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Empowering Youth Through Sustainable Design: Community-Based Upcycling of Pine Forest Waste in Mekarwangi Village

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ABSTRACT

Creative approaches rooted in local resources play an important role in sustainable community development. This community engagement program aimed to empower youth members of Community Youth Development in Mekarwangi Village, West Bandung Regency, through training in sustainable design using pine forest waste. Mekarwangi is surrounded by pine forests managed by Perhutani, which generate unused organic waste such as dry branches, bark, flowers, and sawdust. The program consisted of an environmental awareness session and practical workshops on upcycling techniques. Participants were introduced to the concept of sustainable design and guided through the process of transforming forest waste into functional and decorative crafts, including fish-shaped ornaments made from pine flower petals and leaves. The training emphasized the creative reuse of natural materials, while also promoting the principles of circular economy and environmental stewardship. As a result, participants developed new skills in material selection, product design, and simple craft production, which enhanced their confidence and awareness of environmental issues. The final products have potential as eco-friendly souvenirs, strengthening local identity and opening economic opportunities. This initiative demonstrated the role of design as a tool for grassroots empowerment, creativity, and sustainable community development.

KEYWORDS

Upcycled Design
Sustainability
Community
Creative Empowerment

INTRODUCTION

Mekarwangi Village is located in the highlands of Lembang, West Bandung Regency, an area known for its natural beauty and ecological richness. This region is surrounded by pine forests managed by Perhutani, which contribute to the local economy and environment. However, the management of these forests also results in a considerable amount of organic waste, such as dry branches, pine bark, floral debris, and sawdust. These materials are often discarded or left unused, despite their potential as raw materials for creative, functional, and sustainable products. The local youth community, organized under a local community youth development group (locally known as *Karang Taruna*), plays a significant role in village development through volunteerism and community-based programs. While Community youth group actively engages in sports, arts, and social events, their participation in environmentally conscious and economically productive activities remains limited. The challenge lies in equipping them with the necessary skills and knowledge to transform local natural resources into opportunities for creative entrepreneurship.

In response to global environmental challenges and the growing interest in circular economies, upcycling has emerged as a relevant method for sustainable design. Upcycling refers to the process

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of creatively reusing waste materials to produce items of higher value or quality (Aldelya, 2023). Unlike recycling, which typically breaks down materials into raw form, upcycling preserves the essence of the material while adding aesthetic or functional value (Kurdhi et al., 2024). This approach is particularly useful in contexts where industrial infrastructure is limited but creativity and manual skill are abundant. The integration of upcycled design into community development projects has shown promise in empowering marginalized groups, increasing environmental awareness, and promoting sustainable practices. However, most documented cases focus on urban populations or formal education settings (Avila-Garzon & Bacca-Acosta, 2024). Rural youth organizations like Community youth group in Mekarwangi Village have received limited attention in terms of design-based interventions that utilize local waste materials (Paramita et al., 2022). This presents both a challenge and an opportunity for innovation in community-based creative practice.

Several studies have explored design as a tool for social innovation, sustainability, and grassroots empowerment. Design for sustainability (DfS) and social design approaches often advocate for participatory methods, local knowledge integration, and material resourcefulness (Astuti et al., 2023) Nonetheless, the application of these frameworks in non-urban, resource-constrained communities remains underexplored. Design research and practice that emerge from rural contexts are crucial to diversifying the narrative of sustainable development and creative industries. In the case of Mekarwangi Village, the untapped potential of pine forest waste aligns well with the principles of sustainable design. These materials, though considered waste, offer unique aesthetic textures and organic qualities that can be transformed into craft products with both functional and symbolic value. Moreover, the involvement of youth in the design process helps cultivate a sense of ownership, creativity, and ecological responsibility.

This community engagement initiative was designed as a response to those conditions. The program focused on introducing sustainable design principles through workshops and hands-on activities, aimed specifically at empowering members of Community youth group. It offered environmental education, design thinking exposure, and technical training using accessible tools and materials derived from the surrounding environment. The program emphasized the importance of ecological stewardship and local identity in crafting meaningful products.

The activities included initial awareness sessions, collaborative material exploration, and the development of simple prototypes, such as pine-flower-based ornaments shaped like fish. The fish shape was chosen due to its familiarity, simplicity, and visual appeal, making it suitable for beginners. Participants not only learned how to design and assemble the product but also discussed its potential as a marketable souvenir and a symbol of local creativity and sustainability. Through this process, participants acquired practical skills, expanded their environmental knowledge, and engaged in reflective discussion about design and community. The project proved that sustainable design education could be implemented effectively at the village level using low-cost methods and local resources. More importantly, it demonstrated how creative practices could foster empowerment and social cohesion among young people.

Therefore, this paper aims to document and analyze the implementation of this design-based community empowerment program. It seeks to contribute to the discourse on rural design practices and sustainable craft by highlighting the value of local resources, youth participation, and creative education. The novelty of this study lies in its context-specific application of upcycled design within a rural youth organization, offering insights into how design can support environmental and social goals in underserved areas.

METHOD

This community engagement program adopted a co-creation method, a participatory approach in which facilitators and community members collaboratively explore problems, generate ideas, and produce solutions (Sanders & Stappers, 2008). This method was used to empower youth in Mekarwangi Village through hands-on training and creative engagement using pine forest waste. The participants were 20 active members of a community youth development group (locally known as *Karang Taruna*), aged 13–30, who voluntarily joined the program. The materials used were collected from nearby pine forests managed by Perhutani, including pine bark, flowers, twigs, and leaves—

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natural waste that is typically discarded. To support the creative process, simple and accessible tools such as glue guns, scissors, cutters, and cardboard templates were used. All materials and tools were intentionally selected to allow for easy replication and minimal cost.

The co-creation process was carried out in four main steps, adapted from Sanders & Stappers (2008) as seen in Figure 1.

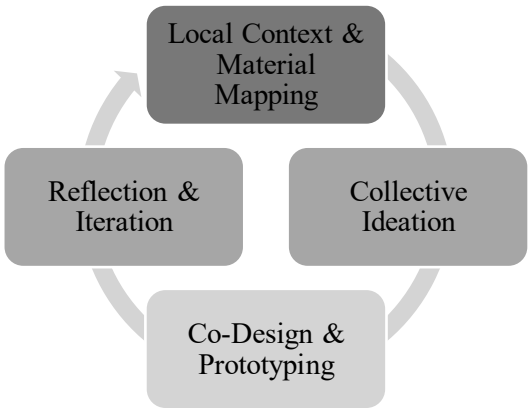

Figure 1. Co-creation process adapted from Sanders & Stappers (2008)

The co-creation process implemented in this community engagement program was structured into four main phases to guide participant involvement from understanding the context to reflecting on the outcomes. Co-creation provides opportunities for participants to share ideas and shape outcomes collaboratively (Trapani, 2019). Each phase was designed to encourage active participation, creativity, and shared decision-making, ensuring that the youth group members were not only recipients of knowledge but also co-designers of the products. The following describes each step in detail:

1. Context mapping and immersion: Participants were introduced to issues related to environmental sustainability, upcycling, and circular economy through an interactive awareness session.
2. Collective idea generation: Youth participants were guided through group discussions and visual mapping to explore ways in which forest waste could be transformed into valuable products.
3. Prototyping and making: In a hands-on workshop, participants worked with facilitators to design and create simple craft items—such as fish-shaped ornaments—using pine waste. These prototypes served as eco-friendly souvenirs that reflect local identity.
4. Reflection and iteration: After making the products, participants discussed the outcomes, exchanged feedback, and shared ideas for improving product quality and exploring additional design concepts.

Data collection was qualitative and included direct observation, informal interviews, visual documentation (photos and videos), and participant feedback through group reflection and a short questionnaire. No statistical models were applied. Instead, insights were drawn from the process itself—focusing on participant engagement, material exploration, and design outcomes.

This co-creation method proved to be effective in fostering local ownership of the design process. It not only facilitated knowledge transfer but also empowered youth participants to see waste as a resource, and design as a tool for community-based sustainability and creativity

RESULT AND DISCUSSION

Participant Engagement and Co-Creation Process

The community engagement program successfully involved 20 active members of the community youth development group in Mekarwangi Village. These participants, aged between 13–30 years, were largely unfamiliar with formal design methods but showed genuine interest in learning about sustainable craft practices. Their participation reflected a shared curiosity about transforming local natural resources into valuable products. The facilitators used a co-creation method, ensuring that participants were treated as equal partners rather than passive learners. This approach encouraged

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open dialogue, where participants felt comfortable sharing ideas, asking questions, and experimenting creatively with new techniques. The process began with contextual immersion sessions, in which facilitators introduced key concepts such as the circular economy, sustainable design, and upcycling. This foundation was essential for aligning participants' perspectives with the project's environmental objectives.

During group discussions, participants shared personal observations about the underutilization of pine forest waste in their village. They reflected on the seasonal availability of materials and potential challenges, such as the fragility of pine flowers or the irregular shapes of twigs. By acknowledging these issues collectively, the group built a shared understanding of both the opportunities and constraints inherent in their environment. The facilitators encouraged participants to document ideas through quick sketches and mood boards. This simple visual method helped bridge communication gaps, especially for those unfamiliar with formal design vocabulary. As a result, the participants gained confidence in articulating their creative ideas.

Figure 2. Participants engaging in group discussions and idea exploration during the co-creation workshop

To clarify the structure of the co-creation process implemented in this program, Table 1 summarizes the four main phases adapted from Sanders & Stappers (2008). These phases guided the participants from understanding the local context to developing and reflecting on their design outcomes.

Table 1. Co-Creation Framework Phases

Phase	Activity Focus	Output
Context Mapping & Immersion	Awareness session on sustainability & upcycling	Shared understanding of local context
Collective Ideation	Brainstorming, sketching, discussion	Initial product ideas & design concepts
Co-Design & Prototyping	Hands-on material exploration & making prototypes	Fish ornaments & other decorative items
Reflection & Iteration	Group feedback & discussion of improvements	Insights & ideas for future products
Phase	Activity Focus	Output

As shown in Table 1, the process was designed to be participatory and iterative, starting with context mapping, followed by idea generation, hands-on prototyping, and ending with reflection. This structure allowed participants to engage as co-designers, rather than passive learners (Yousuf & Zehra, 2024).

Material Exploration and Design Choices

Material exploration was a central component of the program. Participants examined different types of pine waste—including dry branches, bark, pine flower petals, and leaves—to understand their texture, color, and workability. Many noted the unique textures of pine flowers, which inspired them to use them as decorative "scales" on fish-shaped ornaments. The choice to design fish-shaped ornaments emerged from group discussions about local cultural symbols and simplicity of form. Fish were seen as familiar, easily recognizable, and symbolically associated with life and prosperity. This

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decision aligned the products with local cultural context, increasing their potential appeal as souvenirs or decorative items (Bentz & O'Brien, 2019) representing Mekarwangi Village. Participants learned that imperfections in natural materials added character to each piece, highlighting the aesthetic value of upcycled craft, as illustrated in Figure 3.

Figure 3. Participants experimenting with pine forest waste materials during the co-creation workshop

Participants also considered practicality: complex shapes could be difficult to produce consistently using only hand tools and natural waste. By focusing on simpler, modular designs, they could create products that balanced creativity, cultural relevance, and production feasibility. Experimentation revealed interesting visual effects when pine petals were layered to mimic scales, and when thin bark pieces were shaped into fins. Participants learned that imperfections in natural materials added character to each piece, highlighting the aesthetic value of upcycled craft.

Product Prototypes and Creative Outcomes

The program's hands-on workshops resulted in several prototypes, the most notable being fish-shaped decorative items. These could function as wall hangings, keychains, or small souvenirs. Each product was unique, reflecting the natural variation of materials and individual design choices. The making process involved assembling pine flower petals on pre-cut cardboard templates to form the fish's body, attaching bark pieces as fins, and using pine leaves for texture and contrast. Participants refined their technique over time, improving adhesion and achieving cleaner finishes. This creative process is illustrated in Figure 4.

Figure 4. Fish-shaped ornament prototype made from pine flower petals and bark pieces

Beyond fish ornaments, some participants proposed future products like bird or leaf-shaped decorations, showing that the training sparked creative thinking beyond the initial prototypes. This openness to new ideas demonstrated that participants internalized the concept of design iteration. The final products successfully combined natural aesthetics with cultural symbolism, embodying principles of sustainable design while remaining visually appealing (Martono et al., 2025). Despite being handmade with simple tools and local waste materials, these products showed commercial potential, especially for eco-conscious tourists visiting the Lembang area, highlighting how local

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creativity can transform forest by-products into meaningful and marketable crafts. The final products combined natural aesthetics with cultural symbolism, embodying principles of sustainable design while being visually appealing. Despite being handmade with simple tools, the products had commercial potential, especially for eco-conscious tourists visiting the Lembang area.

Learning Reflections and Skill Development

Participants reported significant personal growth in both creative and technical skills. Many had never worked with natural materials in a structured design context. Through the workshops, they developed abilities in material selection, form exploration, and basic prototyping. They also reported increased awareness of environmental issues, understanding how waste could be reimagined as a resource. The idea of extending the lifecycle of natural materials through design resonated strongly, especially among those concerned about deforestation and environmental degradation.

Reflection sessions highlighted both achievements and challenges. Some participants found it difficult to handle fragile materials, while others struggled to visualize abstract ideas. These challenges became opportunities for shared learning, with more confident participants helping others troubleshoot techniques. Participants expressed pride in their creations, noting that the products felt meaningful because they originated from their local environment and cultural context. This sense of ownership strengthened their motivation to continue experimenting independently. Feedback collected through informal interviews and questionnaires showed strong enthusiasm for future training sessions. Participants also expressed interest in learning marketing and packaging techniques to support small-scale commercialization.

Potential for Sustainability and Community Impact

The project's outcomes extend beyond individual skill-building and creative experimentation. By transforming local pine forest waste into craft products, the community youth development group actively engaged with the principles of the circular economy, where materials that are typically discarded are reimagined as valuable resources. This practice not only reduces environmental impact but also nurtures a mindset of resourcefulness and sustainability among participants. The process demonstrated how design thinking and hands-on making can empower local youth to see potential in what was once considered waste, fostering environmental stewardship rooted in everyday practice.

The handmade products—such as fish-shaped ornaments and other prototypes—have tangible potential as **eco-friendly souvenirs**, particularly within the tourist market of Lembang, an area already known for its natural beauty and local crafts. This aligns well with broader local economic strategies that promote sustainable tourism and creative industries as drivers of rural development. Moreover, the products reflect the unique environmental and cultural character of Mekarwangi Village, turning local identity into an economic and symbolic asset that can be shared with visitors. Beyond immediate economic potential, the training approach itself is **designed to be replicable and scalable**. The co-creation framework, which emphasizes participant ownership and local material use, alongside the reliance on low-cost, widely available tools, makes it accessible to other communities with similar resources.

To ensure that the impact of the program would continue beyond the initial workshops, the facilitators developed a dedicated training module. This module was created as part of the project's dissemination strategy, aiming to support the replication of the co-creation process by other community groups, youth organizations, or local schools interested in sustainable design practices. By documenting the methods, materials, and design steps, the module helps transform experiential learning into a structured resource that can be reused and adapted. The content of the module includes illustrated step-by-step instructions, material preparation tips, and guidance for creating simple prototypes like fish-shaped ornaments using pine forest waste. It is designed to be practical and easy to follow, even for individuals without prior design background. This approach reflects the project's commitment to accessibility, cultural relevance, and the broader goal of embedding sustainable, creative practices within the local community.

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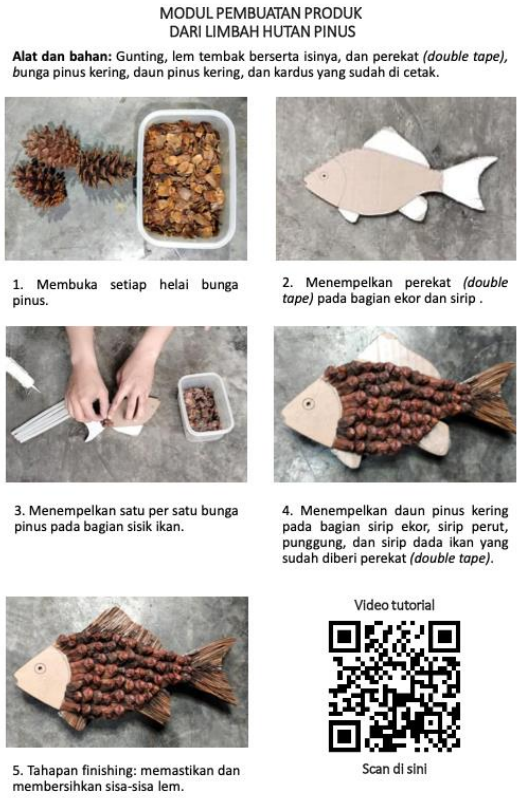

Figure 5. Training module on crafting products from pine forest waste

After introducing the module, participants and local stakeholders expressed interest in using it as a reference for future workshops or creative activities, highlighting its value as both an educational and empowerment tool. Sustainability was also evident in participants' willingness to share knowledge with peers, suggesting the possibility of forming small production teams or teaching workshops to younger members. This aligns with the regeneration model common in community youth development organizations. The collaborative process fostered trust among participants and between the youth group and facilitators. Such social capital is critical for future community initiatives, whether in design, environmental education, or entrepreneurship.

Figure 6. Reflection and discussion among participants after the co-creation process

Participants' reflections revealed a shift in mindset—from viewing design as an external, professional activity to recognizing it as a local, collective practice grounded in everyday materials and experiences. This project illustrates how design can act as a tool for empowerment, enabling young people to engage creatively with local challenges and resources. It also shows that design-led approaches can complement traditional community development methods. Future directions

proposed by participants and facilitators include diversifying product types, exploring other local materials, and developing simple branding strategies to increase product visibility in local markets. The project also identified areas for improvement: for instance, providing more structured drawing exercises could help participants better translate ideas into prototypes. Additional sessions on pricing and market testing could strengthen economic outcomes.

In conclusion, the program demonstrates that co-creation and sustainable design can effectively build creative capacity, environmental awareness, and economic potential in rural youth communities. By centering local resources and cultural identity, the approach supports both ecological sustainability and community resilience. This experience reinforces the importance of participatory design methods that value local knowledge and creativity, suggesting that similar frameworks could benefit other rural communities seeking to transform local waste into meaningful products.

CONCLUSION

This community engagement project has demonstrated the practical application of sustainable design and upcycling principles in a rural context. By involving the community youth development group of Mekarwangi Village, the program successfully introduced participants to the creative reuse of pine forest waste, turning what was previously considered environmental debris into valuable craft products. This experience shows that even low-cost, natural materials can become the basis for innovative and culturally meaningful designs. Through a structured co-creation process—including context mapping, idea generation, prototyping, and reflection—participants not only learned technical skills but also developed greater awareness of environmental sustainability. The collaborative approach allowed them to see design as an accessible and participatory activity rather than a professional practice limited to experts. This shift in perspective is significant for building long-term community capacity and encouraging future creative initiatives.

The products developed—such as fish-shaped ornaments and decorative crafts—embody both local identity and environmental responsibility. While simple in form, these items carry cultural symbolism and highlight the aesthetic potential of natural materials. Their commercial potential as eco-friendly souvenirs aligns with local tourism strategies and opens pathways for economic diversification in the village. Beyond individual skill-building, the program fostered social connections among participants and between the youth group and the facilitators. This strengthened social capital is essential for sustaining community-driven projects and can inspire similar initiatives in other rural areas. The training module and video tutorial produced as part of the program further support knowledge transfer and replication. In conclusion, this project illustrates how design-led community engagement can effectively combine creative empowerment, environmental stewardship, and local economic development. It affirms the role of design as a practical tool for addressing sustainability challenges at the grassroots level, offering lessons that extend beyond Mekarwangi Village to broader contexts of community-based innovation.

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