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Research Article

The Local Wisdom to Innovative Utilization of Banana: Wall Panel Decoration from Banana Tree Fibers to Strengthen the Grassroots Economy of Ramdang Community, Singhanakhon District, Songkhla Province

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Abstract

This study aimed at improving and developing the existing capital of the community by using local wisdom to produce innovative products. The concept of this study is to develop agricultural waste into innovative products that can be produced by the community by using simple tools and processes. This is in order to create added value to the agricultural waste. The research methodology and experiment methods are as follows: 1) survey of the potential and resource utilization of Ram Daeng Community; 2) exploring the needs for innovations derived from the banana trees; 3) study and experiment on the utilization of banana trees; 4) strength test of banana sheath fibers; 5) community participation; and 6) design and presentation of complete creative works. This study examined local knowledge, production, and preservation processes of banana ropes, as well as understanding the problems and solutions for the community by conducting a survey of the needs of 145 consumers from 7 occupations. The results obtained were used in the development and creation of decorative wall panels from banana sheath fibers. The results showed that 2.5 cm. banana sheath fibers were suitable and in line with local wisdom in producing banana fibers. However, the laboratory results revealed that banana fibers had low elongation and strength and were not suitable for compression. They were only suitable for interior wall decoration. The lessons learned from the community participation process and the limitation of the length of the material were used in the design of 30 x 40 cm decorative wall panels. Six wall panels were arranged into a larger panel of 60 x 120 cm. In addition, the calculation, measurement, and evaluation of the return on investment of banana fiber wall panels revealed that the cost was 88.64 baht per panel. The selling price of a banana fiber wall panel can be 150 baht. The banana fiber wall panels should be sold in packages of 6 panels per box, which is the standard size of construction materials sold in the market.

Keywords: Local Wisdom, Innovative, Wall Decoration, Banana Fiber, Grassroots Economy

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Introduction

Currently, Thailand is driving the country towards the "Thailand 4.0" era, which focuses on development towards stability, prosperity, and sustainability, building strength from within the country. The aims are to transform the infrastructure and drive the economy through innovation. This policy also attaches great importance to the community in creating innovations and innovators, applying knowledge to change and manage problems in the community towards self-reliance and sustainability, as well as creating cooperation between the government sector, the private sector, and the public sector. Each community has its knowledge, resources, and local wisdom as the original capital with potential. However, there is a lack of lack management, creativity, new knowledge and external cooperation to add value and enhance the community economy in an effective manner.

The Faculty of Architecture, Rajamangala University of Technology Srivijaya and Ram Daeng Community, Ram Daeng Sub-district, Singhanakhon District, Songkhla Province have established a cooperation in academic services and research since 2011. Ram Daeng Community is located approximately 16 kilometers north of Songkhla Town Municipality in the Songkhla Lake Basin and has a long history of its community establishment. The Ram Daeng Community has an excellent natural resource base and traditional cultural capital, including cultural heritage, such as house construction as well as wisdom and social capital, such as village philosopher and local wisdom. From field surveys, it was found that bananas, which are economic crops and the resource base of the Ram Daeng Community, are tropical, humid, fast-growing, easy-to-grow plants which can be found in all regions of Thailand. Native banana of Southern Thailand is considered the Queen of Bananas with the best quality. In the past, the villagers of the Ram Daeng Community used all parts of the banana tree. Banana ropes are used in handicrafts, but nowadays, their popularity has decreased. The study of local wisdom to create innovations requires an understanding of the problems and solutions for the community in using agricultural wastes available in the community in an upcycling process with the aim of increasing the value of materials. Michael Braungart and William McDonough, authors of Cradle to Cradle: Remarking the way we make things, define recycling as making useless materials more valuable or useful by using an innovative design process. Design Thinking refers to adapting and applying a designer's thinking science in accordance with the business nature of the organization in order to create solutions or innovations that meet the needs of organizations and users (Center for Creative Design, 2016).

The issues found during the field survey and the resources of the Ram Daeng Community were integrated with the research team's architectural knowledge in order to lead to an innovative design process. The local wisdom of banana rope was used to add value and improve the grassroots economy of Ram Daeng Community, Singhanakhon District, Songkhla Province, with the idea to develop agricultural wastes into innovative products that can be produced by the community using simple tools and simple processes.

Objective

To study the resources and local wisdom for developing decorative wall panels from banana sheath fibers using an innovative design process to improve the grassroots economy of the Ram Daeng Community, Singhanakhon District, Songkhla Province.

Literature Review

Banana is a plant native to Southern Asia, and there are many species of bananas (Khumhan, M., Suwanphom, N & Narangsak, P, 2016). In Thailand, bananas native to the South, especially Nam Wa bananas, are considered the queen of native bananas and can be found both seeded and seedless. In the past, villagers have used every part of the banana tree, and banana ropes have been used to make wicker handicrafts for household use with various patterns and shapes, such as baskets, handbags, etc. This wisdom can be found in many southern provinces such as Songkhla, Phatthalung, Nakhon Si Thammarat, etc. Only the stems of 7-month-old banana plants are used. The outer sheaths of the stem are peeled off and cut into 1-inch strips called Tok. These strips are then sun-dried and pressed into flat sheets to be used in the production of wicker products (Plant Genetic Conservation Project Under the Royal Initiative of Her Royal Highness Princess Maha Chakri Sirindhorn RSPG, 2020). Thailand is an agricultural country and produces a large number of natural fibers after the harvest season. Natural fibers are polymers that have been used by humans for a long time, such as banana fibers, sisal fibers, palm fibers, coconut fibers and pineapple fiber. The production process of banana fiber has been greatly developed, which involves peeling of banana sheaths, drying or sun drying, and incubation with

sulfur to increase the strength of the fibers to prevent fungi and insects. The development and transformation of agricultural waste into different products and innovations using local wisdom requires knowledge and theory of the innovation design process. Design Thinking refers to adapting and applying a designer's thinking science in accordance with the nature of the organization's business in order to create solutions or innovations that meet the needs of organizations and users (Thailand Creative & Design Center TCDC, 2016).

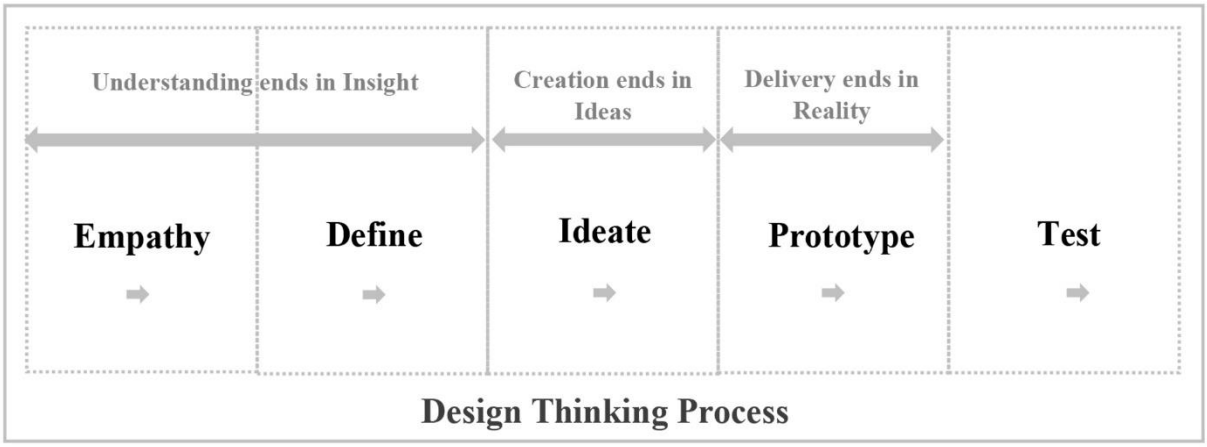


Figure 1 5 Steps of the Design Thinking Process
Source: Damnuirawat, 2023
(5 steps of design thinking process guidelines to development and transformation of agricultural waste into innovative products)

Design Thinking consists of five steps of the thinking process. The first and second steps are "Empathize" and "Define", which involve studying the problem, understanding the problem and interpreting the problem in a comprehensive manner. The third step is "Ideate" which involves creating creative concepts from different perspectives. The fourth and fifth steps are transforming and developing the concept into a prototype for testing and putting it into practice (Thailand Creative & Design Center TCDC, 2016).

Research Frameworks

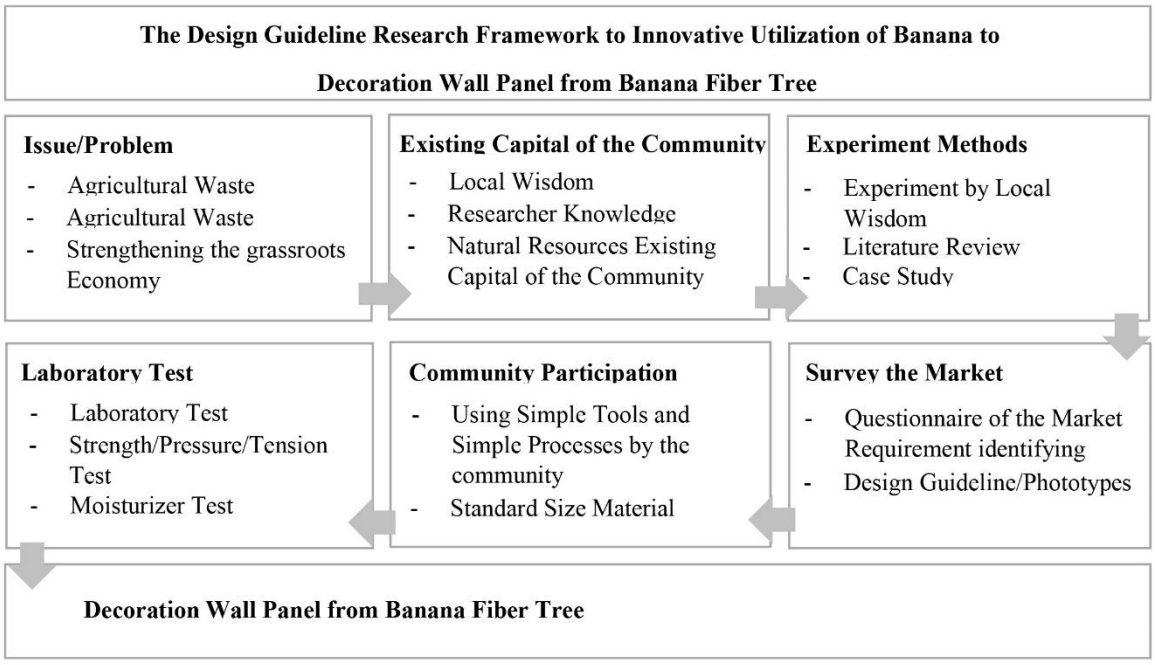


Figure 2 Conceptual Research Methodology Framework
Source: Damnuirawat, 2023
(6 steps of conceptual research methodology framework to innovative utilization of banana to decoration wall panel from banana fiber tree)

Methods

The research methodology and experiment methods are as follows:

1. Survey of potential and resource utilization of Ram Daeng Community;
2. Exploring the needs for innovations derived from the banana trees;
3. Study and experiment on the utilization of banana trees;
4. Strength test of banana sheath fibers;
5. Community participation process;
6. Design and presentation of complete creative works.

Survey of potential and resource utilization of Ram Daeng Community

The research team visited the community to study the potential and resource utilization of the Ram Daeng Community, including the utilization of agricultural resource, banana, which is a well-known economic crop of this community. It was found that bananas are processed into banana crisps by the community enterprise producing a large quantity of banana waste. After the bunches of bananas are harvested, many banana trees are cut down throughout the year and left to rot into fertilizer along the rice fields. These banana trees cannot be used as animal feed as they are old and have hard fibers. According to the literature review, the utilization of natural fibers has now gained a lot of attention due to their environmentally friendly nature and also responds to government policy on the reduction of plastic use. The use of natural fibers as components in building materials has been studied in many studies. In the past, villagers wove natural fibers, such as palm fibers, coconut fibers and pineapple fibers into curtains, chair covers, carpets and sacks. Banana fibers are often used to make ropes and basketwork. In addition, banana fibers have been studied and developed in fashion products. For example, Soiraya (2009) studied the development of clothing from banana fibers and found that it has good heat dissipation. Ban Chang Sakul Baisri Community Enterprise. Photharam District, Ratchaburi Province also produces bags from banana sheaths. The banana sheaths are cut into pieces and dried to remove moisture. The dried banana sheath is then pressed into a sheet overlaid on mulberry paper and sewn into products such as bags, hats, backpacks and file folders. Similarly, Katli Community Enterprise was formed by youths and housewives in Ban Pare, Village No. 2, Barahom Sub-district, Mueang District, Pattani Province. It is a group of banana leaf handicrafts using banana trees as raw materials, which are local resources, to develop into a variety of products, creating jobs and income for the community and people in Barahom Sub-district and nearby sub-districts. There are currently few studies on banana fibers for architectural applications. (Mostafa &Uddin, 2015) conducted a comparative study between conventional clay bricks and banana-fiber-clay bricks and found that the banana-fiber-clay bricks containing 60 mm. long banana fibers had 71% higher compressive strength compared to the conventional clay bricks. In addition, (Sherif, Sabry & Rakha, 2012) studied building materials, such as shading panels for residential buildings in desert areas and found that the shading panels made from wood materials reduced temperature and energy consumption by an average of 25%. They concluded that natural materials have a better shading effect and can reduce the heat entering the building.

Exploring the need for innovations derived from the banana trees

In this study, a Business Model Canvas was prepared in order to explore consumer demand for innovative banana products and to identify the target group in order to utilize the knowledge obtained from research as information in developing the questionnaire on consumer demand and behavior towards innovative design. The primary target groups in this study include government agencies, travel service operators, and designers/architects, while the secondary target groups include green consumers, building material stores, and those who are interested in home decoration using natural materials. The survey of consumer demand for innovative design with 145 people from 7 occupations, representing 100%, showed that the most popular building materials were decorative materials (58%), followed by wall and ceiling materials (15%), while flooring and roofing materials had the popularity score of 8% and 4%, respectively.

Study and experiment on the utilization of banana trees

In the study and experiment on the utilization of banana trees, the important raw material was the banana sheath. When the banana stems are peeled, they turn into several sheaths. The outer sheaths are old,

large, hard, and green with a purplish-brown stripe pattern in the same direction as the length of the stem. The inner sheaths are soft, and greenish white without a stripe pattern.

Study and experimental process

Method 1: To study the physical characteristics of the banana stem and sheath, the banana tree was cut crosswise into small pieces. After that, 1 kg. of banana sheath was weighed, recorded, and dried. It was found that, after sun drying for 1 day, 800 g. of the banana sheath with dark color was obtained. On Day 2, 450 g. of light brown and slightly twisted banana sheath was obtained. On Day 3, 300 g. of dried dark brown banana sheath with smaller in size and twist was obtained. On day 4, 200 g. of dark brown, hard, and twisted banana sheath was obtained.

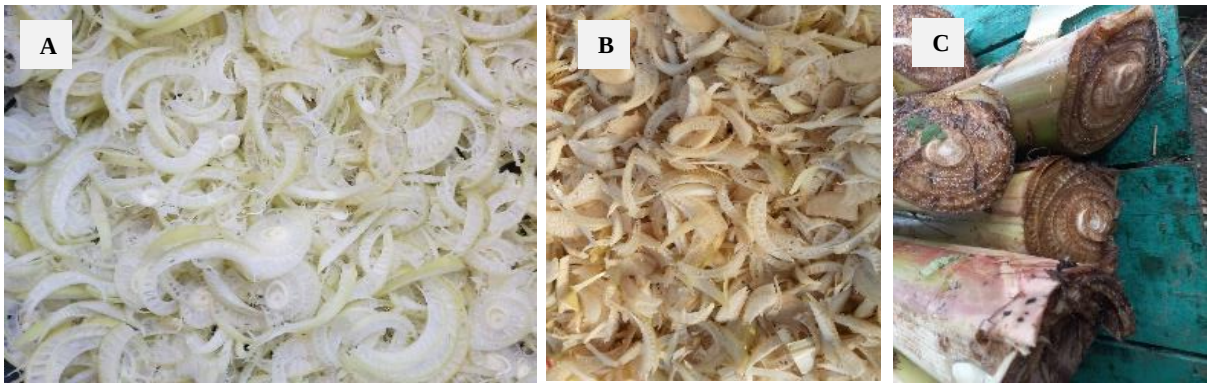


Figure 3 The physical characteristics of the banana trees
(A: the physical characteristic of banana trees cut crosswise,
B: sun drying for 1 day of banana trees cut crosswise, C: banana trees)
Source: Damnuirawat, 2023

Method 2: A study of the physical characteristics of the banana stems after fruit bunch harvest showed that the banana stem was cut and homogenized using a blender. One kg. of the chopped banana sheath was weighed and then squeezed out water. 600 g. of banana sheath obtained was sun-dried for 6 days. On Day 6, 200 g. of dried banana sheath was obtained as dark brown coarse powder.

Figure 4 The physical characteristics of the banana trees after being homogenized
(A: The banana stem was cut and homogenized using a blender,
B: The banana stem was cut, blended, squeezed out water and sun-dried for 1 day,
C: The banana stem was mixed by soil and cement)
Source: Damnuirawat, 2023

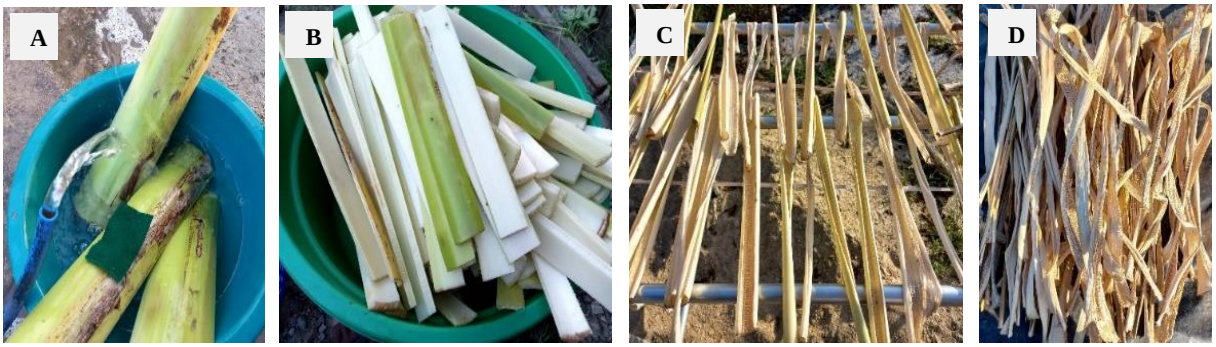


Figure 5 The physical characteristics of the banana trees peeled off from the banana stems
(A: Washing banana tree,
B: Banana sheaths cut into 1-2-inch strips,
C: Banana stripes sun-dred for 1 day, D: Banana stripes sun-dred for 5 days)
Source: Damnuirawat, 2023

From the study and experiment using these three methods, each method showed its different advantages and disadvantages. In Method 1 and Method 2, the banana tree must be processed by cutting it into pieces and homogenizing. Therefore, it may be difficult to further develop into decorative materials because it requires other materials such as binders and additives and is a complicated process. While in Method 3, the banana sheaths were peeled off from the banana stem, cut into 60 cm. long pieces and then sun-dried. This is a simple method and maintains some characteristics of the banana sheaths. It was found that the dried banana sheaths from this method had beautiful patterns and colors that could be further developed into decorative materials.

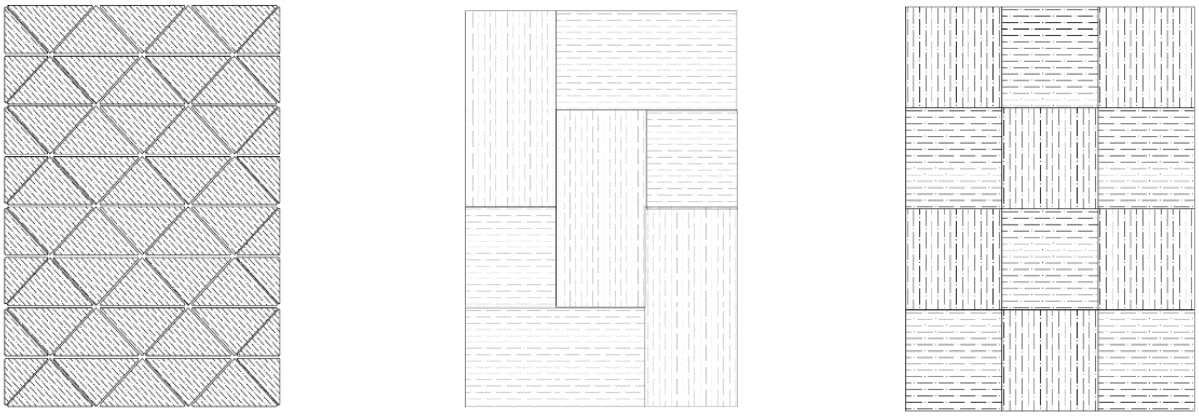
Figure 6 The characteristics of the dried banana tree peeled and cut into 60-cm. long pieces
(characteristics of the dried banana stripes sun-dried for 5 days)
Source: Damnuirawat, 2023

Strength test of banana sheath fibers

The strength test of banana sheath fibers was performed using a Tensile Testing Machine (Z010, Zwick Roell, Germany). The test results were reported as the average value of 5 replicates. The banana sheath fibers showed a tensile strength of 4.6 MPa, which represents the strength of the material when a tensile force is applied perpendicular to the cross-sectional area before breaking, and Young's modulus of 154.2 MPa, which represents the ability of the object to resist longitudinal tensile stress. These values are relatively high. The higher the value, the less the material can stretch and bend. The banana sheath fibers showed an elongation at break of only 4%, which represents the elongation of the material before breaking. This indicates that the banana sheath fibers are easily broken and are not resistant to tensile strength. The banana sheaths are, therefore, not suitable for use in frequently used areas or areas subjected to direct loads.

Community participation process

The development of decorative wall panels from banana sheath fibers was based on the community participation process. People in the community participated in the design and development of innovative products. From the participation activity, people in the community suggested that the product proposed is plausible and interesting and can be produced by the community using simple tools and processes. The size of the decorative wall panels developed should be similar to the size of the decorative wall panels available in the market, such as 0.60 x 0.60 cm. or 0.60 x 1.20 m. or smaller in size arranged into a mosaic or module. The banana sheath strips may be arranged in different patterns or woven into simple patterns, such as twill cloth patterns.



Pattern 1 Pattern 2 Pattern 3

Figure 7 The design process through community participation and consumer survey to select a suitable design
(pattern 1: the prototype idea pattern from existing capital of the community,
pattern 2: the prototype idea pattern with limited materials,
pattern 3: the prototype idea pattern with simple patterns)
Source: Damnuirawat, 2023

The design process through community participation and consumer survey was to select suitable designs, sizes and patterns for producing the prototypes, with the idea to develop innovative products that can be produced by the community using simple tools and processes. It was found that Design 3 of wall panels with the size of 30 x 40 cm. was suitable considering the properties and characteristics of banana sheath fibers. Design 1 was too complicated because many modules were required to be assembled. While the size of the modules of Design 2 was too large. When the banana sheath fibers were pressed into strips, the banana sheath fibers may twist and come off easily.

Selection of banana sheath fibers

The banana sheath fibers were used in making 50 cm. long ropes using 2.5 cm. long fibers for tying objects and 5 cm. long fibers for making stronger ropes. It was found that 2.5 cm. banana sheath fibers were suitable for pressing into sheets as they curled and contracted and had less recovery after 5 days of sun drying, compared to 5 cm. banana sheath fibers left at room temperature for 6 hours.

Fiber preparation Process

After the appropriate fiber size for making decorative wall panels from banana sheath fibers was obtained, the fibers were prepared with the following 8 steps:

1. Use the mature banana trees after fruit bunch harvest as they have stronger fibers. In addition, the outer sheaths are dark brown with beautiful patterns.

2. Cut the banana stems into pieces of about 40-50 cm. long. In most cases, old banana stems can be cut into 3-4 pieces depending on the maturity of the banana trees.

3. Peel off the sheaths. A long piece of banana stems yields 10 -12 sheaths.

4. Cut the banana sheaths into 2.5 cm. strips. A banana sheath yields 2-3 strips.

5. Wash the banana peels and cut them in half to make them thinner. This is to make it easier to press into sheets and dry faster.

6. Dry the banana sheaths 4-5 times depending on the sunlight intensity each day. The shape of the banana sheaths is curling. Regarding the color, older sheaths will turn dark brown, while younger sheaths will turn yellow.

7. Dry the banana sheath fibers with sulfur in a bucket to prevent molds. Place banana sheath fibers around the inside of a bucket or glazed water jar. After that, set on fire in the charcoal brazier. Put the sulfur into the charcoal brazier and then place it in a bucket or glazed water jar. Place the cover on and leave it overnight.

8. Select the intact fibers. Separate them into soft and hard fibers and press them into sheets to be used in the production of wall panels.

Production of decorative wall panels

The production process of decorative wall panels from banana sheath fibers are as follows:

1. Unfold the banana sheath fibers.

2. Press the banana sheath fibers using a regular iron with the highest heat for 1–2 minutes or until the banana sheath fibers are flat and smooth.

3. Measure and cut the flattened banana sheath fibers into 10-12 cm. In lengths

4. Trim the edges of the fibers evenly.

5. Spray the sheath fibers with a permanent adhesive or use latex glue to attach the sheath fibers to the canvas. After that, press it with an iron to let the glue dry for better adhesion.

6. Attach banana sheath fibers on the 10 x 10 cm. canvas and trim the edges.

7. Use 12 banana panels to produce a 30x40 cm. decorative wall panel.

8. Attach 12 10x10 cm. banana panels using spray glue or latex glue onto the canvas.

9. Attach the decorative wall panels onto the 4 mm. thick plywood and sand the edges.

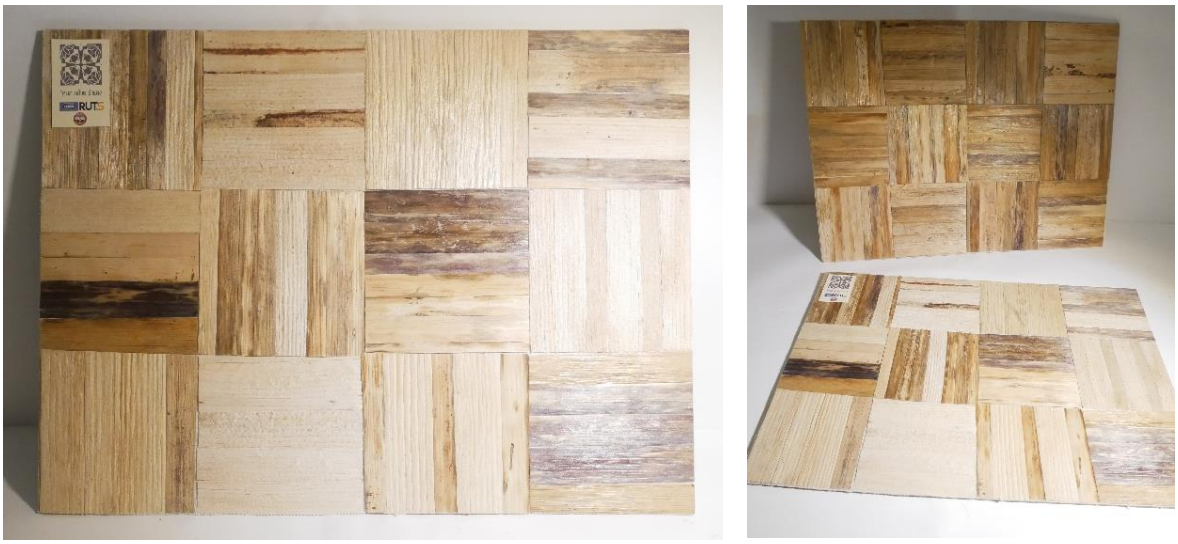


Figure 8 The final product of the decorative wall panel from banana tree fibers
Source: Damnuirawat, 2023

Conclusion

The objective of this study was to improve and develop the existing capital of the community using local wisdom to produce innovative products. The issues during the field survey and the resources of the Ram Daeng Community were integrated with the research team's architectural knowledge in order to lead to an innovative design process. The local wisdom of banana rope was used to add value and improve the grassroot

economy of Ram Daeng Community, Singhanakhon District, Songkhla Province, with the idea to develop agricultural wastes into innovative products that can be produced by the community using simple tools and simple processes. This is in order to create added value to the agricultural wastes. The research methodology and experiment methods are as follows: 1) survey of the potential and resource utilization of Ram Daeng Community; 2) exploring the needs for innovations derived from the banana trees; 3) study and experiment on the utilization of banana trees; 4) strength test of banana sheath fibers; 5) community participation; and 6) design and presentation of complete creative works. as well as understanding the problems and solutions for the community by conducting a survey of the needs of 145 consumers from 7 occupations. The results obtained were used in the development and creation of the decorative wall panels from banana sheath fibers. The results showed that 2.5 cm. banana sheath fibers were suitable and in line with local wisdom in producing banana fibers. However, the laboratory results revealed that banana fibers had low elongation, low strength and were not suitable for compression. They were only suitable for interior wall decoration. The lessons learned in the community and the community participation process and the limitation of the length of the material were used in the design of 30 x 40 cm decorative wall panels. Six wall panels were arranged into a larger panel of 60 x 120 cm. It can be seen that the number and size of the sheet plates cannot be divided into square meters. As a result, the calculation for sales in square meters is impossible. It was also found that mass production in the industrial system requires more advanced equipment and machines, such as heat press machines and ovens, instead of sun drying, which will increase production costs. In addition, the calculation, measurement and evaluation of the return on investment of banana fiber wall panels revealed that the cost was 88.64 baht per panel. The selling price of a banana fiber wall panel can be 150 baht.

Discussion

This innovation was found to be interesting in terms of their patterns. However, the patterns were too simple and lacked complexity due to the fact that the banana sheath fibers cannot be made into large sheets and are exposed to moisture. When exposed to moisture, the banana sheath fibers curl and fall off the panel. In addition, decorative wall panels made of banana sheath fibers have limitations due to the thickness of the plywood, so they cannot be used to decorate curved walls. To develop the banana fiber decorative wall panel, the following issues should be further studied:

1. Humidity control to prevent curling of fibers and mold growth in the long term
2. The decorative wall panels should be reduced in thickness and bendable to be used in curving or wavy walls.
3. The sound absorption test of decorative wall panels should be performed in the laboratory.
4. The development and upscaling at the industrial level may require more steps or advanced technology in production, such as a press machine for the banana sheaths.

Suggestion

The decorative wall panels made of banana sheath fiber are only suitable for interior wall decoration due to two problems encountered in the production process:

1. Pressing of banana sheath fibers was a slow process. It was performed using an iron to press the fibers due to the limitations of tools and technology in the community, resulting in low throughput and taking a longer time. Therefore, better tools should be developed to assist in pressing of banana sheath fibers for greater throughput and faster speed.
2. The decorative wall panels made of banana sheath fibers was 5 mm. thick, as the banana sheath fibers were attached to the canvas and 4 mm. thick plywood, making it impossible to bend the decorative wall panels. Therefore, there is a limitation in the installation of wall panels.

Acknowledgement

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