



Design-led upcycling innovation via appropriate technology: A participatory study of women artisan in Jakarta's circular economy

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Abstract.

This study aims to discover how design-oriented community interventions can enable women artisans to transform plastic waste into increased economic value. The study was performed using a participatory methodology with Komunitas Pengrajin Rasyid, a collective of female artisans in Setu, Cipayung, East Jakarta. The program included five phases: socializing, training, technology implementation, mentorship, and sustainability planning. Data collection methodologies include observation, interviews, and documentation. Findings indicate that the implementation of suitable technologies, specifically the gas oven and pressing machine, markedly advancement from earlier single material weaving techniques, demonstrating the potential of material fusion to improve product stability, durability, and aesthetic value. The community developed three novel product prototypes; coasters, tableware holders, and tissue boxes exhibiting improved durability and aesthetic appeal. The introduction of clearer organizational structures, bookkeeping processes, and visual branding improved managerial and marketing capabilities. The results demonstrate that even minor technology and design modifications can yield significant social, economic, and environmental effects, hence enhancing the viability of community-based circular organizations. Future research should focus on longitudinal market testing of the new visual branding to assess its effectiveness, alongside consumer perception studies that evaluate how recycled products are interpreted in different market segments.

Keywords: Design-Led Upcycling, Visual Communication Design, Plastic Appropriate Technology, Craft-Design Ecosystem, Gender Equity/ Empowerment

Introduction

The growing amount of plastic garbage presents a significant environmental and social challenge worldwide, with Indonesia being no exception. Currently, fewer than 10–15% of plastic waste is formally recycled (GR & FCI, 2025), with the remainder frequently disposed of in landfills, waterways, or informal waste streams. In metropolitan areas such as East Jakarta, this pressure becomes more severe due to high population density and consumption behaviors. Local community driven programs that combine design, technology, and entrepreneurship have the potential to turn garbage into something useful while also creating jobs and reducing environmental impact.

This article covers a community-focused creative effort which involves Komunitas Pengrajin Rasyid (hereinafter "Rasyid"), a collective of female craftsmen located in Setu, Cipayung District, East Jakarta. The community initially focused on transforming post-consumer coffee sachets, a flexible, multi-layered material typically used in weaving, into functional household products. However, limitations in material consistency and quality inherent to sachet-based weaving prompted a strategic

shift toward using plastic bottle caps (predominantly HDPE and PP) as the primary raw material. This transition represents a fundamental methodological and design decision, enabling the adoption of melting and molding techniques that produce more consistent, durable, and differentiated products. By redefining its material strategy, the community sought to overcome the constraints of traditional weaving and enhance both the technical quality and aesthetic value of its recycled product line.

These female artisans specialize in transforming packaging trash into various products, including shopping bags, wallets, mats, storage containers, tissue holders, and souvenirs and accessories such as keychains. Since 2022, their actions have been conducted constantly, driven by economic and environmental factors. These efforts aim to boost household income while simultaneously aiding in the reduction of plastic garbage that pollutes their environment.

The Rasyid community demonstrates discipline and a commitment to craftsmanship, however their operations are generally unorganized and inconsistent. They obtain raw materials, primarily used beverage sachets from external suppliers (for example, warung stall) via informal agreements, frequently receiving inconsistent quantities and unpredictable delivery timelines. Consequently, the output quantities are unpredictable and heavily depend on the uncertain supply of raw resources.

The production process starts with the cleaning and preparation of plastic packaging waste received from powdered beverage vendors. The cleansed materials are then cut, assembled, and woven to create alternative sheet-like substances that replicate textile surfaces. These are then turned into functional home products, including shopping bags, wallets, small storage containers, tissue boxes, and mats measuring around 2 × 1 meters. The design methodology emphasizes minimalism and functionality, employing the original colors and patterns of the packaging as a unique visual element.

The community members demonstrate decent weaving skills. However, inconsistencies in product quality frequently emerged due to the varied nature of coffee-sachet waste, ranging from variations in polymer composition and multilayer thickness, to residual dirt adhesion, printing-ink differences, and irregular sachet dimensions. These differences in materials made it hard to clean the sachets using the same method, cut them into standardized strips, or produce woven sheets with consistent size, rigidity, and color patterns. As a result, achieving stable product quality became increasingly challenging. These limitations provided a strong rationale for shifting to plastic bottle caps (primarily HDPE and PP), which offer uniform polymer characteristics, predictable melting behavior, and higher structural stability, making them more suitable for controlled molding processes. The switch to bottle caps therefore represents a strategic material decision aimed at improving consistency, enhancing product durability, and enabling greater design innovation.

Craftswomen are only able to process materials using simple weaving techniques, without product innovation based on fusion or material combinations (Anooja & Kumar, 2025; Blundel & Smith, 2013; Rima Dwi Novianawati & Irma Yuliani, 2025). This results in limited product variety and a tendency for monotony, making them less attractive to a market that demands innovation and differentiation. This issue is not exclusive to the Rasyid community. It is also equally common among recycling MSMEs in Indonesia. Research conducted by Gumulya et al. (2020) and Kusnaedi (2021) indicates that limited access to basic technology obstructs the advancement of plastic crafts into a high value creative sector.

Not only do the limited availability of high-quality and sustainable plastic waste as a raw material and the lack of modern production technology contribute to decreased efficiency and increased production costs, but the lack of experience in business management and digital marketing also limits their capacity to compete in broader markets, (Raya et al., 2021; Sharabati et al., 2024). In the absence of appropriate management assistance, the business will fail to achieve its maximum potential.

Nevertheless, significant opportunities for expansion are available. East Jakarta generates approximately 844,252.43 tons of waste per year, of which 14% consists of plastic, representing a large and largely untapped resource stream that underscores the environmental urgency and relevance of the intervention (see table 1). The growing public awareness of sustainable lifestyles presents favorable market opportunities for eco-friendly products (Camilleri et al., 2023; Reddy et al., 2023). The long term potential is in collaborations with stakeholders, including government entities, private

entities with CSR initiatives, and waste banks, which could enhance raw material supply chains and facilitate market access (Istiyani et al., 2024; Valdez-Juárez et al., 2018).

Table 1. Total Volume of Waste Generation in DKI Jakarta in 2022

No	Region	Waste generation
1	Administrative city of East Jakarta	844,252.43
2	Administrative city of West Jakarta	738,547.77
3	Administrative city of South Jakarta	713,300.85
4	Administrative city of North Jakarta	499,480.75
5	Administrative city of Central Jakarta	310,268.53
6	Administrative city of Kep. Seribu	6,531.08
Total Volume		3,112,381.04

Source: (Annur, 2023)

Despite their artisanal expertise, with the community production system is disorganized and lacks standardization and managerial ability for collective coordination remains constrained, their marketing channels primarily consist of informal methods consignment sales via local kiosks, community bazaars, or direct buyer engagement with a lack of systematic branding or digital outreach. However, their position in Setu, Cipayung, East Jakarta, offers a strategic foundation for establishing a more organized, small-scale circular enterprise. With sufficient institutional and technological assistance, the Rasyid community may become an anchored participant in Jakarta's recycling ecosystem, lowering plastic waste and generating sustainable green employment through a community-oriented circular economy model.

In 2025, a supported program funded by the Ministry of Education, Culture, Research, and Technology (Kemendikbudristek) executed a three-phase training program involving (1) marketing and branding (focusing on STP: Segmenting, Targeting, Positioning), (2) production (plastic upcycling, weaving, cleaning, and refining), and (3) visual communication and product innovation. The third training is the final phase, resulting in the development of three new recycled plastic items with improved aesthetic appeal and market value.

Despite increasing knowledge of the concepts of the circular economy, numerous small-scale artisan businesses find it challenging to turn sustainable ambitions into commercial success. In Rasyid's setting, production is mostly manual and labor intensive, leading to low volume, inconsistent quality, and challenges in maintaining consistency. They also lack brand identification, digital marketing capabilities, and well-organized value chains. Without these capabilities, their recycled products are not very competitive in larger urban markets, even though they have benefits for the environment.

In the larger Indonesian context, informal recyclers (typically women) are very important for collecting and sorting plastic, but they are also quite vulnerable because they do not earn much money, are not recognized, are at risk of getting sick, and are pushed to the edges of society (GR & FCI, 2025). Interventions that empower these actors through design and entrepreneurial support are increasingly recognized as crucial for transforming plastic waste management systems from simple collection and disposal to value-creation loops (Pambudi et al., 2025).

Previous studies on waste and the circular economy highlight that technological recycling alone is not sufficient. The success factors often depend on social, institutional, and design aspects. A study on the involvement of the public in plastic waste management in Indonesia revealed an important relationship between the readiness to recycle and factors such as community awareness, institutional support, and the accessibility of technical infrastructure (Pambudi et al., 2025). Research on plastic weaving in Indonesia highlight that women's craft based recycling is not an entirely new practice but is limited by insufficient design innovation and market positioning (Damayanti et al., 2024).

Therefore, the Rasyid program aims to fill this gap by integrating industrial design, visual communication strategies, and suitable technological instruments within a participatory framework. The objective is to not only reduce plastic waste but also to enhance the value chain of artisan recycled products, making them appealing, recognized and economically viable.

Prior to exploring the significance of the research, this paper initially delineates its primary guiding question. This research is motivated by the question: “In what ways does the integration of design-led product innovation and suitable technology influence the production efficiency, managerial capacity, and market positioning of women-led upcycling cooperatives operating within the informal sector?” This question articulates the methodological decisions of the study and offers a consistent basis for assessing the impact of the intervention across technological, managerial, and market dimensions.

Subsequently, the study explores various aspects of importance. The initial dimension regards environmental significance, specifically the contribution of community-driven upcycling initiatives in mitigating plastic waste and supporting local circular economy practices. It also demonstrates how small communities can enhance formal waste management infrastructure through upcycling initiatives aligned with circular economy principles (Ratnasari & Aschemann, 2024).

The second aspect is empowerment and gender equity. The target demographic, female artisans, is a population frequently ignored in formal waste management systems. Equipping them with design and business competencies can facilitate a transformation in power dynamics and improve livelihoods. Research on gender specific waste issues indicates that female recyclers have unique social and economic obstacles (GR & FCI, 2025), making supportive measures especially crucial.

The final aspect is design-led innovation within circular practices. The combination of industrial product design, visual branding, and suitable technology provides a comprehensive framework for expanding circular artisan organizations. Previous studies emphasize recycling activities and technical methods, with limited focus on the design-to-market narrative.

Methods

This section discusses the research methodologies used to investigate the challenges met by the Rasyid community, formulate suitable treatments and assess the effectiveness of those treatments. The methodology combines participatory, descriptive, and practical methodologies to fully capture both technical and social dimensions of community empowerment. The approach comprises five primary phases: Socialization, Training, Technology Implementation, Mentorship and Assessment, and Program Sustainability, performed using a combination of qualitative and quantitative methods.

The study used a community based participatory research methodology, positioning the Rasyid artisans as active collaborators instead of passive users. This method guarantees that interventions address real, context specific issues faced by the community. The study concentrates on two principal aspects of development production optimization and marketing growth, both aimed at reinforcing a small-scale circular economy ecosystem in Setu, Cipayung, East Jakarta.

Data collection was conducted using both primary and secondary sources. Primary data were collected through direct observation, structured and semi-structured interviews, and focus group discussions with ten core members of the Rasyid community, who served as the key informants for the initial needs assessment and qualitative exploration. These ten members represent the original artisan group active since 2022, whereas the full training cohort consisted of twenty-four participants who joined the capacity-building sessions. This distinction is significant as the qualitative insights were obtained from the core group (10 people initiator), whilst the pre- and post-training quantitative evaluations of skills and production outputs were performed with the whole group (approximately 24 members) to assess the overall impact of the intervention.

Observations were performed throughout the production process to track workflow, tool utilization, and output quality. Interviews and focus group discussions examined the artists' understanding of raw material acquisition, production methods, marketing strategies, and management procedures. Qualitative insights were supplemented with survey data on waste generation and composition from the Jakarta Environmental Agency, indicating 844,252,43 tons of garbage in East Jakarta, with 14 percent comprising plastic.

Secondary data comprised statistical records from Badan Pusat Statistik and pertinent academic literature about community empowerment, circular economy, and small enterprise management. All data were cross verified to guarantee validity and reliability. Thematic analysis was used to classify qualitative data into production, management, and marketing categories. Coding was conducted to uncover ongoing concerns, including supply inconsistencies, technological limitations, and inadequate branding. Descriptive statistics (such as means and percentages) were used to assess changes across clearly defined operational variables: productivity, measured as the number of units produced per artisan per week and sales volume, measured as total estimated monthly revenue and average selling price per product. These metrics were derived from community production logs, sales records, and cross-referenced with direct observation during the intervention period. The combined use of these methodologies facilitated a thorough comprehension of structural, operational, and behavioral limitations.

The implementation of the community-empowerment program followed five stages:

1. **Socialization:** A four-hour initial session introduced project objectives, timelines, and expected outputs while building commitment among participants.
2. **Training:** A series of workshops delivered 5-hour modules on sustainable product design, recycling techniques, market segmentation (STP & 4P), branding, and digital marketing using Canva and Instagram Ads.
3. **Technology Implementation:** Hands-on practice was conducted using the gas-powered melting oven (operating at a temperature range of 120–180°C, suitable for melting HDPE and PP) and a manual hydraulic pressing machine with a capacity of 1–2 tons of applied force and mold sizes ranging from 10 × 10 cm to 20 × 20 cm. These technical specifications are provided to enable other community design practitioners to replicate the process under similar conditions.
4. **Mentoring and Evaluation:** Continuous mentoring over one month to monitor technology adoption, design development, and marketing performance. Evaluation employed pre and post assessment of skills and production quantity.
5. **Sustainability Planning:** Facilitation of institutional transformation toward a registered UMKM or cooperative, ensuring easier access to funding, partnerships, and government support.

Data triangulation was employed across numerous sources (interviews, observations, and documentation) to guarantee trustworthiness. Member checking meetings were used with participants to confirm the accuracy of interpretations. Quantitative outcomes, including production output and social media measures, were confirmed by cross referencing community records and personal observation. All participants were apprised of the research aims, assured of confidentiality, and informed of their voluntary involvement. Informed consent was secured prior to any interview or documentation procedures. The study complies with the university research ethics requirements on community based activities.

Result and Discussion

Overview of Program Implementation

The intervention program with Komunitas Pengrajin Rasyid was implemented in five consecutive phases socializing, training, technology application, mentorship, and sustainability planning. The stages were intended to augment the craftsmen's competence in handling recycled materials, elevating product quality, and increasing market competitiveness. The program involved 24 women craftswomen who regularly participated in each session and actively contributed to talks, practical exercises, and collaborative work. The training sessions included marketing tactics, product design, and the implementation of suitable technologies, including the gas oven and pressing machine. Participants showed much passion and curiosity, frequently discussing ideas and assisting one another, so fostering a collaborative learning atmosphere.

Despite the emergence of several difficulties including limited digital literacy, disparities in technical knowledge, and time limitations because of household responsibilities, the participants' motivation remained high, driven by common values of caring for the environment and collective empowerment. The participatory approach implemented in the program fostered collaboration, enabling facilitators and artisans to collaboratively explore solutions and innovations. This inclusive approach increased the community's sense of ownership, along with the fundamental principles of community based participatory research, highlighting empowerment, the integration of local knowledge, and the sustainability of community initiatives.

Improvement of Product Capacity

The addition of gas oven and pressing machine technologies in the production process has significantly enhanced the efficiency, consistency, and innovative capacity of Komunitas Pengrajin Rasyid's recycling activities. These technologies expanded the variety of objects that might be produced, enabling artisans to make new things with increased value for use and greater artistic appeal. This innovation highlights how simple, suitable technology can transform traditional manual recycling methods into improved, design-focused processes that produce greater economic and aesthetic value.

Komunitas Pengrajin Rasyid and Paramadina University have achieved a significant milestone in the creation of unique, recycled household items through the development of coasters, tableware holders for utensils, and tissue holders. The new prototypes were created by integrating traditional craftsmanship with suitable technology, demonstrating the transformation of common plastic trash into usable and visually appealing products. The primary raw material utilized is plastic bottle caps, which are abundant and durable, making them appropriate for melting and remolding.

The producing method starts with the gathering and sorting of used bottle caps from various local sources, including residences and garbage collectors. The gathered caps are meticulously cleaned to eliminate dirt, labels, and adhesive remains that might disrupt the melting procedure. After washing, they are sun-dried to eradicate any residual moisture (as shown in Figure 1). This natural drying technique minimizes energy use while ensuring the plastic is sanitized and prepared for further processing.



Figure 1. Washing and sun-dried process

After drying, the bottle caps are crushed using a mechanical shredder, resulting in small plastic flakes or pellets (as shown in Figure 2). This stage is essential as smaller plastic particles melt consistently, resulting in smoother end products. The shredded material is subsequently placed into molds specifically constructed for each product type circular molds for coasters, rectangular molds for tissue holders, and partitioned molds for tableware containers. Each mold is delicately treated with an adhesive to avoid adhesion and ensure a clean finish.



Figure 2. Bottle caps being chrushed with mechanical shredder

The molds containing plastic flakes are subsequently positioned in a gas oven and heated for several minutes, enabling the consistent melting and fusion of the plastic. After being heated, the molds are carefully extracted and put into a pressing machine to attain a consistent thickness and a polished, dense surface.

The following stage in product development involves combining molded plastic components with woven materials to produce items that are both functional and aesthetically pleasing. This integration combines two separate methods; plastic molding utilizing gas oven and a pressing machine, and traditional weaving using used sachet strips. By integrating these techniques, artisans can create hybrid designs that show both solid foundations and artisanal complexity. Molded plastic bases can be combined with woven sides or decorative panels, creating coasters, baskets, or storage containers that exhibit improved texture, color diversity, and artistic value.

The prototype shown in Figure 3 consists of tableware holders and tissue boxes made from post-consumer coffee sachets and a molded plastic base produced from recycled bottle caps. The tableware holders measure approximately 10–11 cm in diameter and 14–15 cm in height, while the height of tissue box component measures approximately 22 cm (length) × 15 cm (width) × 12 cm (height). They are constructed using strips cut from multilayer metallized plastic sachets (primarily aluminum-laminate PET/PE composites). The sachet strips were manually folded and woven using a diagonal interlacing technique that provides structural flexibility while retaining the original color patterns of the packaging.

As for the tableware holders, the octagonal mold measures 14–15 cm across and the tableware holders' base plate measures 25 cm × 18 cm × 1.2 cm. They are both composed of shredded bottle caps made from HDPE (High-Density Polyethylene) and PP (Polypropylene). The base serves both as a stabilizing platform and as a contrasting visual element, showcasing the speckled aesthetic characteristic of mixed HDPE/PP flakes. This pressing stage ensures uniform thickness, smoother surfaces, and improved stability.

The combination of a rigid molded base with a lightweight woven container represents an advancement from earlier single material weaving techniques, demonstrating the potential of material fusion to improve product stability, durability, and aesthetic value. This hybrid approach also enables a wider range of product applications within the circular economy craft sector.

This innovative combination improves aesthetic appeal while preserving the product's sustainability and durability. This approach enables artisans to investigate novel possibilities for design and commercial areas, connecting wasted crafts with modern home decor. This phase signifies a substantial development in design-oriented circular products with enhanced economic and cultural attractiveness.



Figure 3. Combining molded plastic components with woven materials

The transition to a semi mechanized process utilizing suitable technology simple, cost effective, and adapted to local capabilities marks a significant advancement toward sustainable craft-based manufacturing. This fits with the principles of sustainable product design, emphasizing efficiency, material optimization, and durability. The Rasyid case illustrates that minor technological interventions can significantly influence productivity, quality, and market value, thereby advancing the overarching objectives of the circular economy by prolonging material life cycles and improving the economic sustainability of community-oriented recycling initiatives.

Improvement in Management Aspects

The program improved the managerial and financial practices of Rasyid by implementing fundamental ideas of production planning, cost documentation, and task allocation among members. Through mentorship sessions, the community developed a more defined organizational structure, assigning jobs such as production coordinator, materials handler, and marketing representative. This framework improved communication and accountability among the group, guaranteeing a more equitable distribution of tasks. From an academic point of view, these modifications correspond with the principles of small-business management and collaborative entrepreneurship, wherein organized coordination improves collective efficiency and sustains long-term economic viability. The implementation of fundamental bookkeeping and cost tracking techniques allowed members to gain a clearer comprehension of material costs, profit margins, and pricing strategies, a crucial advancement for business scalability. Nonetheless, other restrictions still exist, including the need for continuous mentorship and additional training in financial literacy and digital recordkeeping to guarantee that these management enhancements are maintained and incorporated into routine business practices.

Development of Marketing & Branding

The team from Universitas Paramadina and the Rasyid community agreed on the importance of developing a brand logo to enhance product recognition and raise consumer awareness. The logo was designed not only as a visual symbol but as a reflection of the core values of the Rasyid community, creativity, collaboration, and dedication to environmental sustainability. This collaborative branding initiative aims to improve the market positioning of Rasyid's recycled products and communicate a unique message about environmentally friendly craftsmanship to a wider audience.

The visual marketing and design training allowed the community to create a unique logo, an eco label, and original product packaging that express their identity as ecologically conscious artisans (Figure 4). A review of this logo must include more than its symbolic meaning; creativity, sustainability, and collaboration by providing a professional visual communication evaluation. The chosen color palette, characterized by dark and medium green, underscores principles of environmental sustainability, growth, and community development. These colors are deliberately selected to attract an adult female demographic desiring tranquility, reliability, and environmental consciousness. The

typography, a sleek modern sans-serif, improves readability and communicates professionalism, transparency, and organizational simplicity, features that reflect the identity of environmentally involved community groups. The design features a centered vertical arrangement that creates a distinct visual hierarchy: the icon at the top captures initial attention, while the logotype below enhances brand awareness. This harmonious composition emphasizes cohesion, organization, and dependability.

These graphic selections are directly aligned with the STP strategy. The segmentation targets women aged 30–50 involved in social and environmental initiatives; the focus is on mothers who participate in recycling and community empowerment; the positioning presents the brand as an elegant, organized, and supportive environmental community. Components such as the maternal archetype, foliage emblem, soothing greens, contemporary font, and unified layout collectively bolster this positioning and guarantee visual consistency with the target demographic.



Figure 4. New logo to be used by Rasyid Community to consumers

These activities ideally align with digital marketing frameworks for small and medium firms (SMEs), highlighting brand differentiation and narrative driven communication to engage target consumers. Visual branding has demonstrated significant efficacy in altering consumer perceptions; recycled products are now regarded not just as economical substitutes but as innovative, sustainable lifestyle items with aesthetic value. Although the community needs to create storytelling content for social media, the implementation of fundamental branding components, such as logos, eco-labels, and product packaging have established a crucial groundwork for prospective digital interaction. Visual branding is essential in influencing consumer views; recycled products can be redefined not just as economical options, but as innovative, sustainable lifestyle items with aesthetic and social significance.

Nonetheless, the durability of digital adoption continues to pose a concern. The community's exploration of online marketing needs continuous mentoring, enhanced digital literacy, and greater access to smartphones and internet services for long-term consistency. Developing these capabilities will be crucial for the evolution of future storytelling initiatives into a cohesive and sustainable digital marketing strategy.

Conclusion

This study reveals that the combination of sustainable design, suitable technology, and participatory methods can significantly enhance the efficacy and competitiveness of small-scale artisan groups involved in recycling. Through methods of a systematic intervention that integrated training, technical implementation, and mentorship, Komunitas Pengrajin Rasyid successfully improved its production capacity, product quality, and brand identity. The implementation of the gas oven and pressing machine improved production efficiency by lowering melting times and augmenting material quality, leading to the development of new, higher-value product prototypes like coasters, tableware holders, and tissue boxes. In addition to the technical results, managerial and marketing skills were enhanced

through job allocation, financial understanding, and brand building facilitated by Universitas Paramadina. These results demonstrate the potential for a transformative shift, contingent upon the successful scaling of the documented efficiency gains, product quality improvements, and emerging managerial frameworks, rather than claiming full transformation at this stage. Still, rather than emphasizing only continued coaching or digital marketing support, the next stage of inquiry should extend toward future design scholarship. Future research should focus on longitudinal market testing of the new visual branding to assess its effectiveness, alongside consumer perception studies that evaluate how recycled products are interpreted in different market segments. Additionally, exploring modular design systems using the thermoplastic molding process would enable the Rasyid community to diversify their product line further and maintain sustained innovation within a circular design framework.

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