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Analysis of the Characteristics of Post-Harvest Turmeric Stems Waste for Sustainable Interior Fillings

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Abstract

This study examines the potential of turmeric stems (*Curcuma longa*) as an alternative raw material for sustainable crafts. The research employed a qualitative descriptive approach through observation, interviews, and simple tests on the strength and elasticity of turmeric stems. The results indicate that turmeric stems possess unique natural fibers, a yellowish-brown color, and a distinctive aroma that provides high aesthetic value. Natural drying for 10–14 days produces a stable structure without cracks, while soaking in a betel leaf and salt solution naturally prevents mold growth. Mechanically, the material has about 20–30% of the strength of bamboo and is sufficiently flexible for non-structural products such as containers and interior accessories. The utilization of post-harvest turmeric stem waste contributes to reducing agricultural waste and enhancing the creative economy based on local resources. This study emphasizes that turmeric stems hold strategic potential in eco-friendly craft innovation, combining aesthetic value, functionality, and sustainability.

Keywords: eco-friendly innovation, natural material, sustainable craft, turmeric stem

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1. Introduction

The global environmental crisis including climate change, land degradation, and the increasing volume of organic and inorganic waste has raised awareness and fostered the growth of sustainable lifestyles (Amrullah & Sakbani, 2023). *Back to nature* has become one of the prominent slogans in promoting environmentally friendly consumption, production, and products. Among its key aspects is encouraging the use of alternative materials to replace non-renewable synthetic resources.

Products made from natural or organic waste materials are increasingly popular, as they are considered to have lower ecological impacts and are safer to use, thereby contributing to the reduction of environmental damage. In the context of handicrafts, the *back to nature* principle has led to the creation of products that are not only aesthetic and functional but also rich in ecological value. People's orientation toward handicraft products has shifted from mere visual appeal to tangible contributions to environmental sustainability (Ahmad et al., 2024).

The concept of *eco-friendly craft innovation* in the creative industry has evolved by integrating aesthetics, functionality, and sustainability. This concept emphasizes the use of renewable resources managed through innovative approaches that generate economic value while supporting environmental conservation. Environmentally friendly craft innovation is not only creativity-oriented but also considers the product life cycle, from material selection to recycling potential (Windrianto et al., 2016).

Handicraft production, which relies heavily on manual skills, is generally found in suburban, village, and rural areas. Efforts to harmonize processes and eco-friendly products have been successfully implemented using materials such as bamboo, banana midribs, rice straw, and corn stalks, all of which have been transformed into various craft products (Bahrial, 2021; Haidar & Wahmuda, 2019; Purwandaru et al., 2021; Setyowulan & Kusumaningrum, 2023). Processing such waste materials not only reduces disposal waste but also utilizes biodegradable substances.

Farmers, as professionals closely connected to nature, cultivate plants based on their utility—such as food, vegetables and fruits, fiber, oil-producing, ornamental, medicinal, and animal feed crops. *Empon-empon* (traditional rhizomatous herbs) are among the most abundant and multifunctional agricultural plants. This group includes *temu mangga*, *temu lawak*, *temu ireng*, ginger, *bangle*, turmeric, and *kencur*. One of the *empon-empon* species with soft, flexible, strong, and aromatic stems is turmeric. These stems hold potential as sustainable craft materials. However, post-harvest turmeric stems (waste) remain underutilized. Therefore, analyzing the characteristics of turmeric stems as a sustainable craft material is essential.

Turmeric (*Curcuma longa*) is widely known as a spice, natural dye, and herbal medicine, yet studies on its stem remain very limited (Winarto, W.P., 2004), despite its potential to expand the range of environmentally friendly materials for crafts. Turmeric grows in clumps with pseudostems measuring 25–100 cm in length and reproduces vegetatively, with a harvesting period of 7–10 months (Rohmah, 2024). In this context, the neglected post-harvest turmeric stems can serve as research objects due to their unique fibers and textures.

Morphologically, turmeric stems exhibit fibrous tissue with distinctive textures that may serve as craft materials like bamboo, banana midribs, rice straw, and corn stalks, which are already commonly used in handicrafts. However, comparative analysis of the strength, mechanical properties, elasticity, and texture of turmeric stems is crucial for advancing eco-friendly craft studies.

The lack of research on turmeric stems as an alternative material highlight both academic and practical gaps. Academically, this study broadens the literature on agricultural waste–based material innovation, focusing on material assessment. Practically, it provides valuable references for artisans and the creative industry in selecting materials that are not only aesthetic but also functional, durable, and sustainable.

2. Research Methods

This study employs a qualitative descriptive approach supported by empirical analysis to examine the potential of turmeric stems (*Curcuma longa*) as a sustainable craft material. This approach was chosen to explore the morphological characteristics, texture, fibers, and elasticity of turmeric stems, which have not been optimally utilized after harvest. The first stage involves data collection. Data was gathered through direct observation of the physical conditions of turmeric stems, interviews with farmers and local artisans regarding material availability and feasibility, and a literature review of previous relevant studies on the use of natural materials and agricultural waste in environmentally friendly crafts. Furthermore, simple tests on the strength and flexibility of turmeric stems were conducted and compared with other natural materials commonly used in the craft industry, such as bamboo, banana midribs, and rice straw.

The second stage is data analysis. The collected data were analyzed descriptively to describe the visual and functional characteristics of the material, along with simple quantitative analysis to assess its mechanical strength. The third stage is data validation. Data validation was carried out using source and method triangulation techniques by comparing observation results, interview data, and literature findings to ensure the accuracy and consistency of the results. Discussions with natural material experts and craft practitioners were also conducted to strengthen the validity of the findings. The fourth stage is data presentation. The validated data were presented in the form of narrative descriptions, comparative tables, and visual documentation to illustrate the potential of turmeric stems as an alternative material for eco-friendly craft innovation that fulfills the values of aesthetics, functionality, and sustainability.

3. Results and Discussion

Physical and Aesthetic Characteristics of Turmeric Stems

Field observations and morphological analysis revealed that turmeric stems possess unique natural fiber characteristics with varying patterns and textures among individual stems. The fibers tend to extend longitudinally with irregular arrangements, creating an organic and natural visual effect. The base color of the turmeric stem, ranging from brownish to yellowish hues, gives a warm, natural, and distinctive impression that differentiates it from bamboo or rattan. This uniqueness has the potential to provide high aesthetic value within the context of environmentally friendly craft design. In addition, the distinctive natural aroma of turmeric stems offers a multisensory experience that can enhance the market appeal of products made from natural materials.

Fiber texture observations showed that variations in fiber patterns are influenced by differences in maturity levels and moisture content within the stems. After a natural drying process lasting 10–14 days, the fiber

structure becomes more stable and rigid, with a darker color tone. This indicates that turmeric stems have good physical adaptability to the drying process without significant cracking or deformation. Such stability strengthens their potential as a material for decorative and non-structural products, such as containers, frames, or interior accessories.

Comparative Analysis of Natural Materials

Based on comparative analysis with other natural materials, turmeric stems exhibit characteristics that fall between bamboo and rattan. The mechanical strength of turmeric stems is categorized as moderate lower than bamboo, which has a strong hollow cylindrical structure but still suitable for decorative and light functional applications. In terms of flexibility, turmeric stems are less pliable than rattan; however, they offer advantages such as being lightweight and easy to shape after soaking in water for several hours. These properties provide flexibility in design exploration and improve energy efficiency during the crafting process.

Table 1. Comparison of Turmeric with Natural Fiber Materials: Rattan and Bamboo

Aspect	Turmeric Stem	Bamboo	Rattan
Availability	Post-harvest turmeric waste, easily obtained in turmeric-producing areas.	Abundant, commercially cultivated.	Available from community forests, slower growth rate.
Texture & Aesthetics	Unique natural fibers with varied patterns, yellowish-brown color.	Long, fine fibers with greenish-yellow hue.	Smooth surface, ideal for weaving.
Strength & Durability	Moderate; requires natural drying and preservation.	Strong and durable.	Flexible and strong, but sensitive to moisture.
Processing & Energy Use	Natural drying and preservation; low energy consumption.	Simple drying process; moderate energy use.	Traditional preservation; high manual labor demand.
Environmental Impact	Reduces agricultural waste; low carbon footprint.	Environmentally friendly if managed sustainably.	Dependent on sustainable forest supply.
Market Value Added	High potential due to unique visual appeal.	Widely accepted in the global market.	Popular products: profit margins depend on design.

Material Processing Process

The natural drying and preservation process serves as a key stage in maintaining the stability of turmeric stem material. Test results indicate that gradual drying for 10–14 days at room temperature produces a stable material without major cracks, while preserving the natural color and fiber integrity. Meanwhile, soaking the stems in a natural solution made from betel leaf extract and salt has proven effective in inhibiting fungal growth and strengthening inter-fiber bonds naturally. This approach aligns with the principle of eco-friendly processing, which emphasizes the use of renewable resources, avoidance of synthetic chemicals, and low energy consumption (Windrianto et al., 2016).

Simple physical endurance tests show that turmeric stems can withstand light compressive loads approximately 20–30% of bamboo's strength while maintaining good elasticity after complete drying. However, the high moisture content in fresh stems makes them prone to decay if not properly dried. To enhance mechanical performance without compromising sustainability principles, this study proposes the application of twisting and weaving techniques as natural reinforcement methods for turmeric stems.

The twisting technique involves partially dried stems being twisted into tightly wound, spiral structures to increase compactness and strength. The weaving technique uses split turmeric stems processed into fiber sheets, which are interlaced to improve tensile and compressive resistance. Both methods enable the formation of more resilient and stable natural composite structures, while also opening new design opportunities for sustainable craft products (Apriyanti, 2018).

Turmeric Stem Rope Making

Turmeric stems can be utilized as raw material for rope making. The process involves combining several stems into a single coil. The number of stems used depends on the desired rope diameter. For craft industry applications, the standard diameter is around 8 mm, typically made by twisting three stems together. The stems

are continuously joined and elongated through rolling, twisting, and spinning motions. Depending on the number of twists, the resulting rope can consist of two-ply or three-ply strands. Below is the process of manual rope production using turmeric stems.

Figure 1. Twisting Activity Process to Form Rope.

Weaving Process to Form Sheets

Weaving has been a method of fabric production for centuries (Ullu et al., 2022). Yarn serves as the primary material used to produce woven sheets. Weaving itself is a fabric-making technique that interlaces longitudinal threads (warp) with transverse threads (weft). Over time, this technique has evolved into various patterns and material combinations, resulting in a wide range of woven products.

Originally, weaving was performed manually, but modern developments have introduced advanced mechanical weaving systems. However, machine-based weaving requires significant investment and often leads to the overexploitation of natural resources. Traditional weaving using non-mechanical looms (*Alat Tenun Bukan Mesin* or ATBM) begins with warping, which involves arranging threads in parallel on the loom beam (Gravitiani et al., 2018). The next stage, threading, involves inserting each thread through the eyelets of the heddles, followed by reeding, where the warp threads are passed through the reed. The ends of the threads are then tied to the fabric beam. The experimental utilization of post-harvest turmeric stems seeks to replace or complement traditional yarns in the warp or weft. This experiment explores the potential of weaving turmeric stems into sheets, aiming to transform agricultural waste into functional and aesthetic eco-friendly materials.

Figure 2. Woven Sheet Made from Turmeric Stems

Social and Economic Relevance in Sustainable Crafts

The utilization of turmeric stems offers not only ecological benefits but also significant social and economic advantages. As abundant agricultural waste, their use can increase farmers' income while reducing the volume of organic waste in farmland. Within the creative economy, the unique fibers and visual characteristics of turmeric stems can differentiate local products in the eco-friendly craft market. Modern consumers, particularly environmentally conscious younger generations, are attracted to products that embody sustainability narratives and local authenticity (Putra et al., 2024).

This study also highlights the potential for collaboration among artisans, farmers, and academics in developing innovations based on natural materials. With proper technical training, turmeric stems can be

transformed into high-value products such as household accessories, photo frames, table lamps, or natural packaging. Such innovation supports the Sustainable Development Goals (SDGs), particularly responsible consumption and production (SDG 12) (Obaideen et al., 2022).

Interpretation and Implications of Findings

The findings strengthen the position of turmeric stems as a potential material for eco-friendly craft innovation that integrates aesthetics, functionality, and sustainability. Ecologically, their use contributes to reducing agricultural waste and carbon emissions. Socially, it creates employment opportunities in rural communities through processing and craft production activities. Economically, it generates products with distinctive visual appeal and sustainability narratives, which hold high market value.

Turmeric stems show strong potential for development as raw material for functional crafts, such as multipurpose containers, interior decorations, and household accessories. Natural drying and preservation maintain fiber structure, producing a distinctive visual appearance. Variation in texture among stems ensures each product possesses an authentic character and aesthetic value. This supports Hertati et al., (2021) who argue that utilizing local materials with distinctive characteristics can create high-value product differentiation in the sustainable creative industry.

Using turmeric stems as a craft material also represents tangible eco-friendly innovation, emphasizing agricultural waste reduction and optimal use of local resources. This aligns with the eco-friendly craft innovation concept by Amrullah & Sakbani (2023), which emphasizes integrating function, aesthetics, and sustainability. Plant-based coatings and low-energy traditional finishing techniques further enhance their ecological value. Compared to bamboo and rattan, turmeric stems offer advantages in material availability and unique natural textures, appealing to eco-conscious markets. Furthermore, using post-harvest waste supports circular economic practices, reduces organic waste, and creates new economic opportunities at the village level (Putra et al., 2024).

However, several technical challenges must be addressed in processing turmeric stems. High moisture content makes them susceptible to decay if not properly dried. Additionally, their relatively fragile nature limits their use in structurally demanding products. These observations align with Apriyanti (2018), who emphasized that moisture content is a critical factor in preserving organic materials. Gradual drying, soaking in natural solutions, and adding organic fibers have been shown to enhance turmeric stem durability without compromising eco-friendliness.

Overall, this study demonstrates that turmeric stems have strategic potential as an alternative material for sustainable crafts. With unique fibers, lightweight properties, and high availability as agricultural waste, turmeric stems integrate ecological, economic, and aesthetic values in a single innovative material. Proper processing techniques and creative design support can strengthen their position in the eco-friendly craft market while offering practical solutions for waste reduction and local resource–based creative industry development.

4. Conclusions and Recommendations

This study demonstrates that turmeric stems (*Curcuma longa*) have significant potential as a raw material for sustainable, eco-friendly crafts. Their unique natural fibers, varied textures, and distinctive color provide high aesthetic value and authenticity to craft products. Analysis results indicate that gradual drying for 10–14 days at room temperature produces a stable material, while soaking in a natural solution of betel leaf extract and salt effectively prevents fungal growth and strengthens the fiber structure. Physically, turmeric stems exhibit light to moderate compressive strength (approximately 20–30% of bamboo's strength) and sufficient elasticity, making them suitable for non-structural products such as containers, interior decorations, and household accessories.

Based on these findings, it is recommended that future studies focus on optimizing natural drying and preservation techniques to enhance the stability and durability of turmeric stems against moisture and microbial attack. Further experiments on the application of twisting and weaving techniques, with variations in material moisture and thickness, are necessary to achieve optimal mechanical strength. Research on combining turmeric stems with other natural fibers, such as banana fiber or coconut coir, is also important to develop more resilient yet environmentally friendly composite materials. Additionally, attention should be given to product design, natural finishing innovations, and market analysis to ensure the economic sustainability and competitiveness of turmeric stem crafts within the sustainable creative industry.

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