Study of Local Materials and Agricultural Waste to Develop Souvenir Products by Integrating Technology with Cultural to Support to the Aging Society: Khuan Kalong District, Satun Province

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Abstract

This research studies local materials and agricultural waste to develop cultural souvenir products in line with the circular economy and supports the development of cultural souvenir products from local materials that reflect cultural narratives to promote social innovation for the aging society in Khuan Kalong District, Satun Province. This Participatory Action Research (PAR) study included three stages. The first involved interviews with five community members and local academics to identify design directions and material characteristics. After completing design-specific surveys, thirty designers, scholars, design experts, and marketers created prototypes of memorial products. Finally, 385 visitors, specialists, and designers aged 20-60 (near retirement) completed satisfaction rating surveys after product design. Results were summarized by percentage, mean, and standard deviation.

Findings revealed that cultural gifts made from oil palm, rubber, and banana sheaths, together with local batik fabric patterns inspired by the Nora performance and Kalong flower motif, represented the charm and cultural identity of Khuan Kalong community. Processed agricultural waste materials such as oil-palm fronds, rubber leaves, palm fruit bunches, banana sheaths, and batik fabric prototypes (N = 30) scored 4.77 (SD = 0.50) in the prototype development evaluation, indicating a very high level of satisfaction. A large-scale satisfaction test (N = 385) showed a mean score of 4.40 (SD = 0.81), also at a high level. The developed products were practical, aesthetically pleasing, and suitable for elderly participation in production and sales.

This initiative supports the network of local creative industries, motivating innovation and enhancing intellectual capital. It also aligns with the United Nations Sustainable Development Goals (SDGs), particularly Goal 12: Responsible Consumption and Production, by encouraging sustainable design, resource efficiency, and circular economy practices within aging communities.

Keywords: Local Materials, Agricultural Waste, Cultural Souvenir, Circular Economy, Aging Society

Introduction

Thailand's population is aging steadily. According to the National Statistical Office, Ministry of Digital Economy and Society (2023), the number of people aged 60 and reached 12.7 million, or about 19.2% of the total population, not 116 million as previously reported. By 2025, Thailand will be classified as a fully aged society (with seniors making up 20%), and by 2033 it will enter the super-aged stage (with seniors accounting for 28%). This demographic shift is impacting Thailand's economy and society through labor shortages—thanks to a shrinking working-age population—and rising government spending on healthcare and social services for the elderly. Accordingly, promoting healthy, high-quality lives among older adults has become one of Thailand's greatest challenges (Klakayan, 2022). Moreover, Thailand's tourism industry continues to expand, propelled by its strategic location and the diversity of its natural, cultural, and heritage resources. As a gateway to Southeast Asia, Thailand offers unparalleled access; its wealth of natural attractions, distinctive arts and traditions, and famed Thai hospitality create abundant tourism and international business opportunities. Embracing sustainability by conserving at-risk natural sites, managing visitor capacity, and fostering environmental stewardship while celebrating cultural identity and local wisdom is essential for long-term success (Office of the National Tourism Policy Committee of

Thailand, 2017). The strategy for goods, services, and tourism is underpinned by clear, sector-specific policies. In particular, public relations campaigns play a vital role in reaching target audiences and helping travelers appreciate the unique value of each destination. Effective promotion not only informs but also educates visitors about local ways of life, arts, customs, and traditions laying the groundwork for deeper engagement and broader dissemination of cultural knowledge. Satun Province exemplifies a compelling "must-see plus" destination. Its name derives from the Malay word "Setoi", meaning the ambarella fruit that grows abundantly there. It was later honored with the Malay epithet Negeri Setoi Mumbang Segara "Satun, the city of the Sea Deity" and the "Sea Deity" emblem remains the province's symbol to this day. Administratively, Satun Province is divided into seven districts, featuring a diverse landscape of plains and mountains. The northern and eastern parts are dominated by the Sankalakhiri mountain range, which slopes gently toward the Andaman Sea in the west. To the south lies a narrow coastal plain bordered by extensive mangrove forests dominated by Avicennia and Rhizophora species. Most residents are engaged in agriculture. Rubber is the province's main cash crop, covering approximately 437,051 rai, followed by oil palm (109,212 rai), rice (21,067 rai), and various fruit orchards such as longkong (4,063 rai), durian (3,140 rai), rambutan (2,455 rai), mangosteen (1,384 rai), and champadak (10,945 rai). Although Satun is one of Thailand's smaller provinces, it ranks fourth nationally in rubber production—after Songkhla, Yala, and Narathiwat—and possesses the largest rubber-growing area within its agricultural zone (Satun Provincial Office, 2018). Most local farmers depend on rubber for household income. Global price declines have squeezed profits, prompting smallholders to cut costs, improve yields, reduce household expenses, and seek supplementary livelihoods. At the same time, the community is aging. Older adults, though less physically robust, bring invaluable knowledge and experience; they offer guidance on careers, family life, and social matters, and some possess specialized skills in carpentry, woodcarving, Thai culinary arts, traditional dessert making, sewing, floristry, and music that they pass on to younger generations (Prapakorn, 2020). Against this backdrop, the Khuan Kalong Subdistrict of Khuan Kalong District serves as a model community. With 2,750 rubber-farming households and a 2017 population of 5,463, it has the potential for economic uplift. Its vision, "a sustainable agricultural economy, tourism, and environment at the center of education, sports, religion, culture, and comprehensive infrastructure, all through participatory peace and safety" and its mission align with national economic strategies. These emphasize forming occupational groups, developing community markets via the sufficiency-economy philosophy, and leveraging the creative-industry framework to stimulate innovation, competition, and community development. The "creative industry" cycle from ideation to production to distribution relies on intellectual capital and aims for sustainable, quality improvements. Research into the elderly network thus focuses on designing user-friendly products that meet the needs of all ages and abilities.

One key outcome is the development of creative cultural souvenir products—tangible keepsakes that capture the "memories" forged during travel: discovering new places, meeting new people, sampling exotic foods, or engaging in novel activities. Beyond photographs, travelers often seek souvenirs to commemorate their experiences or to gift others, signaling "I was here, and it was memorable" (Ministry of Culture, 2015, p. 14). Souvenirs also function as promotional media, showcasing product and destination attributes while boosting the competitiveness of target industries (Thailand Science Research and Innovation, 2020, p. 38). They support sustainable tourism by honoring natural and cultural resources and by managing visitor flows effectively (Ministry of Tourism & Sports, 2023, p. 38). This, in turn, fosters social and connectivity innovations for seniors—combating isolation and promoting "ways of happiness". Engaging older adults meaningfully helps reduce the loneliness,

depression, and anxiety which profoundly affect health (Klakayan, 2022). By creating participatory models of exchange, learning, and giving back, this work yields creative souvenirs that authentically reflect local cultural identity—and it lays the groundwork for integrating tourism with modern technology.

Objective

1. To study local materials and agricultural waste for developing creative cultural souvenir products that support sustainability and align with the circular economy in the aging society.

2. To design and develop cultural souvenir products from local materials that reflect cultural stories, supporting innovations in an aging society for the Elderly Occupational Group in Khuan Kalong District, Satun Province.

Methods and Materials

1. Research Methodology

1.1 Research Design

- **Quantitative Research:** The objective of a quantitative research study is to reveal facts and derive quantitative conclusions. Quantitative statistics serve as evidence to corroborate conclusions. Objective tools, including structured questionnaires, tests, observations, and interviews, are utilized for data collection.

- This study employs Participatory Action Research (PAR) (Sutthinarakorn, 2017) to comprehend real-life experiences and propose innovative methods for knowledge creation aimed at enhancing the lives and activities of the community. Data are typically gathered through participatory observation and unstructured interviews. Analysis is qualitative rather than quantitative.

The study categorizes its subjects into three sample groups:

- Regional community leaders and local academics.

- Designers, scholars, and design specialists.

- Individuals aged 20-60 (approaching retirement), encompassing both local and non-local visitors, professionals, and designers.

This method approach assist emphasis on the data descriptively, including percentages, averages, and standard deviations, as well as displays of design outputs and knowledge-transfer initiatives.

1.2 Demographics

The population consists of all inhabitants of Khuan Kalong District, totaling 11,026, with 1,492 individuals classified as elderly (Khuan Kalong Subdistrict Administrative Organization, Khuan Kalong District, Satun Province, 2020).

1.3 Specimen

We ascertained the sample by employing the following methodologies:

- **In-Depth Interviews:** Five participants, including community members and local scholars, were interviewed to explore the material attributes and design considerations relevant to the development of cultural souvenir products.

- **Design Questionnaire:** Thirty participants—comprising designers, academics, design experts, and marketers—were engaged to contribute ideas and feedback on the conceptual design of souvenir products and community marketing strategies.

- **Post-Design Satisfaction Survey:** This study employed a non-probability sampling method using convenience sampling (Phothisita, 2009), which was appropriate for selecting participants relevant to the research

objectives. A total of 385 respondents, aged 20–60 years, including local and non-local visitors, specialists, designers, and marketers from Khuan Kalong District and nearby communities, participated in the satisfaction survey after prototype development. This sampling approach ensured that participants had practical experience or direct engagement with cultural product design and community-based creative industries, thereby providing meaningful insights for evaluating the developed prototypes.

Since the sampling process did not employ a probability method, the Yamane (1969) formula was not applied in determining the sample size. The sample size was determined based on the study's participatory design framework and the feasibility of data collection within the local context.

1.4 Preparation and Production of Plant-Fiber Paper

Oil-palm fronds, rubber leaves, and banana sheaths were mixed in equal proportions (3:3:3 by weight), cut into 5 cm pieces, and oven-dried at 80 °C for 8 hours. The dried fibers were cooked in a 15 wt% sodium hydroxide (NaOH) solution (1 L per 100 g of fibers) at 90–95 °C for 2–3 hours. During the process, Personal Protective Equipment (PPE)—including gloves, goggles, and chemical-resistant aprons—was used to ensure safety. The cooked pulp was rinsed with distilled water until neutral pH (6.8–7.2), and the wastewater was neutralized with 1% acetic acid before disposal. The cleaned pulp was then blended for 10 minutes, poured into a 50×40 cm mold, and evenly distributed in water. After draining, the sheets were air-dried for 6 hours and oven-cured at 45 °C for 10 hours. This standardized procedure ensures reproducibility, operator safety, and environmental compliance.

2. Data Acquisition

This study examines existing academic literature and findings in addition to instrument creation. As Participatory Action Research (PAR), it reflects practical realities within its conceptual framework and collaboratively generates new knowledge to improve community well-being and productivity. The same three sample groups were employed as detailed in Section 1.3, using the following instruments: 1) a comprehensive interview manual, 2) a design and feedback questionnaire, and 3) a post-design efficacy and satisfaction assessment. Data collection was carried out in two stages. The first involved qualitative interviews with five community members and academics to identify materials, production techniques, and cultural contexts. The second applied structured questionnaires to 30 experts and 385 respondents aged 20–60 to evaluate design performance and satisfaction using a five-point Likert scale (1 = very low, 5 = very high). Descriptive statistics (mean and standard deviation) were used to analyze the results, and internal consistency reliability was confirmed with Cronbach's alpha = 0.89. All participants gave informed consent, and the study was approved by the RMUTP Human Research Ethics Committee (IRB-COE-011-2024).

3. Validation and Reliability of Instruments

3.1 Content Validity: The research instruments were validated by three subject matter experts and design professionals specializing in product design, community development, and social research methodology. The experts evaluated the relevance, clarity, and consistency of each item to ensure content validity. The Index of Item-Objective Congruence (IOC) values ranged from 0.80–1.00, indicating that all items were appropriate and consistent with the research objectives.

3.2 Reliability: Following expert validation, the revised questionnaires were pilot-tested with a small group of participants sharing similar characteristics to the main sample. The internal consistency of the instruments was assessed using Cronbach's alpha, which yielded a coefficient of 0.89, signifying a high level of reliability.

Item-total correlation analyses confirmed that each question contributed meaningfully to the overall construct being measured.

These validation and reliability procedures ensured that the instruments were both conceptually sound and statistically reliable for subsequent data collection and analysis.

4. Data Acquisition Protocols

The research procedures were conducted in five stages under the Participatory Action Research (PAR) framework, as described below:

4.1 Community Context Analysis: Assess local resource endowments and design elements.

4.2 Material Synthesis and Prototype Design: Convert raw materials into novel substrates and create commemorative prototypes in accordance with contemporary research frameworks. Preliminary outcomes inform progressive enhancement.

4.3 Questionnaire Quality Assessment: Confirm the completeness of submitted questionnaires prior to analysis and synthesis for product modeling purposes.

4.4 Prototype Implementation and Knowledge Transfer: Present prototypes and research findings to the community, conduct training sessions, gather post-training satisfaction data, and document results.

4.5 Design Enhancement: Utilize the conceptual framework and research objectives to inform final design modifications.

This project has submitted the application for Institutional Review Board approval under certificate number IRB-COE-011-2024.

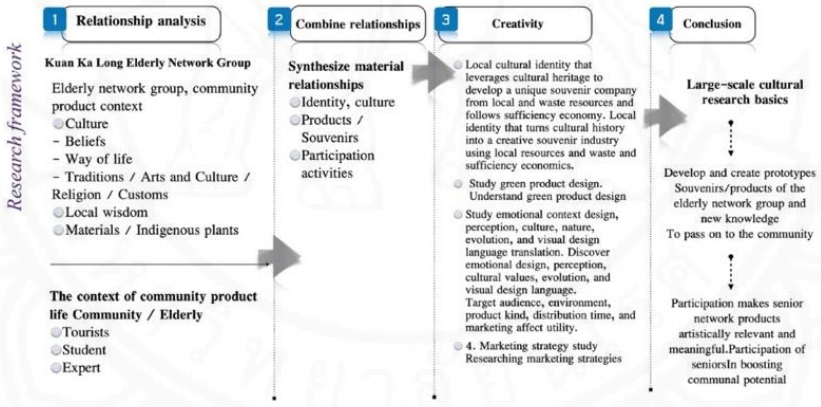

Figure 1 Research Framework. (Wongsuwan, 2025)

Results

1. Results of the Study on Local Materials and Agricultural Waste Creatively Transformed into Cultural Souvenir Products

1.1 Information Gathering in the Context of Local Materials

Recommendations for Souvenir Product Design Factors: Summary from five interviewed community participants and local academics on material attributes and product design in Khuan Kalong District, Satun Province, were surveyed to discover local resources, cultural aspects, and materials that may inspire cultural souvenir goods. According to the data, orchard and crop farming are the most important local livelihoods. Oil palm (35.71%) was the most famous local resource. These two agricultural wastes also have the greatest souvenir

creation potential. Culture matters in product design. People cited tourism, customs, and performing arts—especially the Nora dance—as crucial components of the community's identity. Local batik cloth has the Kalong flower design, symbolizing the region's culture. Batik was Khuan Kalong's most distinguishing material. With 80% of choices, useful and ornamental products had the greatest potential for product development, followed by apparel. For product coloring, mangosteen is the best natural dye. Community members also wanted to participate in eco-printing workshops, skills training, and agricultural waste product creation. The findings encourage the use of local resources—especially oil palm and rubber—for product innovation sustainability, which incorporate local motifs and crafts to create meaningful souvenirs. Sustainable cultural product projects in Khuan Kalong are supported by the community's commitment to training and improvement.

Figure 2 Community Identity Prototype: "Batik Stamp-Kalong Flower" / "Batik Stamp-Rubber Leaf". (Wongsuwan, 2025)

Figure 3 Community Identity Graphic Pattern "Nora Design". (Wongsuwan, 2025)

1.2 Identifying Properties of Local Materials and Experimentation

In Khuan Kalong District, oil palm is the second most important economic crop after rubber. Palm fronds, palm bunches, banana sheaths, and rubber leaves generate a significant amount of agricultural waste. These materials are currently underutilized. This research investigates the potential of these materials by developing a method to produce paper from plant fibers, emphasizing the sustainable use of natural resources. The process involves preparing raw materials, boiling the pulp with tapioca starch and nano zinc powder, and forming the paper

using molds. Both community and industrial levels can utilize the resulting paper to create packaging or various products.

1.3 Community Identity and Local Materials

The Kalong flower (*Bauhinia acuminata*), the provincial flower of Satun, is used as a cultural symbol representing purity, gentleness, and prosperity. The community incorporates the Kalong flower motif into handicrafts such as batik fabrics, woven textiles, basketry, pottery, and herbal products. Using the Kalong flower as design inspiration not only preserves local heritage but also promotes cultural tourism and supports circular economy principles within the area.

Figure 4 Preparation of Materials for the Experiment. (Wongsuwan, 2025)

Figure 5 Methodological Framework for Testing and Processing Agricultural Waste Materials. (Wongsuwan, 2025)

The Process of Paper Production from Plant Fibers Encompasses the Subsequent Stages:

a. Combine oil palm fronds, rubber tree leaves, banana sheaths, and shredded palm fruit bunches in a ratio of 30:30:30:10. Segment them into pieces roughly 2 inches in length, then sun-dry until entirely devoid of moisture.

b. Formulate a clean water solution with a 3:1 water-to-fiber ratio, and incorporate caustic soda at 15% of the dry fiber weight (as determined in step a). Heat the liquid until it reaches a boil, then incorporate the desiccated

oil palm fronds, rubber leaves, banana sheaths, and shredded palm fruit bunches. Slowly incorporate a slurry consisting of 2 tablespoons of tapioca starch mixed with 1 cup of water. Dissolve 5 g of nano-zinc powder in 1 cup of purified water. Sustain the boil for 2-4 hours.

c. Thoroughly rinse the boiling pulp with clean water—until it feels only slightly slippery—then mechanically beat or stir the pulp to distribute the fibers, enhancing inter-fiber bonding and strength. Eliminate all surplus water.

d. Measure identical quantities of the cleaned pulp for each page. Submerge the pulp in water within a vat or tub equipped with a 50×40 cm screen, ensuring a uniform distribution across the mesh. Remove the screen, allow the surplus water to drain, and air-dry in sunlight for 2-3 hours. Subsequently, transfer the semi-dried sheets to a shaded area and allow them to cure for 10-13 hours. The outcome is artisanal paper crafted from plant fibers.

2. Results of the Design and Development of Cultural Souvenir Products from Local Materials Reflecting Cultural Narratives

Figure 6 Draft Prototype of Souvenir Products: Operational Level (Plant Fiber Paper). (Wongsuwan, 2025)

Figure 7 Draft Prototype of Souvenir Products: Operational Level (Batik Fabric Patterns). (Wongsuwan, 2025)

Table 1 Satisfaction Scores for Prototype Development (N = 30)

No.	Souvenir Product Prototype	N = 30		Satisfaction Level
		$\bar{x}$	SD	
1	Draft Prototype of Souvenir Products 1	4.37	0.67	High[3]
2	Draft Prototype of Souvenir Products 2	4.20	0.89	High
3	Draft Prototype of Souvenir Products 3	4.77	0.50	Highest[1]
4	Draft Prototype of Souvenir Products 4	4.43	0.57	High[2]
5	Draft Prototype of Souvenir Products 5	4.37	0.61	High[4]
6	Draft Prototype of Souvenir Products 6	4.07	0.94	High
7	Draft Prototype of Souvenir Products 7	3.93	0.87	High
8	Draft Prototype of Souvenir Products 8	4.20	0.76	High

From Table 1, the satisfaction evaluation of eight draft prototypes of souvenir products by 30 participants showed an overall mean score of 4.29 (SD = 0.73), indicating a high level of satisfaction. All prototypes scored above the "high" level (mean score ≥ 3.51), reflecting a positive response from experts and designers. Among the eight prototypes, Prototype 3 achieved the highest mean score (mean = 4.77, SD = 0.50), followed by Prototype 4 (mean = 4.43, SD = 0.57), Prototype 1 (mean = 4.37, SD = 0.67), and Prototype 5 (mean = 4.37, SD = 0.61).In contrast, Prototype 7 obtained the lowest mean score (mean = 3.93, SD = 0.87), although it still fell within the "high" satisfaction range. The findings suggest that Prototype 3, which incorporated locally sourced fibers and cultural motifs, was the most well-received among experts for its design coherence, practicality, and aesthetic appeal. The relatively small standard deviations (SD ≤ 0.9) across all prototypes indicate consistent agreement among respondents. These results confirm that all prototypes were positively evaluated, with Prototype 3 identified as the most suitable model for further community development and commercial application.

Table 2 Questionnaire on Product Life Cycle for the Development of Draft Prototypes of Souvenir Products

No.	Item	N = 30		Satisfaction Level
		$\bar{x}$	SD	
1	Environmentally low-impact materials	4.03	0.85	High
	Non-toxic, non-hazardous materials (non-contaminated)	3.67	0.84	Moderate
	Use of renewable materials	4.57	0.57	Highest
	Use of agricultural waste	4.70	0.65	Highest
	Use of recyclable raw materials	3.70	0.65	Moderate
	Use of low-energy materials	3.20	0.55	Moderate
	Environmentally friendly	4.37	0.49	High
2	Material utilization	4.13	0.84	High
	Weight of the souvenir product	3.67	0.84	Moderate
	Suitability of volume and size for transportation	4.57	0.57	High
	Type of material	4.63	0.49	Highest
	Reusable or recyclable	3.63	0.81	Highest
3	Production process	4.20	0.83	High
	Use of environmentally friendly production technology	3.63	0.76	Moderate
	Reduced number of production steps	4.53	0.57	High
	Waste reduction in production process	4.83	0.38	High
	On-demand production process	3.80	0.85	Moderate

Table 2 (Cont.)

No.	Item	N = 30		Satisfaction Level
		$\bar{x}$	SD	
4	Product lifespan	4.28	0.79	High
	Strong structure and form	3.77	0.90	High
	Durability	4.50	0.57	High
	Protection during use	4.57	0.63	High
5	Design characteristics	4.29	0.78	High
	Design appropriate for the community context	4.13	0.94	High
	Use of composite materials	4.37	0.49	High
	Use of illustrations and patterns	3.67	0.84	Moderate
	Use of color tones in prototype design	4.57	0.57	Highest
	Symbols indicating chemical components and disposal	4.83	0.38	Highest
	Composite and main material compatibility	3.90	0.84	High
	Material suitability for functional use	4.57	0.57	Highest
6	End-of-life management	4.28	0.80	High
	Recyclable souvenir product materials	4.17	0.83	High
	Low-impact materials after end-of-life	4.57	0.57	Highest
	Easy-to-separate materials for disposal	4.77	0.43	Highest
	Safe landfill disposal	3.63	0.81	Moderate
7	Suitability for elderly groups to produce, use, and sell	4.63	0.61	Highest
	Overall Average	**4.63**	**0.61**	**Highest**

The satisfaction evaluation of 30 participants regarding the eco-friendly souvenir prototypes indicated a high overall mean score of 4.63 (SD = 0.61), interpreted as the "highest level" of satisfaction. Participants generally agreed that the designs were well-aligned with environmental and social responsibility goals. Across the seven major criteria, the three dimensions receiving the highest appreciation were:

1. Suitability for elderly groups to produce, use, and sell (mean score = 4.63, SD = 0.61) – reflecting the inclusiveness of the design and its ease of production for community artisans.

2. Material utilization and environmental performance – particularly the use of agricultural waste (mean = 4.70) and renewable or recyclable materials (mean = 4.57–4.63), which highlight a commitment to sustainability and the circular economy.

3. Design characteristics – especially the use of appropriate color tones and clear labeling of chemical components (mean = 4.57–4.83), showing an understanding of both aesthetic and safety considerations.

Meanwhile, aspects such as energy efficiency in production (mean = 3.20) and symbol clarity for recycling and disposal received moderate scores, suggesting opportunities for improvement in process optimization and eco-label communication.

Overall, the findings reveal that the souvenir prototypes were perceived as environmentally responsible, practical, and culturally meaningful, capable of promoting sustainable local craftsmanship and serving as an exemplary model for green design within aging communities.

Figure 8 Real Model—Souvenir Product Prototype: Operational Level 01-03. (Wongsuwan, 2025)

Figure 9 Real Model—Souvenir Product Prototype: Operational Level 04. (Wongsuwan, 2025)

Table 3 Satisfaction Survey on Souvenir Product Prototypes (N = 385)

No.	Item		N = 385		Satisfaction Level
			$\bar{x}$	SD	
Prototype 1					
1	Material Utilization	Weight of the souvenir product	3.19	0.53	Moderate
		Suitability of volume and size for transportation	3.68	0.83	Moderate
		Type of material	3.63	0.75	Moderate
		Reusable or recyclable	3.66	0.83	Moderate
2	Appropriate Product Lifespan	Increased credibility	3.77	0.88	Moderate
		Durability	4.49	0.56	High
		Protection during use	4.57	0.61	Highest
3	Design Characteristics of Souvenir Product Prototypes	Design suitable for community context	4.14	0.92	High
		Use of composite materials	4.37	0.48	High
		Use of illustrations/patterns	3.66	0.83	Moderate
		Color tones used in prototype design	4.56	0.56	Highest
		Emotional connection with customers	4.83	0.38	Highest
		Chemical symbol and disposal indication	3.90	0.83	Moderate

Table 3 (Cont.)

No.	Item		N = 385		Satisfaction Level
			$\bar{x}$	SD	
		Appropriate selection of materials	4.57	0.56	Highest
		Material suitability for function	4.38	0.65	High
		Strength and protection	4.21	0.87	High
4	Suitability for elderly production/use/sale		3.66	0.87	High
	Overall Average		**4.08**	**0.85**	**High**
Prototype 2					
1	Material Utilization	Weight of the souvenir product	3.19	0.53	Moderate
		Suitability of volume and size for transportation	3.68	0.83	Moderate
		Type of material	3.64	0.76	Moderate
		Reusable or recyclable	3.66	0.83	Moderate
2	Appropriate Product Lifespan	Increased credibility	3.75	0.88	Moderate
		Durability	4.49	0.56	High
		Protection during use	4.57	0.61	High
3	Design Characteristics of Souvenir Product Prototypes	Design suitable for community context	4.09	0.93	High
		Use of composite materials	4.37	0.48	High
		Use of illustrations/patterns	3.67	0.84	Moderate
		Color tones used in prototype design	4.56	0.56	Highest
		Emotional connection with customers	4.65	0.64	Highest
		Chemical symbol and disposal indication	3.88	0.84	Moderate
		Appropriate selection of materials	4.57	0.56	Highest
		Material suitability for function	4.24	0.76	High
		Strength and protection	4.21	0.76	High
4	Suitability for elderly production/use/sale		3.66	0.87	Moderate
	Overall Average		**4.05**	**0.86**	**High**
Prototype 3					
1	Material Utilization	Weight of the souvenir product	3.61	0.90	Moderate
		Suitability of volume and size for transportation	3.94	0.93	Moderate
		Type of material	4.59	0.75	Highest
		Reusable or recyclable	4.09	0.75	Moderate
2	Appropriate Product Lifespan	Increased credibility	4.46	0.85	High
		Durability	4.46	0.64	High
		Protection during use	4.53	0.70	High
3	Design Characteristics of Souvenir Product Prototypes	Design suitable for community context	4.36	0.89	High
		Use of composite materials	4.34	0.63	High
		Use of illustrations/patterns	4.23	0.90	High
		Color tones used in prototype design	4.54	0.67	Highest
		Emotional connection with customers	4.75	0.56	Highest
		Chemical symbol and disposal indication	4.40	0.83	High
		Appropriate selection of materials	4.64	0.60	Highest
		Material suitability for function	4.57	0.67	Highest
		Strength and protection	4.49	0.78	High

Table 3 (Cont.)

No.	Item		N = 385		Satisfaction Level
			$\bar{x}$	SD	
4	Suitability for elderly production/use/sale		4.82	0.49	Highest
Overall Average			**4.40**	**0.81**	**High**
Prototype 4					
1	Material Utilization	Weight of the souvenir product	3.47	0.70	Moderate
		Suitability of volume and size for transportation	3.70	0.83	Moderate
		Type of material	3.63	0.76	Moderate
		Reusable or recyclable	3.72	0.83	Moderate
2	Appropriate Product Lifespan	Increased credibility	3.78	0.84	Moderate
		Durability	4.35	0.69	High
		Protection during use	4.57	0.61	Highest
3	Design Characteristics of Souvenir Product Prototypes	Design suitable for community context	4.10	0.91	High
		Use of composite materials	4.15	0.69	High
		Use of illustrations/patterns	3.72	0.82	Moderate
		Color tones used in prototype design	4.36	0.74	High
		Emotional connection with customers	4.54	0.73	Highest
		Chemical symbol and disposal indication	3.88	0.83	Moderate
		Appropriate selection of materials	4.41	0.70	High
		Material suitability for function	4.10	0.70	High
		Strength and protection	4.21	0.87	High
4	Suitability for elderly production/use/sale		3.78	0.84	Moderate
Overall Average			**4.03**	**0.85**	**High**

Table 3 presents the results of a satisfaction survey involving 385 participants who evaluated four different souvenir product prototypes. The assessment focused on key aspects such as material utilization, product lifespan, design characteristics, and suitability for elderly users. Among the four prototypes, Prototype 3 received the highest overall satisfaction with a mean score of 4.40, followed by Prototype 1 (4.08), Prototype 2 (4.05), and Prototype 4 (4.03). Across all prototypes, participants rated the design-related items—particularly emotional connection with customers, color tones, and appropriate material usage—as highly satisfactory. Notably, Prototype 3 achieved the highest scores in almost every design aspect, especially in usability and suitability for elderly users (4.82). The results suggest that all prototypes were generally well received, but Prototype 3 based on its balance of aesthetics, functionality, and cultural aspect were showned most relavancy. The high levels of satisfaction demonstrate the attractiveness of these prototypes for further development and production. Overall, the findings support the importance of integrating thoughtful design and user needs in creating cultural souvenir products that resonate with a broad demographic, including aging populations.

Discussion

The research findings point out the importance of local materials and agricultural waste in developing cultural souvenir products. The selection of oil palm, rubber, and banana as raw materials serves as a foundation for creative industry development within the community. This aligns with the circular economy concept, which emphasizes resource efficiency and waste reduction. Currently, a large amount of agricultural waste, such as

the midribs of oil palm leaves, is used to produce paper through a process similar to mulberry paper production. When molded into packaging, the paper can support weights from 0.5 to 3 kilograms, depending on size. However, it is necessary to note that the material is sensitive to water and is flammable. It is suitable for making paper bags, boxes, sheets, and fruit and vegetable wraps as a biodegradable alternative to plastic, capable of decomposing within 45 days (TCDC Material Database, n.d.).

The research conducted in Satun Province also revealed that economic crops such as palm fronds, shredded palm bunches, rubber leaves, and banana sheaths can be utilized after harvest. Boiling and shaping processes can mix these materials to increase the pulp fiber strength. The resulting products can be used as household items, decorations, or creatively integrated with other materials. From a technical standpoint, blending different fibers such as palm, rubber, and banana creates stronger bonding and smoother texture, enhancing tensile strength and durability. Additionally, applying natural bio-coatings made from starch or chitosan improves surface flexibility and water resistance while maintaining biodegradability. These technical refinements make the material suitable for sustainable packaging and souvenir production.

The developed souvenir prototypes received positive feedback from both expert and community groups. During the prototype development phase (N = 30; designers, experts, and marketers), the mean satisfaction score was 4.77 (SD = 0.50), indicating a very high level of satisfaction. In the broader satisfaction assessment (N = 385), the overall mean was 4.40 (SD = 0.81), also rated at a high level. This consistency highlights the reliability of the design concept and its acceptance among different groups of users.

When comparing the performance of the four prototypes, Prototype 3 achieved the highest satisfaction scores across almost all dimensions—particularly in design appearance, material quality, and suitability for elderly production. Prototypes 1 and 2 were also well-received, though respondents suggested enhancing innovation and diversifying materials. Prototype 4, while highly rated for its simplicity and lightweight design, showed room for improvement in user engagement and creative expression. These findings confirm that Prototype 3 best balanced aesthetic, functional, and environmental qualities, making it the most effective and adaptable model for further community development.

Additionally, the developed souvenir products possess distinctive qualities that strongly reflect local cultural identity, enabling them to add market value and appeal to the aging population. Nevertheless, product development must continue to focus on material durability testing and user-centric design, particularly suited to the behaviors and needs of the target demographic. This conclusion is consistent with Roseland's (2000) research, which emphasizes sustainable design and community development.

In terms of practical application, the development of cultural souvenirs from local and waste materials requires support from both public and private sectors, particularly in organizing training and skills development for communities. This will help ensure the production of standard-compliant products that meet market demands. Furthermore, establishing collaborative networks among designers, experts, and local producers is essential to enhance product competitiveness. The satisfaction assessment from a sample group comprising near-retirement individuals, tourists, designers, and design experts revealed a high satisfaction level, with a mean score of 4.63 (SD = 0.6). Environmental impact analysis also indicated that the products have an appropriate lifespan and an effective post-use management system. Moreover, the developed souvenirs have already been successfully introduced into community markets, contributing to income generation and promoting a creative industry based on the community's intellectual capital.

Conclusion and Suggestions

Conclusion

The research concludes that local materials and agricultural waste such as oil-palm fronds, rubber leaves, and banana sheaths play a crucial role in the development of cultural souvenir products. Their transformation into functional materials not only adds economic value but also reflects the principles of the circular economy by promoting resource efficiency and waste reduction. The utilization of these materials in Satun Province demonstrates that agricultural residues can be reprocessed into pulp for handmade paper or molded packaging capable of supporting weights between 0.5–3 kilograms depending on size. However, since the material remains sensitive to water and flammable, further improvement is needed through technical innovations such as fiber blending and bio-based coating to enhance durability, flexibility, and water resistance while maintaining biodegradability.

The satisfaction assessment from two participant groups indicated consistently positive results. During the prototype development stage (N = 30, including designers and experts), the mean satisfaction score was 4.77 (SD = 0.50), showing a very high level of approval. In the broader evaluation stage (N = 385, comprising near-retirement individuals, tourists, and community members), the mean score was 4.40 (SD = 0.81), indicating high satisfaction. These findings confirm the design's acceptance in both professional and community contexts. Among the prototypes, Prototype 3 achieved the highest scores, demonstrating an optimal balance of aesthetic appeal, usability, and environmental sustainability, while effectively representing local identity.

The developed souvenirs possess distinctive cultural value, reinforcing Satun's local identity and providing opportunities for elderly employment and income generation. This supports sustainable creative-industry development and aligns with Roseland (2000) on the importance of sustainable community design. Moreover, the products have already been introduced into local markets, contributing to economic self-reliance. In the long term, such initiatives embody the UN Sustainable Development Goal 12 (Responsible Consumption and Production) (United Nations Department of Economic and Social Affairs, 2025) and serve as models for circular design practices that connect creativity, environment, and community well-being.

Suggestions

1. **Technical Enhancement:** Future research should focus on testing the physical and mechanical properties of fiber-blended materials, particularly water resistance and tensile strength, to improve durability and expand practical applications.

2. **Product Design Development:** Design adaptations should emphasize user-friendly forms suitable for elderly producers and consumers, integrating ergonomic and multipurpose functions while retaining cultural motifs.

3. **Community and Skill Development:** Continued training programs should be organized for local producers and elderly artisans to strengthen design, production, and marketing capabilities, promoting community entrepreneurship.

4. **Networking and Collaboration:** Strengthen partnerships among universities, local enterprises, and government agencies to support product standardization, certification, and broader market access.

5. **Sustainability Integration:** Encourage regional development plans to include agricultural-waste utilization and creative-economy strategies that enhance circular production systems and environmental awareness.

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