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Exploring User Needs for a Household Compost Bag Kit Made from Used Banners Using a Human-Centered Design Approach

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ABSTRACT

Household organic waste remains the largest contributor to urban waste generation in Indonesia. Although it has the potential to be processed into compost, composting at the household level is not yet widely practiced. One of the reasons for this is the lack of practical, user-friendly facilities that meet users' needs. On the other hand, waste from used banners from various promotional activities continues to increase every year, and the majority of this has not yet been utilized optimally. In fact, this material is strong, water-resistant and has the potential to be recycled into functional products of practical value. This study aims to develop a design for a household compost bag kit made from used banners using a Human-Centered Design (HCD) approach. The selection of used banners as the primary material is based on their suitability for the product's functional requirements, while also serving as an application of the principle of upcycling. The research was conducted using qualitative methods through the stages of inspiration, ideation, and implementation. Data were collected through observation, in-depth interviews, and prototype evaluations involving prospective household users. The results of the study indicate that ease of use is the primary consideration for users when selecting a household composting device. Furthermore, the product's ability to control odors, ease of transport, and the availability of clear composting guidelines were also identified as important requirements expressed by respondents.

Keywords: *Human Centered Design, User needs, Sustainable Design, Composting Kit*

ABSTRAK

Sampah organik rumah tangga masih menjadi penyumbang terbesar timbulan sampah perkotaan di Indonesia. Meskipun memiliki potensi untuk diolah menjadi kompos, praktik pengomposan di tingkat rumah tangga belum banyak dilakukan. Salah satu penyebabnya adalah keterbatasan sarana yang praktis, mudah digunakan, dan sesuai dengan kebutuhan pengguna. Di sisi lain, limbah banner bekas dari berbagai kegiatan promosi terus bertambah setiap tahun dan sebagian besar belum dimanfaatkan secara optimal. Padahal, material ini memiliki karakteristik yang kuat, tahan air, dan berpotensi diolah kembali menjadi produk fungsional yang bernilai guna. Penelitian ini bertujuan mengembangkan desain kit tas kompos rumah tangga berbahan banner bekas dengan menggunakan pendekatan Human-Centered Design (HCD). Pemilihan banner bekas sebagai material utama didasarkan pada kesesuaiannya dengan kebutuhan fungsional produk sekaligus sebagai bentuk penerapan prinsip upcycling. Penelitian dilakukan dengan metode kualitatif melalui tahapan inspirasi, ideasi, dan implementasi. Data

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dikumpulkan melalui observasi, wawancara mendalam, serta evaluasi prototipe yang melibatkan calon pengguna rumah tangga. Hasil penelitian menunjukkan bahwa kemudahan penggunaan menjadi pertimbangan utama pengguna dalam memilih perangkat pengomposan rumah tangga. Selain itu, kemampuan produk dalam mengendalikan bau, kemudahan pemindahan, serta tersedianya panduan pengomposan yang jelas juga menjadi kebutuhan penting yang diungkapkan responden. Temuan penelitian menunjukkan bahwa banner bekas memiliki karakteristik material yang mampu mendukung kebutuhan tersebut sekaligus memberikan nilai tambah melalui pemanfaatan kembali material limbah. Penelitian ini menghasilkan kerangka perancangan yang dapat digunakan sebagai acuan dalam pengembangan solusi pengomposan rumah tangga yang lebih berkelanjutan, mudah diterima pengguna, dan berpotensi meningkatkan partisipasi masyarakat dalam pengelolaan sampah organik dari sumbernya.

Keywords: Human-Centered Design, User needs, Sustainable Design, Composting Kit

INTRODUCTION

Household waste management remains a persistent challenge faced by various regions in Indonesia. This obstacle is particularly evident in organic waste, which dominates and accounts for approximately 37% of the total officially processed national waste generation (BRIN, 2025). Although this type of waste holds significant potential to be processed into compost, the majority still ends up in landfills due to low waste segregation and processing practices at the household level (Caucci, 2020:6). Waste segregation is a fundamental step that needs to be taken by every household, yet its implementation has not yet become a habit for most people in Indonesia (Sembiring et al., 2024:1). Various studies show that the community faces a number of barriers when trying to compost independently. These obstacles include a limited understanding of the composting process, concerns about the emergence of unpleasant odors, spatial limitations in the home environment, and a lack of practical, easy-to-use facilities. In this context, design and art-based approaches are seen as highly promising ways to help overcome these behavioral barriers by developing facilities and products that are more tailored to user experiences and needs (Mutmainah & Wardani, 2024:20).

At the same time, used banner waste from the promotion and advertising sectors continues to grow every year. Most of this material ends up as trash even though it possesses excellent characteristics for reuse, such as being strong, water-resistant, and relatively durable. Various previous studies indicate that the development of waste management facilities in Indonesia still faces numerous hurdles, ranging from infrastructural limitations and technological readiness to social and economic factors that influence successful implementation (Mutmainah & Mameli, 2024:327). This study stems from two interconnected environmental issues: the high volume of household organic waste and the suboptimal utilization of used banner waste. These dual problems open up opportunities to present a design solution capable of addressing more than one issue at a time. Besides assisting organic waste management at the household level, the developed solution can also apply upcycling principles by transforming waste material into

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products with new functions and higher utility value. A similar approach has been applied in various design fields and has proven effective in increasing the value of used materials while raising public awareness of environmental issues (Pratama et al., 2024:512).

When reviewed from the actual condition (*das Sein*), composting practices have not yet become a habit for most households in Indonesia, even though organic waste constitutes the largest component of waste generation. Limited facilities, a lack of knowledge, and products that do not match user needs are some of the factors hindering its widespread adoption. Conversely, from a normative perspective (*das Sollen*), sustainable waste management demands the active involvement of the community in segregating and processing waste right from the source. Therefore, a solution is needed that not only functions technically but is also capable of adapting to user characteristics, needs, and habits so that it can be used sustainably. In this context, sustainable design principles relate not only to material selection but also encompass all design aspects that support environmental sustainability (Kartika et al., 2026).

Based on this background, this study poses three main questions. First, what needs and preferences do users have regarding a household compost bag kit? Second, what obstacles does the community face when composting in the household environment? Third, how can a compost bag kit made from used banners be designed to fit user needs through a Human-Centered Design approach? To answer these questions, this study applies a Human-Centered Design (HCD) approach that places the user as the primary focus in the design process. Through the stages of inspiration, ideation, and implementation, the study seeks to understand user needs more deeply, identify the various problems they face, and translate these findings into relevant and easy-to-use product designs. The purpose of this study is to identify user needs in household composting activities and develop a compost bag kit design made from used banners that fits those needs. Accordingly, the resulting product is expected to increase comfort, convenience, and public interest in independent composting.

A number of previous studies have discussed household waste management and various factors influencing community participation in waste segregation and processing activities. Kusumaningdyah & Ratri, (2021) emphasized the importance of a user-centered approach to the success of waste management programs. Mamun et al., (2020) showed that convenience and ease of use are crucial factors that influence the acceptance of eco-friendly products. Meanwhile, Bofylatos, (2022) explained that utilizing waste materials through a sustainable design approach can generate added value while supporting a circular economy. More recent research shows that successful household waste management is influenced by a combination of public knowledge, environmental awareness, active citizen participation, and government infrastructure support (Afnan et al., 2025:1). In addition, household behavior in waste management is also influenced by social norms, perceived behavioral control, and various

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institutional and infrastructural constraints still faced by the community (Amir et al., 2022:1). Recent experimental studies even show that changes in waste sorting behavior require interventions specifically designed according to user characteristics, for example through contextual and easy-to-understand visual campaigns and guidelines (Sembiring et al., 2024:1).

Nevertheless, research that specifically combines the Human-Centered Design approach with the utilization of used banners for the development of household compost bag kits is still very limited. Therefore, this study offers novelty in the form of developing a compost bag kit made from used banners designed based on user needs. This approach not only supports household organic waste management but also simultaneously applies the principles of upcycling and the circular economy (Crocker, 2012:20; Ellen MacArthur Foundation, 2020). Various studies show that upcycling is capable of producing products with higher added value while reducing dependence on new raw materials (Balu et al., 2022:1). The expected output of this research is the formulation of user need recommendations and the production of a viable household compost bag kit design made from used banners. These results are expected to serve as a reference for developing more sustainable household waste management products, increasing community participation in composting activities, and contributing to the simultaneous reduction of organic waste and banner waste.

METHOD

Research Approach

This study uses a design-based qualitative approach with a Human-Centered Design (HCD) framework. This approach places user needs, experiences, and aspirations as the primary foundation in the solution development process so that the resulting innovation is more easily accepted and stands a higher chance of being used sustainably (Papanek, 1971:23-40). Through HCD, designers can understand complex situations more deeply and identify the root causes of problems by focusing on the user experience. The user-centered approach has been widely applied in various design contexts, including product development that directly involves users through the stages of empathy, problem definition, ideation, prototyping, and testing (Wicaksono et al., 2025). In this study, the HCD principle is applied through an iterative process involving prototyping, testing, and continuous design refinement to ensure that the developed product truly matches user needs. Thus, the resulting design not only functions technically but is also easy to use and relevant to the challenges faced by the community in managing household organic waste (Lunag et al., 2021:16).

This study focuses on the early phase of HCD, which is the stage of deeply understanding users and their context of use. This stage was chosen because understanding user needs, behaviors, and environments forms a vital foundation in the human-oriented design process (Wang et al., 2024:1). Through this stage,

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the research attempts to identify the various problems faced by the community and discover opportunities for solution development in household organic waste management, particularly in urban areas (Sharma et al., 2024: 1).

Data Collection Techniques

In the initial phase of Human-Centered Design, the research focused on efforts to understand how users manage household waste, especially organic waste, in their daily lives. Observations were conducted on the behaviors, attitudes, experiences, and various constraints they faced in composting activities. Data were collected through in-depth interviews with prospective users. These interviews aimed to explore waste management habits and composting practices that had been carried out, understand public views on various available composting tools, and identify factors that cause composting practices to not yet be widely implemented at the household level.

In addition, interviews were also used to explore user needs for the product to be developed, their perceptions regarding the utilization of used banners as the primary material, and the motivations driving them to process organic waste independently. The information obtained from the experiences and perspectives of these users became an important basis for formulating design solutions that match the real conditions and needs of the community.

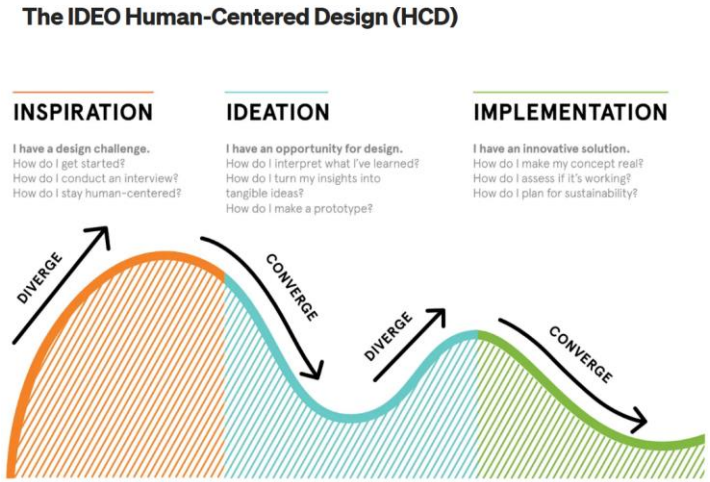


Figure 1 *Design Process in Human Centered Design Method*
(image source: https://juanfernandopacheco.medium.com/ideo-human-centered-design-hcd-design-process-a27eae26e3da)

Data Analysis

Data from the interviews were analyzed using a qualitative approach by tracing patterns, themes, and interrelationships between findings emerging from the participants' experiences. The analysis was carried out in stages to obtain a deeper understanding of user behavior in managing household organic waste. Some of the main aspects that became the focus of the analysis include household

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waste management behavior, motivations for composting, obstacles faced during the composting process, needs for compost bag kits, perceptions regarding the use of used banners as product material, and user price sensitivity.

Through this analytical process, the study sought to identify factors influencing the community's decision to segregate and process organic waste, while simultaneously formulating design requirements that have the potential to increase product acceptance and use in the future. Understanding user behavior and the factors driving responsible waste management are crucial aspects in developing sustainable waste management solutions (Widyatmika & Bolia, 2024:612).

Research Conceptual Framework

This study begins with the identification of problems related to household organic waste management and low levels of community participation in composting activities, especially in urban areas. After the problems were identified, the Human-Centered Design approach was used to explore user needs and experiences through in-depth interviews (Martin & Hanington, 2012:102-107). The collected data were then analyzed to identify various aspects affecting the use of household composting products, including user motivation, obstacles faced, functional product needs, perceptions toward the utilization of used banners as materials, and user preferences for expected features (Norman & Euchner, 2023:11-18). The results of this analysis were subsequently used as a basis for formulating design criteria and developing the concept of a compost bag kit made from used banners. With this approach, the resulting design is expected to meet user needs while applying sustainability principles through the reuse of waste materials.

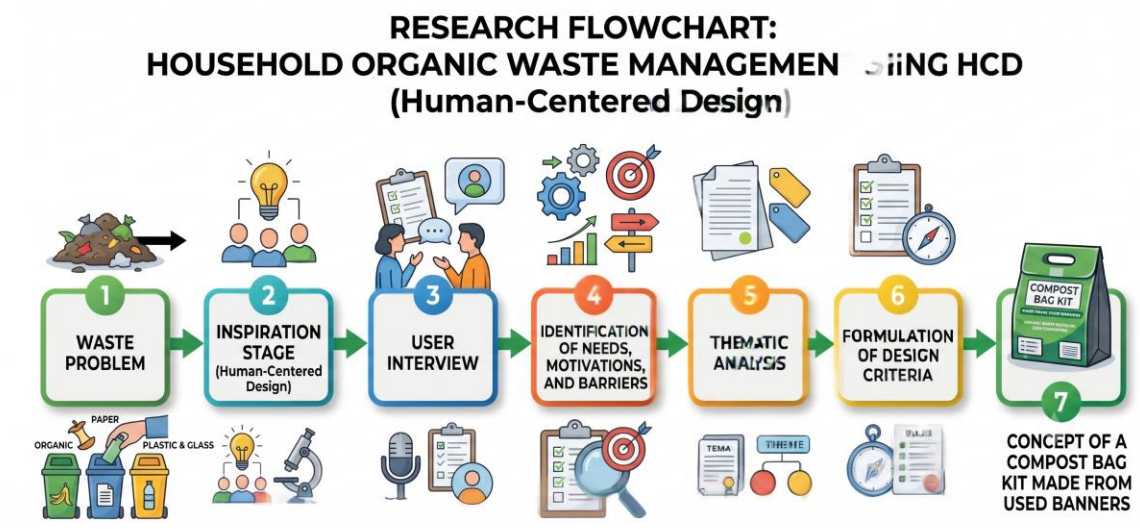


Figure 2 Research Flowchart
(image source: Image generated by OpenAI (2026) via Google Gemini with a simple visual description of the flowchart according to the research flow)

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RESULTS

This initial phase aims to understand the socio-economic and environmental contexts influencing waste disposal behavior, while serving as a foundation for effective intervention strategies. The following is a summary of individual interviews using a human-centered design approach in the form of a Compost Bag Kit.

Table 1 Summary of Interview Results

Respondent	*Habits/ Experience*	*Challenges*	*Needs*	*Perception of Banner Material*	*Price*	*Motivation*
SL	*Has been composting since 2018, separates organic and inorganic waste, and sends them to a waste bank.*	*Organic waste takes a long time to decompose, and dry leaves require extra effort*	*Leaf shredder, comfortable handle, easy to access during harvest.*	*Interested, but worried about durability, stuck zippers, and water leakage.*	*< IDR 100K*	*Environmental concern, family adaptation.*
ZK	*Separates waste, composts using a large bucket*	*Lack of dry materials, causes odor if not closed tightly.*	*Composter with good air circulation, not dependent on dry materials.*	*Interesting idea, but worried about rats.*	*IDR 20-30K*	*Belief that composting can reduce waste problems.*
TR	*Lives in a suburban village, access to garbage trucks is limited. Organic waste is used for chicken feed or compost holes.*	*Odor, maggots, lack of family support.*	*Odor controller, compact design, no need for frequent stirring.*	*Interested if the size is compact and resistant to animal disturbances*	*< IDR 50K*	*Being a role model for children*
NL	*Provides organic trash bins at home, separates inorganic waste into 4 categories,*	*Needs frequent stirring, odors if brown material is insufficient, compost yield is difficult to dry*	*A self-stirring compost bucket or a practical stirring tool.*	*Good for recycling used goods, interested because it is innovative, but worried about expensive prices.*	*IDR 50-75K*	*Protecting the earth and gaining family support.*

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	composts using a bucket.					
ID	*Sorts waste, food scraps for chickens, composter from used paint buckets.*	*Fishy odor, difficult to stir and harvest, smelly leachate.*	*Stirring tool, harvest window, user guide.*	*Supports the use of banner material as long as it is practical to use.*	*IDR 50-70K*	*Support from the community and sharing experiences.*
KL	*Just started sorting waste since the waste crisis in Jogja, buries organic waste in a hole.*	*Time, odor, having to go outside the house.*	*A tool that can be used both indoors and outdoors, anti-odor & pest-proof, equipped with wheels.*	*Worried about ink stains, durability, and rat bites*	*IDR 200-300K*	*Making fertilizer for the garden and saving costs.*
AD	*Implements the Prevent–Sort–Process principles, makes eco-enzyme and compost.*	*Odor, digging the ground, looking for dry leaves.*	*Organic waste shredder, compost stirrer, easy to access.*	*Banners are weak and easily bitten by rats. Wants an aesthetic, strong, and functional design.*	*± IDR 200K*	*Ease of process and environmental value.*

Source: Mutmainah et al. , 2025

The various challenges identified in the interviews, ranging from odor control and pest prevention to the need for an aeration system and a more practical compost harvesting mechanism, indicate that designing household composting solutions cannot focus solely on technical aspects. These findings reveal the complexity of user needs and underscore the importance of a design approach that truly stems from their experience. In this context, an iterative design process based on Human-Centered Design principles becomes essential to ensure that every piece of user feedback can be translated into the development of a product that is more relevant and easy to use. A similar approach has proven effective in various user-centered design studies because it allows for continuous refinement of solutions in accordance with needs that arise during the development process. Furthermore, the large proportion of organic waste, which reaches 83% of the total waste generated, highlights the urgency of developing composting solutions that are accessible, practical, and effective for the public (Glass et al., 2022:4).

Cross-analysis of the interview results shows the consistent emergence of several themes, while simultaneously showing differences in respondents' views regarding composting practices and the concept of the compost kit to be developed. This finding aligns with the participatory design approach that places

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the user as an important part of the product development process so that the resulting solution better matches real needs (Malik et al., 2024:501). For example, most respondents showed interest in using recycled materials such as used banners because they are considered more environmentally friendly. However, some respondents also expressed concerns regarding material durability and the possibility of contamination. This indicates the need for a design strategy capable of addressing user doubts, both through better material processing and through features that can increase trust in the product. In-depth interviews not only revealed various challenges faced by users but also showed the expectations, motivations, and concerns underlying their decisions in managing organic waste. By combining these diverse perspectives, cross-interview analysis provides a solid foundation for the development of solutions that are truly user-oriented.

User Needs and Preferences for Household Compost Bag Kits

In response to the various constraints they experienced during composting at home, participants identified a number of needs deemed important in a composting tool or kit. The most frequently mentioned need was the product's ability to control odors. For most respondents, odor control is not just an additional feature but a primary requirement for the composting system to be used comfortably in the home environment. In addition, users also expect features or materials capable of preventing the entry of pests so that the composting process can take place in a more hygienic and secure manner. Ease of carrying out various composting activities is also an important concern. Respondents want a system that allows them to add organic waste, stir compost materials, and harvest the resulting compost without difficulty and without causing a lot of mess.

To support this process, users assess that the presence of supporting tools such as an organic waste shredder, a stirring tool, and clear instructions for use will be highly helpful, especially for those who are just starting to compost. Besides functional aspects, visual aspects also become a consideration. Most respondents want a product that is compact, visually appealing, and can be placed in various types of dwellings without disrupting the room's aesthetics. These findings are consistent with research showing that perceived ease of use, convenience, and the user's ability to operate a system are important factors influencing household participation in waste management and the implementation of a zero-waste lifestyle (Salah El Haggar, 2007:12). Furthermore, the participatory design approach has also been proven capable of producing solutions that match user needs while increasing the chances of product adoption in daily life.

Regarding the idea of using used banners as the main material for the compost kit, participants showed mixed responses. Some respondents viewed the utilization of used banners as a creative and eco-friendly idea because it is capable of giving a new function to material previously considered waste. On the other hand, several participants expressed concerns regarding the functional aspects of the material. The most frequently arising concern related to the material's resistance to moisture, long-term safety of use, the possible presence of ink

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residue, and its resistance to pest disturbances like rats.

These diverse responses show that the acceptance of recycled materials is determined not only by their sustainability value but also by the user's perception of the quality, safety, and performance of the material in daily use. Therefore, aspects of material durability and safety need to be proven and well-communicated to prospective users so that trust in the product can be established. This finding aligns with the view that the successful implementation of circular economy-based products depends not only on material innovation but also on the design's ability to build a positive perception toward the resulting product (Braungart & McDonough, 2010:92-117). This is supported by research showing that the utilization of waste materials through an upcycling approach requires design communication strategies capable of increasing user acceptance of products made from recycled materials (Pratama et al., 2024:129).

Interview results show that price is one of the factors considered by users in deciding to use a household compost bag kit. Price estimates considered reasonable by respondents are quite diverse, ranging from IDR 20,000 to IDR 300,000. This difference indicates variations in economic capability, needs, and how users assess product benefits. Some respondents emphasized price affordability and prioritized the basic function of the product as a practical composting medium. This group tends to expect a product that is simple, easy to use, and accessible to various segments of society. Conversely, there were also respondents willing to pay a higher price if the product offered clear additional benefits. These benefits include better material quality, higher durability, attractive design, and a contribution to environmental preservation efforts through the use of recycled materials.

These findings indicate the existence of two distinct user groups: a price-oriented group and a value- and sustainability-oriented group. This condition opens up opportunities for multi-tiered product development to reach diverse user needs. This result is in line with research showing that consumer decisions to adopt sustainable products are influenced not only by price but also by perceived benefits, product quality, and the product's alignment with the environmental values they hold (Camilleri et al., 2023:8923). In addition, users' willingness to pay a higher price tends to increase when the functional and environmental benefits of a product can be well understood (Nguyen et al., 2021:289).

User Motivations and Constraints Faced by the Community

Interview results show that the decision to compost is based not only on practical and functional considerations but is also influenced by various personal and social motivations. One of the most frequently expressed motivations by respondents is awareness of the importance of protecting the environment. Many participants understand that organic waste processing at the household level can help reduce the volume of waste ending up in landfills. Therefore, composting

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activities are viewed as a simple yet tangible form of contribution to environmental preservation efforts. For some respondents, composting has even become part of efforts to adopt a more responsible and sustainable lifestyle.

In addition to environmental concern, the direct benefits obtained from composting outcomes also serve as a strong driver. Several respondents shared that the resulting compost can be utilized for home gardening needs, allowing organic waste that was previously discarded to be transformed into a useful resource. This process provides not only practical advantages but also brings personal satisfaction from being able to manage waste into a valuable product. Another quite prominent motivation relates to the role of the family in building environmental awareness. A number of respondents, particularly those with children, view composting activities as an effective educational tool to introduce sustainability values from an early age. By involving family members in the composting process, they hope to foster positive habits that can continue to be applied in daily life.

Beyond individual factors, social support also plays a role in encouraging user involvement. The surrounding environment that provides support, the existence of a community actively sharing experiences, and opportunities to learn from others' practices become additional sources of motivation for respondents to start or maintain composting activities. These findings show that the successful adoption of composting practices is determined not only by the characteristics of the product used but also by the environmental values believed by the user, the benefits they feel, and the social support available around them.

These findings correspond with research showing that intrinsic motivations, such as environmental concern, perceived personal benefits, and identity as an environmentally responsible individual, have a significant influence on public participation in sustainable waste management practices (Birkeland, 2002:182-187). Other research also confirms that family and community support play an important role in shaping sustainable environmental behavior because it is capable of strengthening individual commitment through social learning processes and collective experiences (Wang et al., 2024:1). Based on these findings, the development of compost bag kits is not enough to focus solely on technical and functional aspects. The product also needs to be designed to support user motivation through experiences that are meaningful, educational, and easy to integrate into daily activities.

Based on the interview results, users face a number of constraints that consistently appear in household composting practices. These constraints become factors influencing the interest and sustainability of using composting systems. The first challenge most frequently mentioned is the issue of odor and pests. Many respondents expressed concern about the emergence of unpleasant odors and the presence of flies, maggots, or rats during the composting process. This condition is considered to disrupt the comfort and cleanliness of the home

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environment, thus becoming a major barrier for some users.

The next challenge relates to the availability of dry materials or "brown" materials needed to maintain the balance of the composting process. Several respondents admitted difficulty in obtaining or maintaining a sufficient amount of dry materials. An imbalance between wet organic waste and dry materials often causes the composting process to run suboptimally and increases the risk of unwanted odors. Furthermore, the process of stirring, shredding waste, and harvesting compost is also considered quite troublesome. Manual stirring requires energy and time, while the absence of appropriate tools makes the process of shredding organic waste or extracting mature compost less practical. For some users, these activities feel quite heavy, thereby reducing their consistency in composting.

Limited space is also a widely found challenge, particularly in urban households. Respondents want a composting system that does not require a large area and can be easily placed in the home environment. Therefore, product size and ease of storage become important considerations in the design process. Overall, these findings show that users need composting solutions capable of reducing odor, preventing pests, simplifying the compost processing operation, and being practically used in dwellings with limited space. Organic waste management in urban areas of Indonesia still faces various obstacles hindering community participation in household composting activities. Currently available composting systems often generate unpleasant odors, have the potential to attract pests, require dry material management that is not always easy to do, and necessitate operational processes considered complicated by some users. This condition highlights the need to develop composting solutions that are easier to use, affordable, durable, and in line with the needs and characteristics of household users.

Table 2 Summary of Design Criteria

Target User	*Design Goal*	*Main Features*	*Limitations & Considerations*
Families concerned about the environment.	*To create a small and portable composting device suitable for homes with limited space.*	*Compost bag with good air circulation and an odor filter.*	***Material durability:*** *Upcycled banners must be resistant to moisture, pests, and tears.*
Young parents who want to teach their children about an eco-friendly lifestyle.	*To ensure odor does not spread and pests do not enter.*	*Easily accessible window with a strong zipper to harvest compost results*	***Price segmentation:*** *Basic and premium versions will be offered.*
Communities lacking adequate access to waste	*To simplify the entire composting process.*	*Option of wheels or handles to move it easily.*	***Cultural perception:*** *The design must look attractive both indoors and outdoors.*

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collection services			
	To use safe and strong recycled materials.	*Simple tool for stirring and shredding waste.*	***Educational value:*** *Clear instructions for children and beginners in composting are very important.*
	To offer prices that suit various budgets.	*Easy-to-understand guide with clear steps.*	
	To create a small and portable composting device suitable for homes with limited space.	*A starter pack to get started.*	

Source: Mutmainah et al., 2025

This holistic approach means that this composting device is not only useful; it is also an excellent way to instill sustainable habits across generations. Furthermore, by transforming waste into something valuable, this composting solution enhances long-term environmental benefits.

Designing a Compost Bag Kit Made from Used Banners that Aligns with User Needs Through a Human-Centered Design Approach

The design stages based on Human-Centered Design are detailed sequentially through three continuous visuals to address the real needs of users. The creative process begins in Figure 3, which displays the initial ideation phase in the form of manual sketch scribbles; here, five alternative bag shapes are explored along with a variety of practical supporting apparatuses such as a compost starter, manual guide, wheeled base, brand tag, and a waste shredder made from a used bucket. These ideas are subsequently matured in Figure 4 using AI sketch visualizations that specifically detail technical solutions to the public's daily constraints, such as compact dimensions for urban spaces, air ventilation holes, a tight pest-preventing zipper, a stirring tool, and a harvest access window at the bottom of the bag. This entire sequence culminates in Figure 5, which pairs the final plan visualization in the form of a 3D digital model (low-fidelity prototype) with an actual physical photograph of the initial prototype (Proof of Concept) of the compost bag kit made from used banners along with its iron waste stirring rod as an embodiment of the design solution ready for use.

Besaung: Journal of Art, Design and Culture
Volume 11 No.02 April-July 2026 | ISSN PRINT: 2502-8626 - ISSN ONLINE: 2549-4074
UIGM | DOI: 10.36982/jsdb.v11i2.7428 | http://ejournal.uigm.ac.id/index.php/Besaung

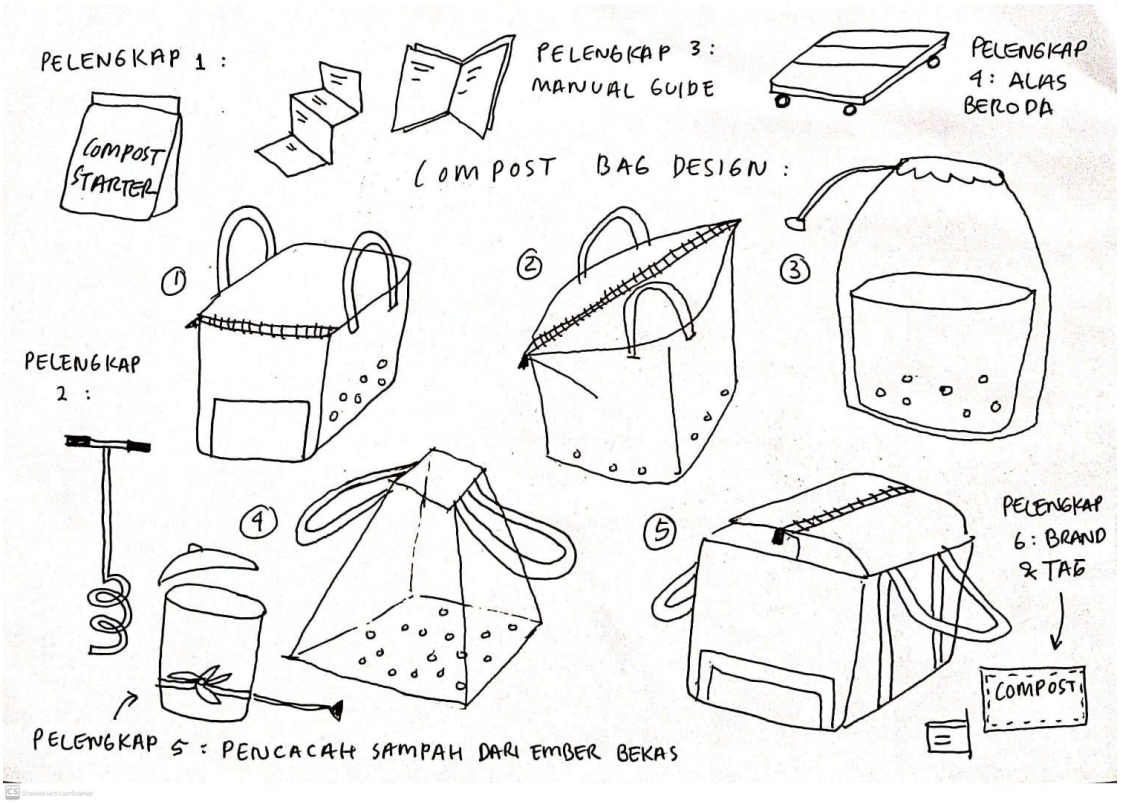


Figure 3 Ideation Image of Compost Bag Kit from Used Banner (Image source: Mutmainah, 2026)

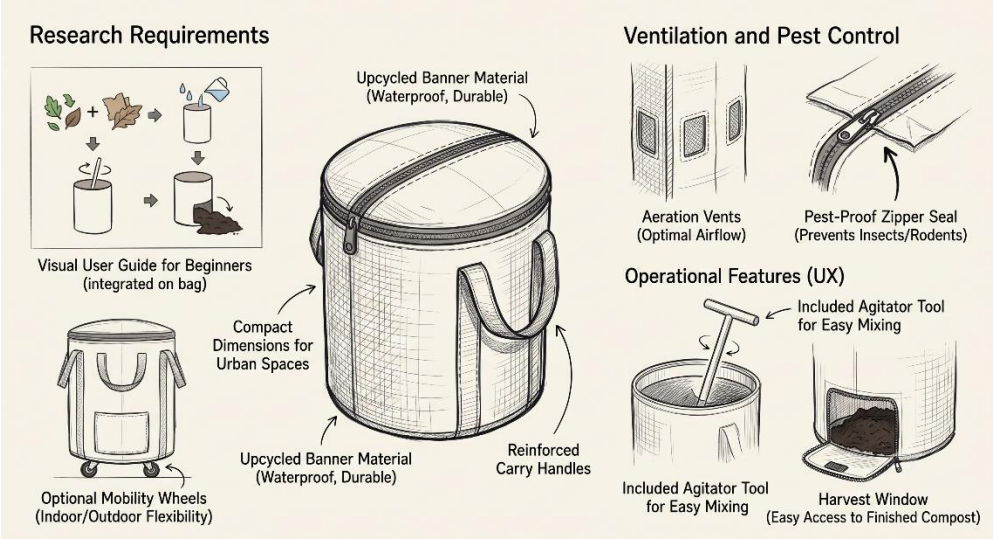


Figure 4 Initial Sketch of Compost Bag Kit from Used Banner Using AI (Image source: Image generated by OpenAI (2026) via Google Gemini with a minimalist sketch description based on the design brief in the study)

Besaung: Journal of Art, Design and Culture
Volume 11 No.02 April-July 2026 | ISSN PRINT: 2502-8626 - ISSN ONLINE: 2549-4074
UIGM | DOI: 10.36982/JSDB.v11i2.7428 | http://ejournal.uigm.ac.id/index.php/Besaung

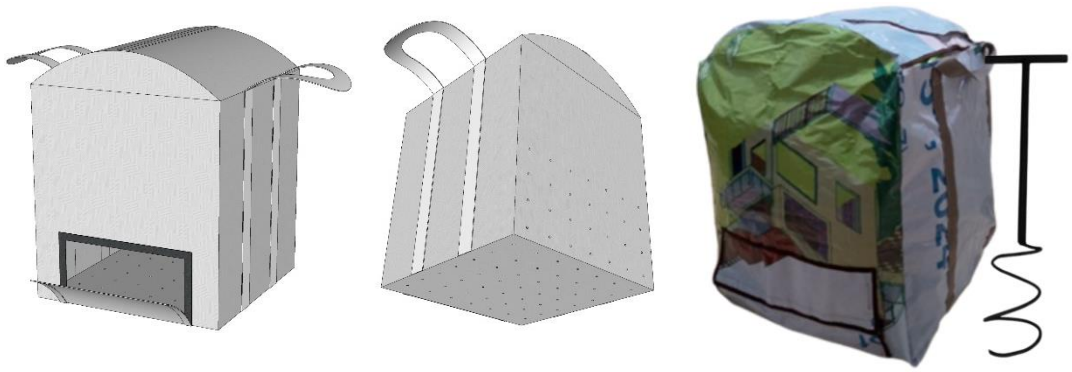


Figure 5 Final Plan Image in 3D (low-fidelity prototype) and Photo of Early Prototype (Proof of Concept PoC) of Compost Bag Kit From Used Banner along with Iron Waste Stirring Tool (Image source: Mutmainah, 2026)

DISCUSSION

Human-Centered Design Approach: Inspiration Phase

The first stage in the Human-Centered Design approach is the inspiration phase, which is the stage to deeply understand user experiences, needs, challenges, and expectations. At this stage, designers do not merely gather information but also strive to understand how users lead their daily activities and the factors influencing their decisions and behaviors. By understanding the context of the user's life, the problems faced can be mapped out more completely before solutions are formulated. The inspiration phase in this study was conducted through interviews with seven respondents who had different experiences in managing household organic waste. These interviews became the primary source for understanding the practices that had been carried out, the obstacles faced, and user expectations for composting solutions that better fit their needs.

Analysis of User Needs and Preferences for the Compost Bag Kit

The interview results show that each respondent has different experiences and household conditions in managing organic waste. Several respondents, such as SL and AD, have long been composting using various methods they learned independently. Conversely, respondents like KL only started sorting waste after the waste crisis occurred in Yogyakarta, so their experience in waste management is still relatively limited. Meanwhile, NL and ID utilized used buckets as compost containers due to limited land, while TR chose a simpler approach by utilizing livestock and ground holes as part of their organic waste management system.

These differences show that waste management practices cannot be separated from the conditions of each household. The availability of space, prior experience, facilities owned, and daily habits influence how users process organic waste. This finding is consistent with research stating that household waste management practices are highly influenced by socio-economic characteristics, housing conditions, and the daily routines of users. These factors also determine

Volume 11 No.02 April-July 2026 | ISSN PRINT: 2502-8626 - ISSN ONLINE: 2549-4074
UIGM | DOI: 10.36982/jsdb.v11i2.7428 | http://ejournal.uigm.ac.id/index.php/Besaung

the level of community participation in waste segregation and organic waste (Loan et al., 2019:65).

In general, respondents want a solution that is practical, easy to use, capable of controlling odors, resistant to pest disturbances, and easy to move according to needs. These expectations emerge as a direct response to the various constraints they experienced while carrying out composting activities. Some of the most frequently mentioned features include an effective ventilation system, ideally equipped with an odor control mechanism, a harvest window to facilitate the extraction of mature compost, a sturdy handle, and wheels that allow the product to be moved more easily. In addition, respondents also expect supporting devices such as an organic waste shredder, a stirring tool, and a clear user guide so that the composting process can be carried out more simply and directionally.

The need for a user guide became an interesting finding. For some respondents, especially those who are just starting to compost, easy-to-understand visual information is considered just as important as the product's function itself. This finding aligns with research showing that clear visual guidelines can increase understanding and encourage changes in public behavior regarding segregation and household waste management activities (Sembiring et al., 2024:100185).From the economic side, the interview results show a fairly wide variation in price preferences. Some respondents want a simple and affordable product within the price range of IDR 20,000 to IDR 75,000. On the other hand, there is a group of users willing to pay a higher price, around IDR 200,000 to IDR 300,000, if the product offers good material quality, an attractive design, and additional features that provide greater comfort.

This difference in preferences indicates the existence of several user segments with different needs and expectations. In the context of sustainable product design, this condition demonstrates the importance of a segmented approach so that the developed solution can adjust to the needs of users from various backgrounds, whether in terms of function, aesthetics, or economic capability (Norman & Euchner, 2023:11). Overall, respondents want a product that is practical, functional, easy to access, and capable of providing a more comfortable composting experience compared to the methods they currently use.

Identification of Constraints and Public Behavior in Household Composting

The interviews also revealed a number of challenges consistently experienced by users. The problems that most frequently emerged were unpleasant odors and the presence of pests such as flies, maggots, and rats. For some respondents, these two issues became the primary reason why composting activities felt difficult to maintain in the long run. Odor control itself is a common technical challenge found in composting systems because it is highly dependent on the balance of aeration and moisture during the decomposition process

Volume 11 No.02 April-July 2026 | ISSN PRINT: 2502-8626 - ISSN ONLINE: 2549-4074
UIGM | DOI: 10.36982/JSDB.V11I2.7428 | http://ejournal.uigm.ac.id/index.php/Besaung

(Elsabbagh et al., 2025:37).

In addition, many respondents admitted to facing difficulties in obtaining dry materials or "brown" materials needed to maintain the balance of the composting process. When the material composition is unbalanced, the decomposition process becomes suboptimal and frequently triggers unwanted odors. Another challenge relates to the operational activities of composting itself. Several respondents stated that the process of stirring, shredding waste, and harvesting compost requires a significant amount of time and effort. This condition is felt even more when the supporting tools used are inadequate. Limited space in urban homes is also a constraint of its own because not all users have a sufficient area to place a large-sized composting system.

In addition to technical factors, support from family members also influences the sustainability of composting practices. Some respondents received full support from family members, while others faced more varied situations. This finding shows that household organic waste management is not only related to the technology or facilities used but is also influenced by social factors and household life dynamics. This perspective is in line with the view that the success of a composting system heavily depends on its alignment with user behavior, living environment conditions, and available social support (World Bank Group, 2026).

An understanding of these various challenges forms an important basis for the design process. By understanding the obstacles actually experienced by users, the developed solution does not only focus on improving technical functions but is also capable of answering practical needs arising in daily life. This kind of approach is crucial for producing composting systems that are easier to use, relevant to the user's context, and stand a greater chance of being applied sustainably (Lunag et al., 2021:16). The interview results also show that user motivation in managing organic waste is based not only on the practical benefits obtained but is also influenced by personal and social values they believe in. Environmental awareness became one of the most dominant motivations. Many respondents view composting activities as a simple way to reduce the amount of waste ending up in landfills while contributing to environmental preservation.

In addition to environmental motivation, practical benefits also serve as a strong reason. Several respondents compost because they want to produce organic fertilizer for home gardening needs. The ability to transform waste into a useful resource provides a certain satisfaction while increasing the utility value of the waste management activities they perform (Penalba-Sánchez et al., 2023:1316634). The family aspect also emerged as an important factor in driving user involvement. A number of respondents see composting activities as a means to provide an example to children regarding the importance of protecting the environment and implementing a sustainable lifestyle. By involving family members in the composting process, they hope these values can grow into a sustainable habit in the future (Crocker & Lehmann, 2013:33).

Volume 11 No.02 April-July 2026 | ISSN PRINT: 2502-8626 - ISSN ONLINE: 2549-4074
UIGM | DOI: 10.36982/jsdb.v11i2.7428 | http://ejournal.uigm.ac.id/index.php/Besaung

Furthermore, several respondents emphasized the importance of social interaction and community support. The opportunity to share experiences, learn from others' practices, and get involved in environmental activities together with the surrounding community becomes an additional source of motivation in conducting composting activities. This finding aligns with research showing that collective values and a spirit of togetherness play an important role in maintaining public participation in community-based waste management programs (Masjhoer, 2025:14). The variety of motivations found shows that household composting practices are influenced by a combination of environmental, social, educational, and practical benefit factors. In many cases, these factors even exert a greater influence compared to economic incentives alone (Widyatmika & Bolia, 2023:1608). Therefore, understanding user motivation becomes an important step in designing interventions that are not only technically effective but also aligned with the values they hold, thereby fostering long-term involvement (Loan et al., 2019:65).This finding also indicates that the compost bag kit can play a broader role than just a waste management tool. This product is expected to potentially become an environmental education medium as well as a symbol of care for sustainability that can be used in daily life.

Design Concept of a Household Compost Bag Kit with a Human-Centered Design (HCD) Approach

The inspiration phase generated a number of important insights that formed the basis for the design development process in the subsequent stage. One of the main findings is that the developed product must be able to make the composting process feel easier, more comfortable, and not add to the user's burden. The designed solution needs to help address the various identified constraints, such as odor problems, the presence of pests, limited space, and the complexity of the composting process itself (Lunag et al., 2021:1).

The next insight relates to the diversity of user conditions. The interview results show that each household has a different background, facilities, experiences, and lifestyle. Therefore, the developed solution needs to have a sufficiently high level of flexibility so that it can be used in various contexts. This finding aligns with research showing that waste management behavior in urban environments is heavily influenced by different perceptions of behavioral control and social norms in each community group (Amir et al., 2022:2). In addition, variations in preferences regarding price and features indicate an opportunity to develop products in several tiers or categories. Some users prioritize affordability and basic functions, while other groups desire a more attractive design with additional features that enhance ease of use. This condition opens up opportunities for product development that is more segmented according to market needs.

Another equally important finding is the strong role of social and educational values in driving user involvement. Environmental concern, the family's role in

Volume 11 No.02 April-July 2026 | ISSN PRINT: 2502-8626 - ISSN ONLINE: 2549-4074
UIGM | DOI: 10.36982/JSDB.v11i2.7428 | http://ejournal.uigm.ac.id/index.php/Besaung

sustainability education, and the spirit of sharing within the community emerged as factors consistently influencing respondents' decisions to compost (Loan et al., 2019:65). This shows that the success of a product is determined not only by its technical quality but also by its ability to build an emotional and social connection with the user (Laplace Ricelli, 2023:12).

Beyond product aspects, several studies show that systemic support also influences the success of composting programs. The availability of easily accessible composting facilities, guarantees that sorted waste will not be remixed during the collection process, and the presence of policy support can increase public trust and participation in waste management activities (Widyatmika & Bolia, 2024:612). ther research also indicates that the provision of supporting facilities and certain incentives can drive household participation, although its effectiveness differs across user groups. Younger individuals and groups with lower income levels tend to be more responsive to the economic benefits obtained from composting activities (Höpfl et al., 2024:2). This finding reinforces the importance of an adaptive approach that considers diverse user characteristics in designing sustainable waste management solutions.

CONCLUSION

This study successfully formulated user design requirements as the primary foundation in creating a household compost bag kit based on Human-Centered Design (HCD). Through this approach, it is clear that the success of an independent composting tool is not solely a matter of technical sophistication, but rather the extent to which the product is able to blend with the habits, anxieties, and space realities of the community's daily lives.

As an answer to these needs, the compost bag kit concept is designed as a cohesive and problem-solving physical system. In terms of the bag structure, it is made compact and easy to move so that it is friendly to urban homes with minimal land, utilizing used banner material that is naturally resilient to water and moisture. Classic problems such as unpleasant odors and environmental disturbances are resolved through a maintained air ventilation system, combined with a tight zipper-based insect cover to cut off access for flies, maggots, and rats. The public's reluctance to stir organic waste is bypassed through a more hygienic stirring mechanism using practical auxiliary tools to minimize direct physical contact. Mobility or the bag relocation process also becomes lighter thanks to a secure handle and the option to install bottom wheels. Meanwhile, for compost harvesting, the designer incorporated a special access window at the bottom of the bag that is easy to open and close so that mature fertilizer can be extracted cleanly without dirtying the floor. To prevent composting from being confusing, the entire system is equipped with a communicative visual guide for beginners.

On the other hand, the experiment utilizing used banners proves that residual promotional materials have great potential to move up the ladder (upcycling). However, the greatest challenge lies in public perception; the design

Volume 11 No.02 April-July 2026 | ISSN PRINT: 2502-8626 - ISSN ONLINE: 2549-4074
UIGM | DOI: 10.36982/jsdb.v11i2.7428 | http://ejournal.uigm.ac.id/index.php/Besaung

must be able to prove and build user trust that this recycled material is safe, sturdy, and long-lasting. Ultimately, the design criteria locked in this study are expected to become a strong blueprint for the phase of concept development, prototype fabrication, and product testing in subsequent research.

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UIGM | DOI: 10.36982/JSDB.v11i2.7428 | http://ejournal.uigm.ac.id/index.php/Besaung

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