

Alternative Pineapple Fibre Advancement in Furniture Design

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Abstract

Malaysian agriculture, centred on pineapple fruit, needs help with the extended decomposition of pineapple leaves, resulting in wasteful disposal methods. This study proposes repurposing discarded waste into sustainable materials for furniture production. Utilizing pineapple leaf waste innovatively can yield eco-friendly alternatives, particularly in crafting tabletops. This approach addresses environmental concerns and aligns with the imperative of fostering sustainable agriculture practices in Malaysia.

Keywords: Pineapple leaves waste, sustainability, material, furniture design, manufacturing

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1.0 Introduction

The investigation focuses on using recycled materials derived from pineapple waste to manufacture furniture parts. Pineapple waste was chosen for this project because it produced the most waste, particularly after harvesting the leaves. The long-term effects of crop waste burning, including the burning of pineapple leaves, have been noted in a study of pineapple harvesting in Malaysia. 1.2 million tons of agricultural waste were recently disposed of (Nur Aziera Ruslan et al., 2017). Leaves are one of the wastes; most plants are not used at this time. However, in pineapple picking activities, farmers will give priority to pineapple fruit because pineapple fruit has obtained a wide range of market resources in the production of food and cosmetics. Besides, after the tree bears fruit and is picked, it will produce seed suckers and the leaves will be removed (Amy Grant, n.d). According to the article, the expanding pineapple plantation industry significantly upsets the balance of the environment and fuels the growth of environmental pollution (Professor Dr Aizi, 2020). In pineapple cultivation, leaves can be further processed to produce value-added products, resulting in a more sustainable agriculture industry. Many unused parts, such as leaves, stems, and outer skin, can be repurposed to make new products and be used in the market (Nur Aziera-Ruslan et al., 2017). Because of the study, several innovations, such as using pineapple waste in decomposable pots and commercialization, have been implemented (Jirapornvaree, 2017). Much past research has already been done on pineapple leaf fibre as a product in textiles—footwear, clothing and accessories, home textiles, upholstery, and interior decoration. However, because pineapple waste composite has strength and aesthetic value as an alternative to new material in Malaysian furniture manufacturing, pineapple leaf waste derived from pineapple fibre has potential that should be explored. As environmental awareness has grown, so has a concern about environmental sustainability. The expected outcome will propose an alternative new material from pineapple leaves waste in making furniture design, part of tabletop.

1.1 Issue Furniture Design

The Malaysian furniture industry is the country's fastest-growing sub-sector within the wood-based industry, and its socioeconomic importance cannot be taken lightly (Ratnasingam J., 2018). In the Malaysian industry, old furniture is standard in landfills and dumpsites (Azalea Azuar, 2021). According to the statement, most Malaysians must learn how to properly discard their old furniture and treat it like any other household waste (Azalea Azuar, 2021). "One of the best ways to get rid of old furniture is to trade them in when buying some

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new ones" (Azalea Azuar, 2021). From the statement, Malaysians say that recycling furniture is complex, impacting the environment in landfills. Malaysian people throw the furniture away because the items are made with poor-quality materials and offered at low prices that many consider disposable, expensive, or difficult to repair, sell, or donate (Anonymous, 2020).

Other than that, using thin structural materials made of wood and wood is a current issue and essential for modern furniture design (Vassil JIVKOV & Boryana PETROVA, 2020). In recent years, elegant and thinner furniture has become increasingly popular. Furniture structural design from thin materials has aesthetic and ecological aspects related to less raw material consumption. This reduces furniture weight, which is essential for transport and furniture operation. New rules related to the green economy also require design solutions that reduce the consumption of raw materials on the planet, solutions that allow a second life for furniture, and reuse or recycle used materials (Vassil JIVKOV & Boryana PETROVA, 2020).

1.2 Issue Challenges of Sustainability

Since Malaysia is today the world's 10th largest producer of furniture, 3rd in Asia, and 2nd in the ASEAN region (MFPC,2009), furniture design is an important area to consider for implementing sustainability. Challenges of employing sustainability could vary depending on product type, knowledge of established principles, consumers' expectations, manufacturers' policies, facilities, legislation, local resources, etc. In the Malaysian furniture industry, a survey conducted in 2009 revealed that the adoption of green manufacturing practices is limited among wooden furniture producers (Ratnasingam & k. Wagner, 2009). Another study in 2008 discovered that the readiness to adopt chain of custody certification among wooden furniture manufacturers was low (Ratnasingam et al., 2009). This certification ensures that wood products come from an environmentally certified source. Although the number of studies on the environmental aspect of the furniture industry still needs to be more prominent in the country, all results demonstrate the poor implementation of sustainability (Shabboo Valipoor & Baharudin Ujang, 2011). In addition, integrating sustainability into the furniture industry has yet to be studied from a design perspective. When companies embrace sustainability issues in their product design practice, they must develop their definitions of sustainability and ensure that the new principles are operational. Design managers frequently meet challenges such as making suitable design policies, controlling and evaluating SD processes, and improving organizational learning (Shabboo Valipoor & Baharudin Ujang, 2011). Management and design tools must also be identified to integrate existing corporate resources into the sustainable product design process (Yang Y, 2005). Many challenges would also arise due to some decision-makers. Designers must also know how to deal with these kinds of challenges. Finding a patron to support SD concepts like a sympathetic upper manager, being up-to-date about environmental policies, and trying to work with the positive parts of these policies rather than thinking about applying pressure to change the policy are some of the suggested ways to face these challenges and encounter obstacles in corporations (IDSA,n.d).

2.0 Literature Review

The researcher discusses the literature review in a few sections in this chapter. Furthermore, this project is linked to several researchers interested in sustainability, materials, and furniture design. This study's researcher is concerned about environmental sustainability and contributes to the sector's furniture by making a table part from sustainable material from pineapple leaves waste.

2.1 What Can Pineapple Leaves do?

Pineapple leaves are the result of the cultivation of pineapple trees. According to the article, many unused parts, such as leaves, stems, and outer skin, can be repurposed to make new products and used in the market. (Nur Aziera-Ruslan,2017). As a result of the study, several innovations, such as using pineapple waste in the production of decomposable pots and commercialization, have been implemented (Jirapornvaree,2017). Furthermore, pineapple waste can be used to create drones, liquid cleaners, and other products (Chandra,2022), and the famous pineapple leaf products can be used, such as in pineapple thread from the extraction. The researchers will investigate and develop various potential structures of compostable agricultural waste to create a new material for indoor furniture innovation based on the preceding.

2.2 Pineapple Leaves Extraction

According to research, pineapple leaf waste will be extracted into fibre and then dried. To ensure the quality and colour of this pineapple fibre yarn, it should be dried immediately and then exposed to the sun for 2-3 days (Anonymous, 2015). According to the article, the next step is to spin the pineapple thread after it has dried. Weaving yarn and spinning are the finishing processes that require skill, patience, and perseverance. In general, 10kg of pineapple leaves can be processed to yield 100 grams of pineapple yarn, which can be used to create a 1-meter-long pineapple yarn fabric (Anonymous,2015). This effort is appropriate for areas with a high concentration of pineapple crops, as pineapple leaf waste can be used to produce a valuable product.

2.3 Raw Material

The raw material used in this study will be pineapple leaf waste, which will be used as an alternative to produce fibres. An experiment will be conducted to investigate the criteria and strengths. Pineapple leaf fibres can be extracted manually, by retraction, or mechanically using a decorticator. The process in each manner, however, involves the separation of the fibres from leafy components and gummy substances. After extraction, fibrous strands are split up into their components (Ifeanyi Charles Okoli, 2020). According to the article, a plate or blunt knife can also be used to collect the fibre to scratch the pineapple leaf on a flat surface (Gameda Gabino,2019).

2.4 A part of Furniture Design

Furniture pieces are designed and fabricated to assist in how people sit and rest, work and play, organize or display items, and partition space. Although function, utility, and social use are essential aspects of furniture performance, function rarely inspires excellent design. Furniture design draws upon ideas of beauty, the principle of the technique, theory, materials properties, fabrication technologies, business economies, environmental design matters, and the surrounding spatial context in which it is placed, all of which are integral and intertwined with function, utility and social use (Anonymous, n.d). In order to create a furniture design, it must be developed and prepared for manufacture, focusing on aspects of furniture that relate to human usage and behaviour, product appeal, and fashion (Design Institute of Australia n.d). In addition, the tabletop is the most critical part, the one that stands out and is also the one that is used most intensively. Rectangular table tops are the most popular, ideal for kitchens and dining rooms; nonetheless, it is expected to find tables with round or oval tops, usually chosen for more formal environments. Furthermore, because a table is the focal point of the furniture in the house, its components must blend in with the surroundings (Archiproducts,n.d).

2.5 Introduction of Coffee Table

Everyone needs a coffee table in their home; it serves as an elegant centerpiece for the room, a place to put drinks or books, and, on occasion, a place to work on your laptop. The coffee table can display decorative items and food and drinks. Occupants would devote a significant amount of time and resources to organizing the living room furniture based on their personal preferences, needs, and priorities within the confines of the available space (Saruwono et al., 2012). Modern furniture, lacking historical or cultural tradition, also laid the foundation for future creations. For the new citizen, the modern design provided rectilinear, smooth, polished, and comfortable furniture (Hasirci & Ultav, 2019).

2.6 Standard of Coffee Table

Although the coffee table does not have a standard height, smooth, low, modern furniture will match a table with linear lines about 15" high. Gignac (2020) stated that in the 17" to 19" range, a more traditional setting would require something beefier. He says this does not mean going the matchy-matchy route; combining styles can create a more dynamic, inviting environment. Choosing the right coffee table is very important to elevate the place in the living room. According to Tzetses (2019), the height of the coffee table should align with the cushions of your sofa and other seating to ensure it is comfortable and aesthetically balanced. A shorter coffee table of a few inches will also work well. "Coffee tables vary depending on the design from 10"-18", which is 25-46 cm" (Fantastic Offense, 2019). The height of the coffee table must be the same or lower than a sofa. The nearer the coffee table to the sofa, the higher the height of the coffee table. Coffee tables should be approximately the same height or 2" lower than the adjacent couch.

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3.0 Methodology

This research methodology focuses on investigating the natural properties of pineapple leaf fiber, including its physical characteristics, material preparation, and experimentation process, and there will not be any participation in the exploration study. The researcher will gather data on product design, images, and materials to create table furniture derived from pineapple leaves. The study will involve generating sketches, exploring ideas, testing mockups, and designing a prototype coffee table. The researcher will then analyze and facilitate critique sessions in furniture design.

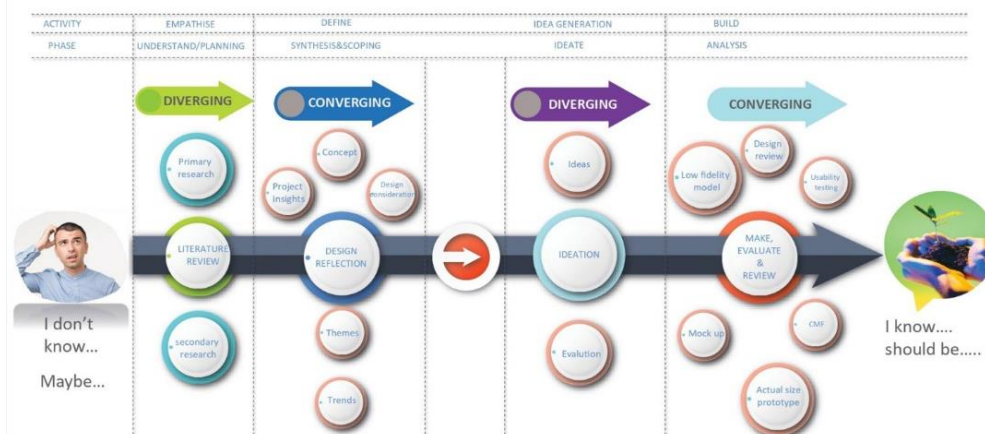


Fig. 1: Research Framework

3.1 Data Collection

Data collection encompasses the instruments and procedures utilized in research. In this study, the required data were obtained through experiments conducted on pineapple fibre, observations, and the identification process using the literature review method.

3.2 Technique and Instrument

The qualitative data was gathered through experiments conducted by the researchers. The researchers gathered the data through observations and experiments. The observations were made by reading relevant articles and observing ongoing behaviours. The information gathered can be analysed and processed to reach meaningful conclusions.

3.3 Experimental

According to the information provided, the study is divided into two stages. The first stage involves material preparation to make compostable pineapple using pineapple fibre, and the second stage involves conducting experiments on the natural components and physical properties of pineapple fibre. In the experimental process, the pineapple fibre leaves are scraped by hand. This manual scraping process involves using a ceramic plate or a dull knife to extract the fiber from the pineapple leaves into long strands with a slightly yellow colour.

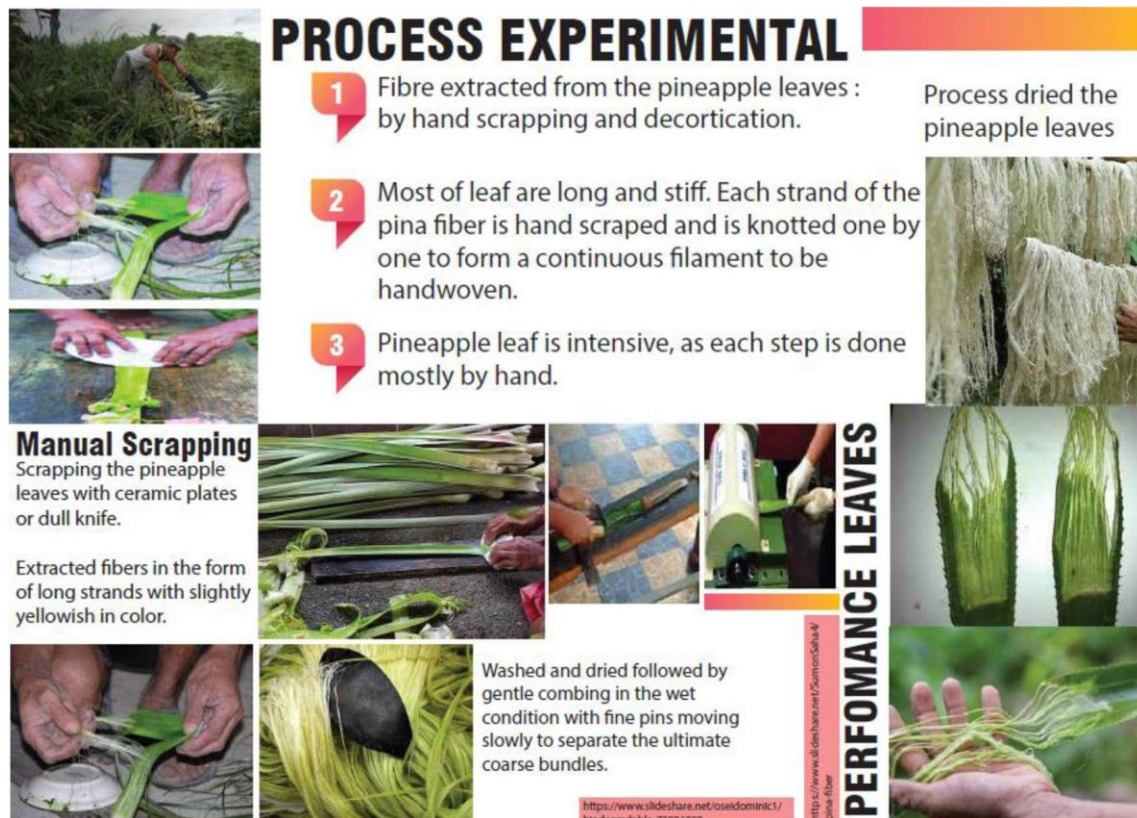


Fig. 1: Experimental of pineapple leaves

3.4 Final Preparation of Experimental

Types of material from pineapple leaf fiber that covered:

- The quality of pineapple fiber in the experiment
- To translate the idea of innovation form

Based on the figures below, a new procedure has been developed for creating an alternative material using pineapple fibre and other materials to construct a coffee tabletop. The following materials are required for this process:

- Pineapple Fiber (1 bag = 100 grams = 2.5 kg)
- Starch Flour (1 packet = 500 grams = 2.5 kg)
- Sawdust (1 kg)
- Recycled Paper (82 pieces of Paper)
- Water (5000 ml)
- Hot Water (2400 ml)
- These specific quantities and types of materials have been determined to create the desired tabletop.



Fig. 2.2: Final Preparation of Experimental

3.4.1 Procedure of the Experimental

Below are the steps that the researcher applied in these experiments, along with some accompanying pictures:



Fig. 2.3 Procedure of Experimental

1. Twenty-five bags of pineapple fibre were mixed, and the fibres were separated and cut.
2. Eighty-two sheets of recycled A4 paper were torn to facilitate the mixing process.
3. The torn paper was mixed with 2400 ml of hot water and crushed by hand for 2 hours.
4. Starch flour was used to create the glue mixture. This process required 2.5 kg of the mixture and 5000 ml of water. The mixture was heated on the stove at medium heat for 2 hours and 30 minutes to complete the preparation.
5. After the starch glue mixture was prepared, 2.5 kg of pineapple fibre was gradually mixed and blended until smooth. This procedure was carried out by hand.
6. Next, 1 kg of wood dust was measured and manually combined with the pineapple fibre and starch glue.
7. The final step thoroughly combined the crushed and mixed 83 pieces of paper. This procedure was done manually and took 2 hours and 30 minutes to complete.
8. After combining the three ingredients, a mould container was prepared and lined with plastic to prevent sticking and ensure smooth drying.
9. The drying process took 14 days under the sun.
10. Cracking at the edge of the mould container indicated that it had successfully dried.
11. The material is ready for use and requires finishing to achieve a new appearance.

3.5 Justification on Data Instrument

These experiments were carried out based on observations from previous articles, journals, videos, and improvements made by the researcher. The experiments conducted for this research involved testing and analysis by the researcher, with the results recorded and collected in a timetable. Additionally, the data collection and material selection led to the development of new alternative materials using pineapple fiber in furniture manufacturing, specifically table tops.

4.0 Findings and Discussion

According to the experimental results, compostable pineapple fiber has certain standard features. Based on these findings, the researchers collected data and conducted analyses to determine the best product design and improvement outcomes using commercially available materials. New materials made of compostable pineapple fiber will be used in furniture design, including parts of a coffee table. The innovative material research involved shaping and designing the furniture to make it more aesthetic and functional.

Based on the figure below, the material outcome can be observed. The upper part of the material, which was exposed to the sun during drying, has a darker shade, while the below part has a lighter shade. The thickness of the resulting material is 15mm. After approximately 14 days of drying, it is now ready to be used for the design of the coffee table. The outcome of the material is consistent with the previous experiment, as it exhibits strength, durability, and a unique texture.



Fig. 3: The outcome of the experimental

The results of this study contribute to the understanding that utilizing alternative materials derived from recycled pineapple fibre can help mitigate environmental pollution. This approach reduces costs and offers an additional source for furniture manufacturing in Malaysia, diversifying options beyond traditional wood materials. The widespread adoption of pineapple fibre in industrial design, particularly in consumer products, can significantly promote sustainable practices.

4.1 Final 3D Design Furniture and Final Models

As shown in the figure below, multiple views offer a comprehensive understanding of the design. The figure below displays the three-dimensional images of the final furniture product and final model. The wood pallet is chosen for the final model due to its strength, durability, cost-effectiveness, and availability. Wood pallet is well-known for its durability and resilience while being a more affordable and eco-friendly material. This cost-effectiveness makes it an appealing option for creating a final model without significantly inflating project expenses. Furthermore, the wood pallet is readily available in various sizes and grades, ensuring easy accessibility for researchers.



Fig. 4: Final 3D Design Furniture: coffee table

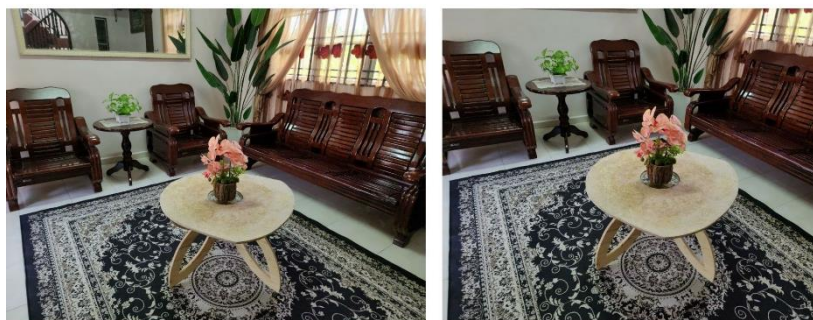


Fig. 5: Final Model based on compostable pineapple fiber as a new alternative furniture material: a section of the table's top

For future researchers conducting similar experiments and material mixing, it is recommended to have sufficient human resources to assist, as excessive material loads can make the mixing process challenging. Furthermore, to enhance the material's durability, it is advisable to increase its thickness by incorporating more pineapple fibre. Proper drying procedures should ensure that the material is dehydrated and free from unpleasant odours. Lastly, employing accurate measurements and precise experimental procedures for improved results is essential. This ensures the success of the research methodology and facilitates the utilization of the procedure by other researchers or practitioners. In summary, the study's findings emphasize the potential of recycled pineapple fibre as an environmentally friendly alternative material, reducing pollution and offering cost-effective options for furniture manufacturing. Future researchers should consider human resources assistance, increase thickness, ensure proper drying, and maintain accurate measurements throughout the experimental process to further enhance the material's properties.

5.0 Conclusion & Recommendations

This study successfully developed an alternative sustainable material without chemical products. The study achieved its goals, which included exploring the potential of pineapple leaves as an innovative material for furniture, examining the material innovation process of pineapple leaves, and designing a table part using pineapple leaves as the primary material. These objectives have been accomplished, leading to the identification of a new sustainable material that can serve as a viable alternative to wood and promote environmental sustainability.

Furthermore, this study material offers potential applications in industrial design, providing unique textures for table tops and other products. In conclusion, the successful outcomes of this research open up avenues for future studies, particularly in understanding how to effectively attract individuals, industries, and designers towards adopting sustainable materials.

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