Sustainable Innovation: Developing Eco-Friendly Products by Blending Banana Fiber with Fabric Waste

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***Abstract*— Environmentally friendly solutions are becoming more and more popular in the textile sector as a result of rising environmental concerns and the need for sustainable development. By combining fabric waste and banana fibre to create eco-friendly items, this article investigates the possibilities of sustainable innovation. The natural and biodegradable substance known as banana fibre presents a viable substitute for traditional textiles, and the recycling of fabric waste deals with the problem of managing industrial waste. The article shows how combining banana fibre with waste fabric may result in goods that are both sustainable and marketable. The results add to the larger conversation on sustainable textiles by emphasizing the potential for up-cycling agricultural and industrial by-products to develop innovative, eco-friendly products.**

Index Terms- Eco-Friendly Fibre, Fabric Waste, Innovation, Sustainable Development

I. INTRODUCTION

Textiles and Apparel sector is considered as one of the most significant industrial sectors and it plays a vital role towards contribution to national economy, employment generation and exports in developing countries and most essential consumer goods industry. However, textile and fashion industry are also blamed for being one of the most polluting industries. It is not only restricted to production but also consumption of textiles also produces waste. To face this problem, textile industry has taken many measures for reducing its negative contribution towards environment and earth. One of such measures is textile recycling-the reuse as well as reproduction of fibres from textile waste. Recycling can be done through thermal, material, chemical and mechanical processes.

Sustainability is a social goal for people to co-exist on Earth over a long time. In everyday use, sustainability often focuses on countering major environmental problems, including climate change, loss of biodiversity, loss of ecosystem services, land degradation, and air and water pollution. The idea of sustainability can guide decisions at the global, national, and individual levels.

Sustainable product development is the process of creating products that use resources responsibly and reduce environmental and ecological impacts. It involves the integration of both environmental and economic considerations, such as energy efficiency, use of renewable materials and reduction of waste, into product design and development. It also takes into account social aspects such as labour standards, poverty, and health impact. Green design which is a part of sustainable product development has two main goals: the prevention of waste and to minimize environmental impact.

India contributes a large percentage to total world production of rice husk, jute, banana, and coconut fiber. All these natural fibers have excellent physical and mechanical properties, which can be used effectively in the development of composite materials for various structural applications (Sharma and Kumar 2013). Today, there is a global increase in the utility of natural fibres. Among the available natural cellulosic fibres derived from agriculture, banana fibres stand out for their high potential. They offer unquestionable sustainability and embrace promising and unexplored potential in the textile industry. Once farmers harvest the fruit, they regularly cut down the parent stem to enable regrowth. This is revealing that the banana plantations are rich in fibres and are basically considered as waste material after harvesting of banana fruit. Banana fibres are extremely strong and can blend effectively with other fibres to create

mixtures. They are lightweight, biodegradable, quickly renewable, water resistant, and flame-resistant.Today, a significant portion of banana fibers produced are utilized for making ropes and cordage (Balda, A. 2021)

According to Dissanayake, and Weerasinghe (2021), fabric waste recycling plays a major role in proceeding towards a circular economy in textiles. The demand for fabric waste recycling originates mainly from the need to improve resources and reduce the environmental hazardous situations associated with discarding and land filling. According to Youjiang Wang (2006), the extensive practice of land filling textile waste is considered as unsustainable. Encouraging greater alteration of textile waste from landfills requires increased technologies for reuse and recycling. Reuse is generally chosen over recycling. There are several textile reuse and recycling technologies available that are continuously developing. Blending the waste threads and shreads with banana fibre makes it more sustainable as it reduces waste from textile industry.

II. METHODOLOGY

2.1 Collection of Banana Stem

Banana stem which was discarded was collected. The layers of the stem were separated and cut into small pieces. (Fig.1)

Banana Stem cut into pieces
Fig 1

2.2 Extraction of Fibers

The outer pulp from the stem was removed and the fibres were extracted from each layer of the banana stem excluding the outermost and innermost parts.(Fig.2a and Fig.2b.)

Removing pulp
Fig. 2a

Fibre extraction
Fig. 2b

2.3. Smashing, Boiling and Cutting

The extracted fibres were then smashed using a grinding stone. The fibres were boiled in normal water to make it soft. It was rinsed, filtered and then cut into small peices and kept dried for further use. (Fig. 3)

Smashing, Boiling and Cut into small pieces
Fig. 3

2.4. Preparation of Fabric waste for mixing with Banana Fibre

Fabric waste were collected from the nearby tailoring units. The fabric pieces were cut into small prices, grinded into a pulp and stained through a filter.(Fig. 4)

Preparation of Fabric Waste
Fig.4

2.5 Preparation of paper from banana fibre and fabric waste

The fabric waste pulp were combined with banana fibres extracted and mixed together to create a paste like mixture. The mixture was strained and then dried for five hours to get a paper texture. A natural gum mixture, made from corn flour, wheat flour, baking soda, sugar, salt, vinegar and water, was applied as a coating to prevent the paper breakage.(Fig.5)

Coating natural gum to paper
Fig. 5

The dried eco- friendly papers developed by blending banana fibres with fabric waste was used to develop utility products namely designers tool bag, coaster, table mat, lamp shade, book cover,Ladies purse and a mouse pad.

III. RESULTS AND DISCUSSION

3.1. Developing Eco-friendly Utility Products

Ten designs of utility products were drawn from which seven was selected.The designs were created in accordance with the strength of the developed fabric mixed banana paper. Each of the products were embellished suitable using box pleat, embroidery.

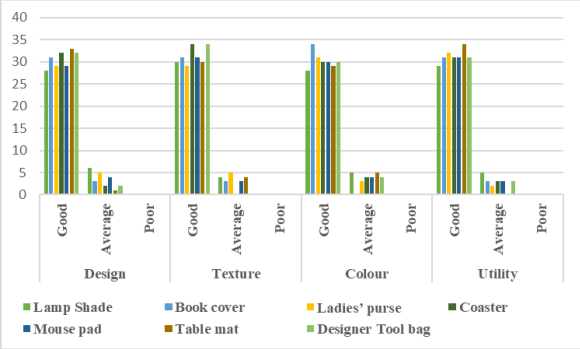
Utility products made from the developed paper
Fig. 6

3.2. Evaluation of the Developed Products

The developed utility products from eco- friendly paper made out of banana fibres mixed with fabric waste were given for physical evaluation. The products were evaluated for design, texture, colour and utility from 34 students. The results are given in Table I, Graph .1.

Table I
Evaluation of Developed Products

Utility Products Developed	Design			Texture			Colour			Utility		
	Good	Average	Poor	Good	Average	Poor	Good	Average	Poor	Good	Average	Poor
Lamp Shade	28	6	0	30	4	0	28	5	0	29	5	0
Book cover	31	3	0	31	3	0	34	0	0	31	3	0
Ladies' purse	29	5	0	29	5	0	31	3	0	32	2	0
Coaster	32	2	0	34	0	0	30	4	0	31	3	0
Mouse pad	29	4	0	31	3	0	30	4	0	31	3	0
Table mat	33	1	0	30	4	0	29	5	0	34	0	0
Designer Tool bag	32	2	0	34	0	0	30	4	0	31	3	0



Evaluation of Developed Products
Graph 1

From Table- 1and Fig.7 it was observed that the total responses for the survey, all the developed eco friendly products made from banana fibre blended with fabric waste were good in design, texture, colour and utility.

IV. SUMMARY AND CONCLUSION

Textile and apparel sectors are considered as one of the most significant industrial sectors in the world. Also, they are one of the most polluting industries. The use of natural fibres is experiencing a global increase due to heightened environmental concerns. Blending banana fibres with fabric waste presents a promising avenue for creating innovative eco- friendly products. This not only contributes to sustainable practices by repurposing waste materials but also shows the unique properties of banana fibre to enhance the characteristics of the resulting products. Instead of using fabric waste, other discarded materials such as waste papers, plastics etc. can also be mixed with banana fibres to create unique products.

REFERENCES

[1] Sharma, N.K, Kumar. V. (2013). *Studies on Properties of Banana Fiber Reinforced Green Composite.* Journal of Reinforced Plastics and Composites.

[2] Sanjeev Balda, A. S. (2021). *Banana Fibre: A Natural And Sustainable Bioresource For Eco-Friendly Applications*. Clean Technologies and Environmental Policy, 1389–1401.

[3] Dissanayake,K,Weerasinghe,D. (2021). *Fabric Waste Recycling: A Systamatic Review of Methods, Applications, And Challenges*. Materials Circular Economy 3, 1-20.

[4] Wang, Y. (2006). Recycling in Textiles. Woodhead Publishing.

[5] R Dunne dunnerk, D. D. (2016). *A Review Of Natural Fibres, Their Sustainability And Automotive Applications*. Journal of Reinforced Plastics and Composites.

[6] Achmad Jusuf Zulfikar, M. Y. (2019). Design and manufacture of skateboard from banana stem. Journal of mechanical engineering manufactures materials and energy.

[7] Vigneswaran,C., (2015). *Banana Fiber: Scope And Value Added Product Development.* Journal of Textile and Apparel, Technology and Management.

[8] Satish Babu Boppana, K. P. (2022). *Different Natural Fiber Reinforced Composites and Its Potential Industrial and Domestic Applications: A Review*. Bio-Fiber Reinforced Composite Materials , 51-73.

[9] Sawitri, S. (2017). *How to minimize the fabric waste in fashion industrie*s. International Conference on Technology and Vocational Teachers, 94-97.

[10] Tanya Domina, K. K. (1997). *The textile Waste Lifecycle*. Clothing and Textile Research Journal 15, 96-102.

[11] Tracy Diane Cassidy, (2017). *Upcycling Fashion For Mass Production*. Sustainability in fashion and textiles, 148-163.