WasteWise and will examine how the technology can be used to introduce circular economy concepts into practice.

Keywords: Circular economy, waste management, upcycling, incentive-based recycling, resource recovery, zero-waste systems, sustainable e-commerce, green technology.

I. INTRODUCTION

The process of Rapid Urbanisation, Consumerism and Industrialisation has increased Solid Waste Generation to unprecedented levels and presented major Challenges to Environmental sustainability[1]. Most of the existing Solid Waste Management Systems follow the linear approach of "Take - Use - Dispose", leading to the waste of resources, pollution and inefficient utilisation of material resources. The emergence of the circular economy system can be seen as an innovative model for solid waste management following the "Reduce-Reuse-Recycle" approach and focusing on Waste Removal and Waste Valorisation, utilising closed-loop systems where waste is returned to the production process.

Digital technologies and intelligent applications have helped develop new approaches to the Circular Economy by providing integrated platforms connecting waste users, waste collection systems and recycling networks using digital technologies[2]. Despite the measures put in place to educate the Public on the need for Recycling and Sustainability, there are still numerous hindrances to Public Participation in Waste Separation and Donation (Lack of incentive, access, and Low Participation). Furthermore, the current Waste Management Strategies only consider waste collection and recycling, without any Consumer Engagement, Rewards, or Global System for Circular Product Reintegration into the Supply Chain as part of their Waste Collection Strategy[3].

In response to these weaknesses, this study proposes WasteWise, an incentive system using technology and circular economy principles that encourages waste donation, provides rewards, and facilitates trading of upcycled products/materials. WasteWise lets the individual donate reusable waste materials (paper, plastics, floral, etc.) to the mobile application and earn rewards through digital wallet credit or any other incentive-based remuneration. The consumer will be able to redeem the reward when purchasing eco-friendly products consisting of recycled and upcycled materials[4].

Through the incorporation of smart waste management, resource recovery, sustainable e-commerce, and incentives for the user in a single system that focuses on reducing the generation of waste, WasteWise provides a platform which helps in minimising pollution and promoting the concept of zero waste[5]. WasteWise also connects users with the environment in a practical way of engaging in an ecofriendly manner through the conversion of waste into commercial goods and rewarding the user economically when he or she donates or recycles their products[6]. This paper is going to discuss the design of WasteWise and its importance as a viable platform for the creation of a digital circular economy and will also explore the possibility of WasteWise being used to promote environmental sustainability, social responsibility, and economic gain[7].

II. LITERATURE REVIEW

Circular economy systems represent sustainable alternatives to existing linear modes of production and consumption. Bashynska et al [6] explored the ethical dimensions of implementing Artificial Intelligence into circular economy models, indicating the potential of technology to optimise resource utilization, reduce waste generation, and ensure transparent decision-making processes without compromising ethical values and ensuring sustainable use of technology. This research reveals the rising importance of intelligent technological systems as key tools to reinforce circular economy models and reflects the technological aspects of the proposed WasteWise platform Okojie et al. [7]. The viability of waste-to-value models of the circular economy.

Sudhanshu, Kansal, and Das [8] studied about stress the importance of integrated waste management techniques and resource efficiency practices. As such, the importance of technological advances and sustainable operations forms the core tenet of WasteWise. Similarly, Ikonen et al [9] evaluated the importance of data utilization for efficient implementation of circular economy practices in the rechargeable batteries sector. In particular, this research suggests using digital technologies for tracking materials, optimizing recovery rates, and managing circular economy supply chains efficiently. The importance of digital transformation as a factor facilitating implementation of circular economy practices cannot be underestimated. According to Chavez et al [10] explored about the digital servitization facilitates the emergence of sustainable industrial ecosystems through digital platforms that connect actors and support resource-efficient service provision. As such, digital servitization represents a strong theoretical foundation for circular economy solutions based on platform design, where users, waste management facilities, and markets for sustainable products can become interconnected in one digital ecosystem.

Furthermore, Compagnone et al [11] emphasised the potential of collaborative innovation in achieving sustainable development objectives through circular economy. The paper stresses the necessity of active stakeholder participation and innovation dissemination through ecosystem-based models for the implementation of sustainable business practices. This idea supports the participative nature of WasteWise and its promotion of citizen involvement through incentive-based programs for waste recycling and sustainable product usage.

The notions of environmental sustainability and green growth have significantly contributed to the body of literature on circular economy. According to Baoha, the concept of green growth implies a strategy that seeks to harmonize economic development and environmental protection through resource efficiency and low-waste manufacturing processes. Such an approach correlates with the mission of WasteWise, which entails making money without causing harm to the environment through a closed loop from waste to products ecosystem [12].

Despite the fact that the current literature comprehensively examines resource recovery, digital circular economies, ethical artificial intelligence adoption, and sustainable services, most of the available studies tend to concentrate on specific aspects of the circular economy model and not on an integrated platform for citizens. Very few articles have examined the integration of waste donations, incentive mechanisms, digital wallets, and recycled products trade in a cohesive circular economy model[13].

III. OVERVIEW OF AI DRIVEN CONCEPTUAL FRAMEWORK AND METHODOLOGY

The conceptual structure of WasteWise is built based on the ideas of circular economy, incorporating concepts such as waste donations, incentive systems, resource recovery, and sustainable trade in a closed cycle. The framework consists of five main elements: waste generation/donation, collection/segregation, recycling/upcycling processes, incentive programs, and sustainable reintegration of products as shown in Fig1. The first step includes the donations of recyclable/reusable waste products made by the users in the form of paper, plastic, and floral waste using the WasteWise application.

Further, the collected waste undergoes sorting and treatment for further recycling and upcycling according to the material's usability. In the second step, the sorted waste material gets recycled or upcycled in various forms, including recycled paper products, decorative articles, biodegradable products, and reused consumer goods. Hereby, the resource recovery concept is embodied in the model[14]. The next step is an incentive-based rewards system, which provides incentives for donating the waste.

This serves as a motivational factor in enhancing waste recycling activities. The rewards can be redeemed by users through the integrated marketplace in exchange for sustainably-made recycled and upcycled products. Lastly, the products get reintroduced to the consumers through the marketplace and thus completing a fully-closed loop system of turning waste into resources and then back into consumption. The proposed model aligns with zero-waste initiatives and resource efficiency practices[15].

Fig1. Representation of the conceptual relation between the variables.

Based on the framework, it is expected that digital incentives, active involvement of users, and product reuse promote waste reduction, resource recovery, and sustainability behavior. The proposed solution, the WasteWise platform, will be evaluated using a design-oriented and conceptual methodology[16]. This research adopts an exploratory approach with the objective of developing a systematic, design-based framework for a novel digital solution that supports sustainable waste management. Rather than validating an already existing system, the study focuses on designing and proposing an innovative implementation model based on circular economy principles[17].

The methodology begins with problem identification, where major issues in current waste management systems are analyzed, including inefficient waste disposal practices, low public participation in recycling activities, and the lack of integrated platforms that effectively support a circular economy. Based on these identified challenges, a conceptual framework for WasteWise is designed using insights from existing literature and sustainability practices. The framework incorporates features such as waste donation through a digital application, smart waste collection and sorting mechanisms, recycling and upcycling processes, digital reward wallets for users, and a sustainable e-commerce platform for circular products[18].

The architecture of WasteWise is structured into multiple layers to ensure efficient operation and integration of circular economy concepts. The User Interface Layer includes functionalities such as user registration, scheduling waste donations, managing reward wallets, and accessing a marketplace for sustainable products. The Processing Layer handles activities including waste sorting and tracking, reward calculation, and inventory management[19]. The Circular Economy Layer focuses on resource recovery, product upcycling, and maintaining closed-loop sustainability processes.

For data collection, the study relies primarily on secondary sources, including research papers, government and industry reports, and case studies related to circular economy models, digital sustainability platforms, incentive-based recycling systems, and waste-to-value initiatives. Finally, conceptual validation of the proposed model will be conducted using sustainability-oriented performance criteria[20]. These criteria include waste reduction potential, efficiency in resource recovery, user engagement through incentives, economic value generation, and the overall sustainability of the circular product life cycle. The workflow of the platform can be seen as illustrated in Fig2.

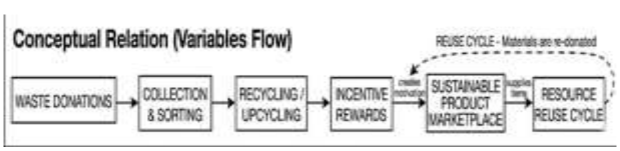

Fig.2. workflow flowchart

As can be seen, the methodology provides a model for scaling technologies to be used for implementing the idea of a circular economy, which contributes significantly towards achieving zero waste. WasteWise can serve as a framework and an example of a practical model.

IV. OVERVIEW OF AI DRIVEN ARCHITECTURE AND PROCESS MAPPING

The proposed WasteWise platform will function through a four-tier architecture designed to support waste donation, incentive management, resource recovery, and the reintegration of products into a circular economy. These interconnected layers work together to provide a seamless and sustainable experience for waste donors, recyclers, and consumers while ensuring efficient waste management and value generation[21]. The architecture of system is given in Fig3.

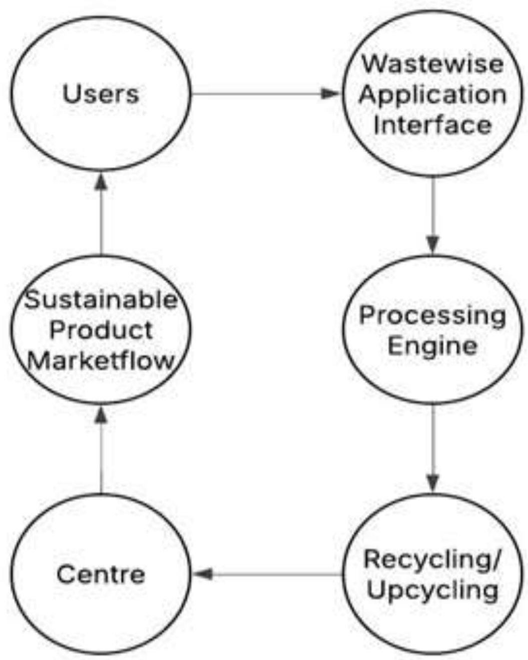

Fig3. System architecture

The first layer, known as the User Interaction Layer, enables users to interact with the WasteWise platform through a mobile or web based application. Through this interface, users can create accounts, authenticate their profiles, submit waste donation requests, select waste categories such as paper, plastic, or flower waste, schedule waste pickups, monitor their digital reward wallets, and purchase sustainable products available on the platform[22].

This layer focuses on providing accessibility, convenience, and active public participation in the waste management process.

The second layer is the Processing Layer, which performs the core operational activities of the system. It manages the processing of waste donations, calculates incentive rewards for users, tracks waste movement across different stages, and maintains records of transactions and inventory. This layer includes modules such as the waste classification engine, incentive calculation system, waste tracking and management system, logistics and inventory control, and the database management system[23]. Together, these components ensure efficient coordination and smooth functioning of the platform.

The third layer, referred to as the Circular Resource Management Layer, represents the foundation of the circular economy model within WasteWise. In this layer, the collected waste is sorted, processed, recycled, or upcycled into valuable reusable materials and products. Key functions include waste sorting, recycling and upcycling operations, manufacturing of upcycled products, and quality assessment of reusable products to ensure sustainability and usability[24]. This layer helps transform waste into resources, thereby reducing environmental pollution and promoting resource efficiency.

The final layer is the Marketplace and Reintegration Layer, which enables the reintegration of recovered products and recycled materials back into the economy. Products generated through recycling and upcycling processes are listed on an integrated marketplace where users can purchase them using their reward wallets or through standard e-commerce transactions. This layer supports product listing and inventory management, reward wallet integration, online transactions, and closed-loop product reintegration, thereby completing the sustainable circular flow of resources within the WasteWise ecosystem[26]. The process mapping and algorithm process mapping is as shown in Fig4 and Fig5 respectively.

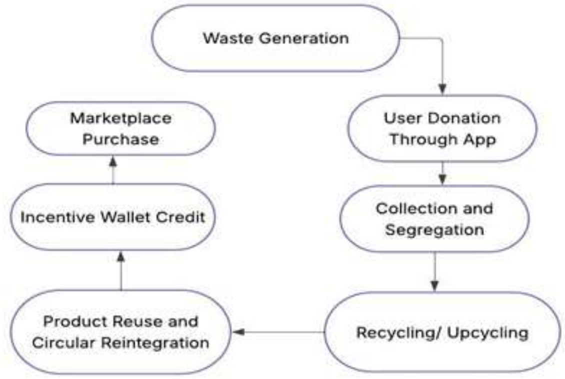

Fig.4. Process Mapping workflow

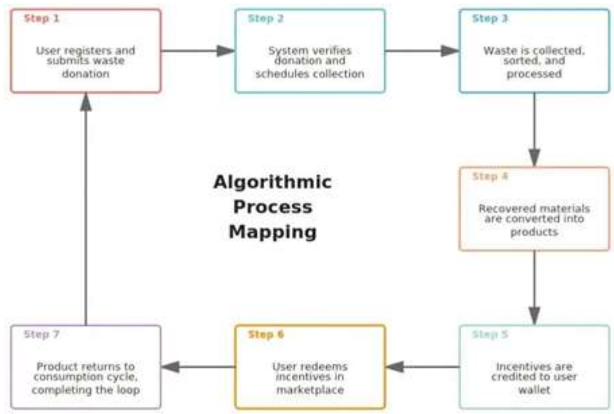

Fig.5. Algorithm Process workflow

V. OVERVIEW OF AI DRIVEN IMPACT ANALYSIS OF WASTE WISE

The WasteWise initiative is designed to create a multidimensional impact across environmental, economic, social, and technological dimensions by applying circular economy principles to waste management. Through waste donation, incentivized user participation, recycling, upcycling, and the reintegration of recovered products into the economy, the platform aims to support sustainable resource utilization and contribute toward achieving zero-waste goals[27].

From an environmental perspective, WasteWise seeks to significantly reduce waste accumulation and minimize landfill dependency by promoting recycling and reuse practices. The collection of materials such as paper, plastic, floral waste, and other reusable items enables efficient resource recovery while preventing environmental pollution. Recycling and upcycling processes reduce the need for new raw materials, lower manufacturing-related carbon emissions, conserve natural resources, and create a sustainable ecosystem in which materials can continuously circulate within the economy.

Additionally, the reuse of floral waste and proper recycling of plastics help prevent improper disposal practices that often lead to water and soil contamination[28]. The environmental performance of the platform can be measured through indicators such as reduction in landfill waste volumes, improvement in recycling and recovery rates, reduction in carbon footprint through resource reuse, conservation of raw materials and energy, and progress toward establishing zero-waste ecosystems.

Economically, WasteWise transforms waste into a valuable resource by converting donated waste materials into reusable and marketable products. This process helps generate economic value from materials that would otherwise be discarded while simultaneously reducing the cost of procuring fresh raw materials. The integration of digital reward wallets creates an incentive-based micro-reward system that motivates users to actively participate in waste donation and recycling activities. Furthermore, the platform can support the growth of green entrepreneurship, sustainable product markets, and circular economy-based enterprises. Economic benefits associated with WasteWise include value creation through recycling and upcycling, reduced procurement costs, development of sustainable marketplaces, generation of green jobs, encouragement of circular economy businesses, and the establishment of an incentivized circular ecosystem[29].

On the social front, WasteWise promotes active citizen participation in waste management and sustainable practices by encouraging individuals and communities to contribute to recycling and circular activities. The reward-based system motivates users to engage responsibly in waste segregation and donation while also increasing awareness about environmental sustainability and resource recovery. Instead of being passive consumers, citizens become active participants in circular economy processes, thereby strengthening community involvement and environmental responsibility. The social impact of the platform includes increased public participation in recycling programs, positive behavioral change toward sustainable consumption, enhanced environmental awareness, stronger community participation in circular activities, and greater citizen engagement in sustainability initiatives through incentivization[30].

Fig. 6 Representation of application of the circular economy

VI. RESULT AND DISCUSSION

The proposed WasteWise concept demonstrates the potential application of innovative technologies and modern sustainability practices to implement a circular economy model through waste donation, incentive-based participation, resource recovery, and sustainable commerce. Unlike traditional waste management systems that primarily focus on waste collection and disposal, the proposed model emphasizes transforming waste into value-added resources and reintegrating them into the production and consumption cycle. In doing so, the platform contributes toward the development of zero-waste circular systems that encourage continuous reuse and recycling of materials[31].

The analysis reveals that incentive-driven participation can serve as an effective solution to one of the major challenges associated with circular economy implementation, namely low consumer engagement. By offering rewards for proper waste segregation, donation, and the purchase of sustainably manufactured products, the platform motivates users to adopt environmentally responsible behaviors and change their waste management and consumption habits[32]. This approach not only increases participation rates but also strengthens awareness regarding sustainability and resource conservation.

Another distinguishing aspect of the proposed system is the integration of a digital marketplace. In the WasteWise model, waste management and sustainable commerce are interconnected rather than functioning as separate activities. This integration creates a circular value chain in which waste materials are converted into reusable products and reintroduced into the economy through an online marketplace. Such an approach supports the concept of resource circularity while promoting sustainable consumerism[33].

From an environmental perspective, the WasteWise platform aims to reduce dependency on landfills, improve resource utilization efficiency, and minimize the harmful environmental effects associated with excessive resource extraction and improper waste disposal practices. Economically, the model creates opportunities for green entrepreneurship and sustainable businesses by encouraging waste-to-product conversion and the manufacturing of eco-friendly products. These activities can generate employment opportunities while also supporting sustainable economic growth[34].

Despite its potential advantages, the practical implementation of the proposed platform may involve several challenges. Efficient logistics operations are essential to ensure effective waste collection, transportation, and high-quality resource recovery. The success of the platform also depends heavily on public awareness, user participation, and willingness to engage in sustainable practices. Furthermore, large-scale implementation would require collaboration with multiple stakeholders, including recyclers, government bodies, sustainable product manufacturers, and environmental organizations. Technological challenges such as real-time waste monitoring, inventory management, and system integration must also be addressed to ensure smooth platform functionality[35].

Nevertheless, the proposed WasteWise concept possesses strong potential for future development as a scalable and technologydriven circular economy model supported by innovative digital solutions. Based on the analysis of the project, several recommendations can be proposed for future enhancement and implementation. The incorporation of advanced technologies such as Artificial Intelligence (AI), Internet of Things (IoT), and blockchain can significantly improve waste monitoring, automated waste sorting, predictive resource recovery, and supply chain traceability. These technologies can increase operational efficiency and transparency within the circular ecosystem. In addition, stronger and more diversified incentive mechanisms can be introduced to enhance user participation. Features such as gamification, loyalty programs, sustainability badges, and community leaderboards may motivate users to participate more actively in recycling and waste donation activities[36] .

Strategic partnerships with recycling companies, municipalities, non-governmental organizations, and sustainable product manufacturers can further strengthen the infrastructure required for scalable waste collection and circularity processes. The platform can also be expanded to include additional waste categories such as electronic waste, textile waste, and organic waste, thereby increasing its applicability and environmental impact. To improve public engagement, awareness campaigns and in-app educational features can be implemented to educate users about proper waste segregation techniques, circular economy concepts, and sustainable behavioral practices. Furthermore, WasteWise would benefit from a pilot implementation program that evaluates system performance using indicators such as the volume of waste collected, levels of user engagement, recycling efficiency, incentive redemption rates, and measures of environmental impact.

The proposed model also aligns well with smart city initiatives and circular economy policy frameworks, making it suitable for integration into municipal sustainability programs and urban environmental management systems. Future research directions may include prototype-based validation models, AI-driven waste classification algorithms, circular supply chain design for WasteWise studies on user acceptance of incentive-based waste management systems , and quantitative analysis of the sustainability impacts of digital circular platforms[37].

VII. CONCLUSION

During the process of conducting this study, the following digital technology, known as WasteWise, was suggested as an option for implementation of circular economy based on donation waste management, resource recovery, upcycling, and reuse of sustainable products. Using this approach will help to address certain limitations inherent to the use of traditional solutions based on waste recycling and disposal since WasteWise provides an opportunity for the transformation of various waste types such as paper and plastics into usable products.

Thus, the suggested system can contribute to citizen engagement in processes linked to the implementation of circular economy and sustainability due to the involvement of certain incentives and digital solutions. In particular, this tool will provide opportunities for the promotion of waste collection, reward generation, and sustainable e-commerce, which will be positive both from the ecological and economic viewpoints. The proposed system can be characterized by significant potential in terms of the implementation of a circular economy since it is useful from various aspects.

From the environmental perspective, the implementation of the system will allow reducing waste and conserving resources as well as preventing pollution. Economically, the suggested approach can contribute to value creation, green entrepreneurship, and circular economy. Furthermore, it will encourage citizens' engagement in these processes. Nevertheless, it should be noted that there are certain limitations related to the scalability, compatibility with current infrastructure, and user engagement. Despite this problem, smart technologies can help in resolving these issues.

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