Fabrication of blanket using eco-friendly banana fiber

N.Tondonsana Singh (22167)

Satwika Das (11706706)

School of design-II, Interior and Furniture Design

Lovely Professional University, Punjab

Abstract

Banana is one of the rhizomatous plants and developing all countries of the world. It is the fourth most significant global food crop in worldwide. India is the largest maker of banana in the world with an approximate annual output of 13.5 million tons, of which 80% is made from six states, namely, Tamilnadu, Maharashtra, Karnataka, Kerala Andhra Pradesh and Gujarat. Yearly about 1.5 million tons of dry banana fibres can be manufactured from the outer sheath of pseudostem. Being a wealthy source of natural fibres, the pseudostem can be fruitfully utilized for numerous applications and preparation of various products like food sources, leaves as food wrapping, and stems for fibre and paper pulp. In banana plantations, after the fruits are harvested, the trunks or stems will be neglected. Billion tons of stems and leaves are abandoned annually .Such waste provides procurable sources of fibres, which advances to the reduction of other natural and synthetic fibres production that craves extra energy, fertilizer, and chemical. The properties of banana fibre are great absorbent, highly breathable, quickly dry with high tensile strength,weatherproof,UV protection(because of its lignin content),anti-oxident,moisture absorption and bio-degradable etc.Recent studies have been indicated that banana fibre acquires a lot amount of advantageous physical and chemical properties which can be used as a very good material for the textile industry . The aesthetic value cohabited with strength and mechanical properties which produce banana trunk fibre-woven fabric-reinforced composites as a suitable and sustainable eco-friendly material for blanket making..

keywords

Banana, pseudostem,fibres,banana fibre, sustainable ,eco-friendly material.

SUSTAINABLE BANANA FIBRE

Introduction

Banana plant (Scientific name-Musa acuminate)produce a large amount of textile fibre. It is mostly found in hot tropical climates. All types of banana plants have banana fibres in abundance .After the fruit is getting harvested, these fibres are produced and decrease in a group of bast fibres. After the manufacture of the banana fruit, the trunk of the banana plant i.e. the , pseudostem us tossed as an agricultural waste to a large

extent .[1] Biomass waste(pseudostem) a great source of natural fibres the pseudostem can be economically utilized as a various products.

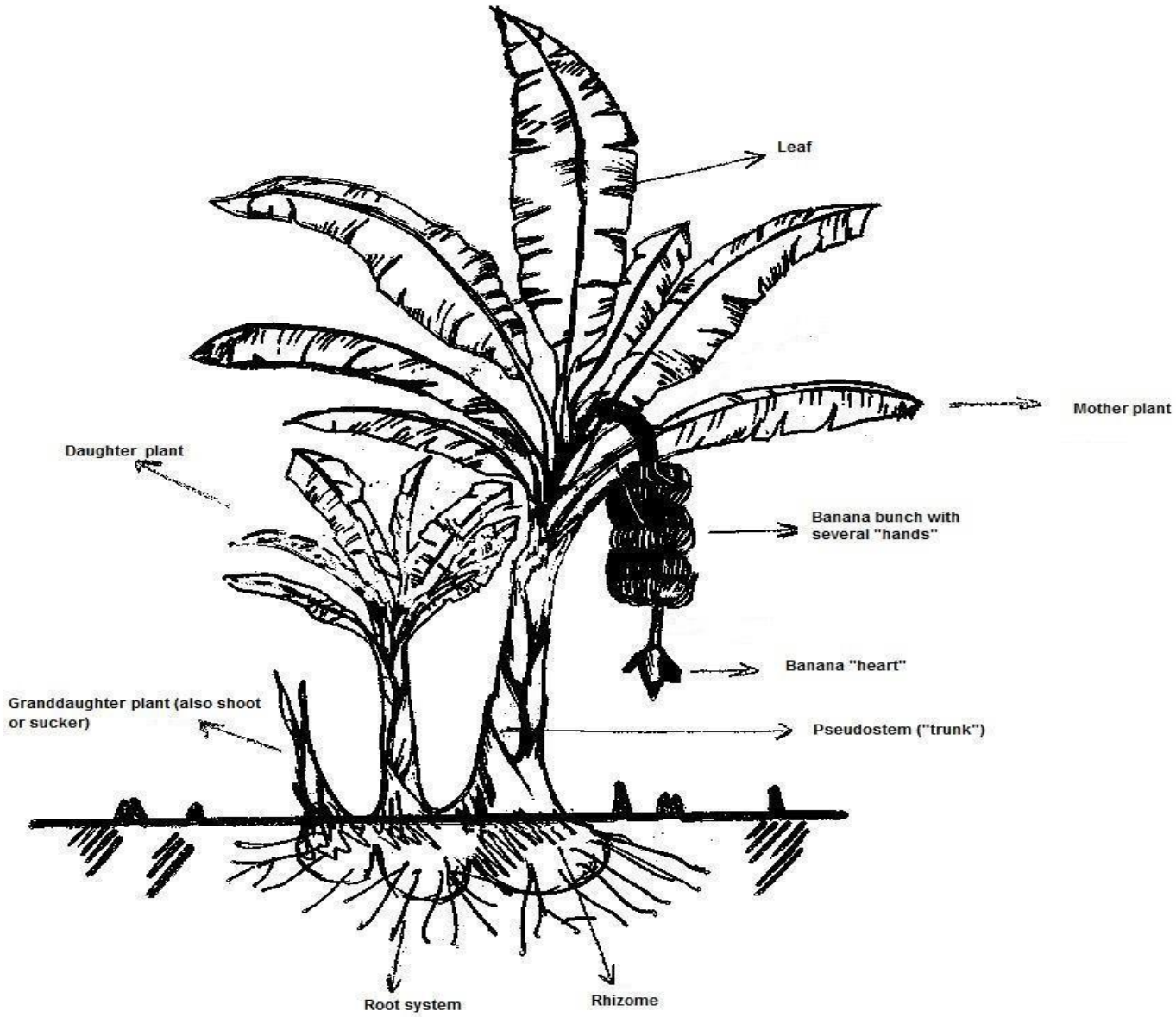

Figure 1. Morphological characteristics of the banana plant (adapted from Epagri 2002)[2]

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Table 1-Percentages of growth of bananas in the world.[1]

India	19%
Mexico	4%
Phillipines	4%
Brazil	5%
Costa Rica	5%
Columbia	6%
China	10%
Ecuado	12%
others	35%

After the industrial innovation, synthetic component and chemistry have been redefined to increase efficiency to cover-up the demands in textile production. It became one of various industries which are highly affecting on the environment, especially water and soil pollution. Textile production develops and release some chemicals that contaminate water and soils resources, including fume emission. Cultivation of natural fibre, including fibres from plants and animals, desires the use of hazardous pesticide and chemical fertilizers to control and increase the quality. Some of chemicals are used during the making are toxic, not-biodegradable and thus change the physical environment. These unbalance natural resources creates draught, heat, and high temperature of the world's atmosphere ,global warming. Textile production processes are now forming toward the concept of environmental-friendly and sustainable development. This research introduces an option of natural fibre, by product from banana fruit cultivation, by suggesting left over banana trunks as fibre source in textile process. Using banana fibre different types of products are making which is available in the market.

Fig 2-Hangbag [3]

Fig 3-Fibre clothing [4]

Fig 4-Purse[5]

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Literature Review

(Zaida Ortega , Moisés Morón , Mario D. Monzón , Pere Badalló , and Rubén Paz etal , Production of Banana Fiber Yarns for Technical Textile Reinforced Composites, 2016) This research paper is to show the workability of using banana fibers to procure a yarn suitable to be woven, after an enzymatic treatment, which is more echo- friendly. Infusion of long fibers are penetrate to 50 mm length and then absorbed into an enzymatic bath for their refining. Conditions of enzymatic treatment have been optimized to produce a textile grade of banana fibers, which have then been characterized..[6]

(S.M. Sapuan1, N. Harun1, and K.A. Abbas2 etal , Design and fabrication of a multipurpose table using a composite of epoxy and banana pseudo stem fibres , 2007) This paper describes the fabrication of a multipurpose table using banana trunk fibre-woven fabric-reinforced composite material. The aesthetic value coupled with strength and mechanical properties make banana trunk fibre-woven fabric-reinforced composites a suitable material for table making.[7]

(Manogna Avunoori , A study on banana fibre clothing , 2017) This research paper indicates that the popularity of Sustainable clothing has increased over the passing years. So Bananas are harvested two to four times a year and the stems are usually cut and thrown away as waste. Banana fibre is also a major alternative to the pulp industry. The research is started to understand and investigate factors influencing the expansion of banana fibre clothing and products developed from waste of banana plants which is bio degradable.[8]

(C. Vigneswaran, V. Pavithra, V. Gayathri, and K. Mythili etal , Banana Fibre: Scope and Value Added Product Development , 2015) Banana fiber is a natural bast fibre which has wide range of uses in handicraft product growths such as mat, rope and twines, other than only 10% of its pseudo stem is being provided for making products and remaining is waste or used as fertilizer. Because it has a quality like weatherproof, UV protection (because of lignin content), moisture absorption, anti-oxidant and bio degradable etc., it can be used to make variety of products that help farmers economically and have wide scope to create new market.[1]

(Vadivel K, Vijayakumar A, Solomon S, Santhoshkumar R etal , Design and Fabrication of Banana Fiber Extraction Machine and Evaluation of Banana Fiber Properties , 2017) The present paper is aimed to design and fabrication of banana fiber extraction machine to develop high quality banana fiber from banana pseudo stems. Banana fiber is a best fiber with good mechanical properties.Manually extraction of the banana fiber better quality of fiber but it much time consuming. This paper explains the new model of machine and its

working. The new machine will overcoming like breakage in fiber, knot formation and discontinuous length of fibers.[9]

Analysis

The organic banana fibre plays a vital role to carry out sustainability in textile industry by providing better quality, healthy and hygienic products, achieving sustainability by helping in environmental, social and economical aspects. As the textile industry leading towards a future where textile resources are scarce, natural fibres such as cotton, which residues a resource-intensive material, and petroleum-based fibres like acrylic, polyester, nylon and spandex remain high in trade. But as the production of these fibres prolongs to do irreversible damage to the planet, companies are seeking out sustainable alternative fibres and fabrics. The sustainable alternatives and textile innovations that are currently being seeking all over the world. In this instalment, the potential use of banana fibre is the great example. Banana fibre, a ligno-cellulosic fibre, obtained from the pseudo-stem of banana plant (Musa sepientum), is a bast fibre with relatively good mechanical properties. Natural fibers instant important advantages such as small density, exact stiffness and mechanical properties and upper disposability and sustainability. Moreover, they are recyclable and biodegradable.

Characteristics of Banana Fibers:

Banana fiber has its particular physical and chemical characteristics and many other properties that make it a fine quality fiber.[10]

- The appearance of banana fiber is alike to that of bamboo fiber and ramie fiber, but its fineness and spinnability is better other than the two.
- The chemical formation of banana fiber is cellulose, hemicellulose, and lignin.
- It is highly strong fiber.
- It has smaller elongation.
- It has moderately shiny appearance consisting upon the extraction & spinning process.
- It is light weight.
- It has strong moisture absorption quality.
- It absorbs and releases moisture very swift.
- It is bio- degradable
- It has no negative results on environment and thus can be divided as eco-friendly fiber.
- Its average fineness is 2400Nm.
- It can be circle through almost all the methods of spinning along with ring spinning, open-end spinning, bast fiber spinning, and semi-worsted spinning surrounded by others.

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Table 2-Properties of banana fibre

Tenacity	29.98 g/denier
Fineness	17.15
Moisture Regain	13.00%
Elongation	6.54
Alco-ben Extractives	1.70%
Total Cellulose	81.80%
Alpha Cellulose	61.50%
Residual Gum	41.90%
Lignin	15.00%

Table -3 Comparison between Banana Fibre and others

``Properties	Banana fibre
Highest tensile strength	yes
Extensibility	yes
Water resistance	yes
` Softness	yes
Fire resistance	yes
Grease proof `	yes
Jute and paper(properties)	Less than banana fibre

Advantages of banana fibre clothing

Fabrics which are made from banana fibres are not only soft and supple, as well as breathable and a natural sorbent. They lean to have a natural shine to them additionally and are frequently compared to silk. In addition, banana fibre is now viewed as a sustainable alternative to cotton and silk.

For making Blankets different types of fabrics are used like

- cotton, linen, wool, silk
- Synthetic fibers like polyester, nylon, and acrylic

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But as the production of these fibres creates irremediable damage to the planet .These has lower durability, poor strength, poor fire resistant. They create harmful impact on the nature.

Solution

Banana Fibre Collection Process

For banana plantations, after the fruits are harvested, the trunks or stems will be removed. These wastes give obtainable sources of fibres, which shows to the reduction of other natural and synthetic fibres production that demands extra energy, fertilizer, and chemical. The banana fibre has good absorbent, highly breathable, quickly dry with high tensile strength.

Figure 1. Banana trunk from the plantation[11]

Banana fiber Extraction Processing, Yarn Spinning & Weaving

Fig: 2 Abstraction of Banana Fiber from bark of Banana plant.[11]

The extraction of the natural fiber from the plant enforced convinced care to avoid detriment. Contamination the rolled fibers such as pigments, broken fibers, coating of cellulose etc. were evacuated manually by means of comb, and then the fibers were cleaned and dried. This mechanical and manual extraction of

banana fibers was monotonous, time wasting, and caused damages to the fiber. Therefor, this type of technique cannot be approved for industrial application. For the extraction of banana fibers , a special machine was designed and developed in a mechanically automated system. It provided mostly of two horizontal beams whereas a carriage with an added and specially designed comb, keep move back and forth. Using this technique, fibre extraction could be accomplished just by placing a cleaned built in the banana stem on the fixed platform of the machine, and clamped at the ends by jaws. This removes relative movement of the stem and escaped premature breakage of the fibers. This process was followed going through cleaning and drying of the fibers in a chamber at 200 C for continous three hours. Then these fibers are labelled for lamination process.

Weaving Preparatory process

Pre-treatment (Bleaching)

To improve the whiteness of fabric, bleaching operation is followed through. This process is known as bleaching. During bleaching the natural colouring matters present in banana are decomposed to colourless substances. The removal of these colouring matters helps to improve the whiteness of banana fabric.[8]

Purpose of bleaching

- For making the white fabric destroy colouring matter with minimum fibre degradation.
- To upgrade brightness of colour later dyeing or printing
- For additional improvement of whiteness by treatment with optical brightening agents when the fabric is to be retailed as white

Purpose of preparatory processes

- To remove natural and added impurities
- To impart certain desirable properties (water absorbency)
- To improve the appearance of fabric (whiteness)
- To make it worthy for subsequent processes like dyeing, printing finishing
- Displacement of impurities to the maximum level with minimum effect on fabric strength.

On

Condition of that cotton succeeding chemical reactions are involved while eliminating the impurities

- Hydrolysis
- Oxidation

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Sizing and Starching

Sizing is a protective process. The process of applying a protective adhesive coating upon yarns surface is called sizing. This is the most important operation to attain maximum weaving efficiency for blended yarns.

Purpose of Sizing

- During beam preparation, sizing is completed for getting some advantage of weaving. Lots of objects given below from sizing.
- To improve the weave ability of warp yarn and the action of weaving like absorption, friction, tension etc for making it more resistance.
- By reducing hairiness , weakness and by increasing smoothness and absorbency of yarn for maintaining the good quality of fabric..
- Elasticity of the yarn is increased

Fig 3 Yarn brushing before starching[8]

Fig 4 Yarn brushing before starching[8]

Fig 5 Sizing of yarns[8]

Fig 6 Starching of the yarns[8]

Dyeing of banana fibres

The extracted fibre after splicing basic colours are used for dyeing. Natural dyes are obtained from hibiscus, pomegranate, henna, harifra plants. The required dye in the required quantity is added to boiling water.[8]

• Then the fibre is added and boiled for 15 minutes to 1 hour according to the requirement. It is later transferred, washed and dried.

• Once the fibres are ready for knotting a bunch of fibres are mounted or clamped on a stick to facilitate segregation

• According to fibre sizes, each fibres are separated and grouped that wise.

• To knot the fibre each fibre is knotted to end of another fibre manually.

The separation and knotting is repeated until the bunches of unknotted fibres are finished to form a long and continuous strand

Fig 7 Dyed Banana Coarse Fibre[8]

Fig 8 Banana fibre extraction machine[8]

The setup of this machine is very simple and anyone can setup the small scale fibre extraction mat weaving unit by purchasing machine from the eco green unit, the entire setup can be done in 2-2.5 lakhs. The space required for the setup is also less i.e. 10*10 sqft they make a turnover of 1.25-1.5 lakh monthly. 100-120 machines are sold per annual.

Blanket making process

- First of all calculate the size of blanket
- Take first piece of fabric with the rougher side facing up

- Then lay the second yard of fabric on top, soft side facing up.
- Make sure that the rough sides of the fabric are facing one another and that the soft sides are facing outward
- Take a self healing mat under the fabric
- Use a rotary cutter to cut off the rough edges of the fabric
- Use the lines on template to ensure a straight cut.
- Using tape measure , lay it surround the fabric from the top of one right angle to the other so that there is a 4-inch strip of fabric below the tape measure.
- Take the tap and tap .Then measure down so that it doesn't shift
- Cut the 4-inch section into strips any thickness and using scissors or rotary cutter.
- Usually 1-inch strips are used. Below the tape measure line only cut that.
- Repeat for the remaining three sides of the fabric, making sure to pin the tape measure in place.
- Separate the top layer of fabric from the bottom layer of fleece for each borderline and tie the two together in a double knot.
- Complete for each borderline on the blanket.

Result & Conclusion

Banana is harvested large scale of India and the fibre yield is around like 8.7 lakh toned. This study conveys that banana stem which is presently wasted after harvesting fruits is good cellulosic source and contains very small amount of lignin. This waste is also produces environmental pollution. The chemical formation of banana stem displays that banana stems which wasted, is a good raw material for industry. Thus the application of waste banana stem guides us to save our forest and decrease environmental issues. From this research ,it is observed that banana fibre clothing is easily made and sell

into the retail market due to its high production value. Utilizing this useless material will make another option to eliminate using new material, additional other cultivated fibers and synthetic petroleum base fibers. The study represents the study and research of sustainable fibers .In this project we give vision about uses and applications of these sustainable fibers to get the competitive advantage in the market. It describes the story from history to the present use of these fibers for different applications like handbags,cloths,etc and making new product like blanket .It will help the designers and companies to change their way of thinking and make new products with vision and aim of sustainability.

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