NIU Journal of Humanities Copyright©2023
Nexus International University ISSN: *3007-1704*; 8(4): 113-121

Development of Technical Textile for Packtech Production Using Jute Fibres

A.B. OMOLALE, E.B. EMIDUN
Federal University of Technology, Akure, Nigeria

Abstract. Jute is a natural renewable fibrous biomass that has long been used as a raw material in the manufacture of packaging items. It resembles both cotton and wood. It features a diversified fibre with soft and firm fibre properties. A diverse range of vertical and horizontal environmentally friendly products can be manufactured using its biodegradable, photodegradable, thermally degradable, high strength, non-plastic, nontoxic, high-water and ultraviolet-absorbing capacities, visco-electricity, and crystalline cellulosic properties. Its extra geotextile and technical textile potential is represented by its porosity, permeability, capillarity, and hydraulic characteristics.
Crystalline hardness and brittleness, on the other hand, are particularly promising for a variety of composite goods that can replace glass, carbon, asbestos, wood, and synthetic composite materials. The purpose of this study is to investigate the environmentally beneficial features and applications of Jute products in a modern era where people are unduly dependant on nondegradable plastic materials (Petrochemical products). Jute products are not only environmentally friendly and help to decrease soil climatic deterioration. As rapid climate change and global warming have become a major concern and challenge for sustainable and eco-friendly development in the twenty-first century, the reduction of carbon footprint, water footprint in buildings/constructions, and green technology is currently gaining global attention (Abdullah & Rahman, 2018).

Keywords: fibrous, biomass, packaging, biodegradable, photodegradable, geotextile, technical textile, eco-friendly.

1. Introduction

Jute fibre is a natural, eco-friendly, and adaptable material that has been utilized in a variety of industries and applications for ages. Jute fibre is noted for its strength, durability, and affordability. It is derived from the inner bark of the jute plant (Corchorus spp.). It is mostly grown in the Indian subcontinent, Bangladesh, and other climate-friendly countries (Akter et al., 2020).

Jute has a long and illustrious history, with traces of cultivation and use extending back thousands of years. The origins of the fibre can be traced back to the Indian subcontinent, when it was originally spun into yarn and sewn into fabrics. Jute gained global reputation and became a key export product over time, particularly during the British colonial era (Akter et al., 2020).

One of the most distinguishing features of jute fibre is its natural golden or brown hue, which gives it a distinct appearance. Jute fibre is mostly made up of cellulose, a complex carbohydrate found in plant cell walls (Abdullah & Rahman, 2018). The high cellulose content of the fibre adds to its strength and capacity to be spun into coarse, robust yarns.

Islam & Ahmed (2012) implies that Jute fibre has several favourable qualities that make it ideal for a wide range of applications. It is an environmentally beneficial and sustainable resource because it is biodegradable and renewable. Jute plants grow swiftly and require few pesticides or fertilizers, which has a lower impact on ecosystems than synthetic alternatives. Jute also has high tensile strength, making it perfect for applications that require strong and long-lasting materials. It has minimal extensibility, which means it can tolerate significant stress without elongating or losing shape. Jute fibre has this quality, which makes it excellent for items such as sacks, ropes, twines, and packaging materials.

1.1 Statement of the Problem

Ejaz et al., (2020) concludes that petrochemicals have raised due to their anti-environmental properties and ongoing depletion. The researchers are currently

looking for alternatives that are environmentally sustainable, biodegradable, ecofriendly, non-abrasive, non-toxic, and petrochemical-free. Green composites made of natural fibres (NFs) and biodegradable polymers have the potential to replace traditional petrochemical-based materials.
According to (Meri, 2020), Over the previous decade, synthetic garbage has grown swiftly and dramatically. People all around the world generate a lot of garbage in their daily lives, which they either toss away or discard. People use a variety of substances, including synthetic garbage and disposable objects. Plastic, poly bags, and other materials are commonly used to make disposable objects. Non-biodegradable chemicals are so named because they cannot be easily broken down by active bacteria and other decomposers.
Tohora et al., (2020) implies that Synthetic fibres are detrimental to the environment. Natural fibre provides advantages such as high strength and modulus, low extensibility, excellent abrasion resistance, good thermal stability, sound and heat insulation, biodegradability, anti-static property, surface shape, and so on.

Technology for improving livelihoods and easing people's lives gave rise to a new way of living. Plastic bags, for example, are handy to use and transport, but their disposal has a harmful impact on the environment. As a result, humans squander tons of items every day, some of which are damaging to the environment. As a result, waste materials can be divided into two categories: biodegradable and non-biodegradable. All of this leads us to the conclusion that non-biodegradable materials are hazardous and should be prohibited (Meri, 2020).

1.2 Aims and objectives

The study's goal is to produce packtech textiles (shopping bags) out of Jute fibre in order to raise awareness about the importance of protecting our eco-system. The study also intends to investigate the jute's opportunities and prospects in terms of environmental and economic benefits.

1.3 Justification

In recent years, Elbadry et al., (2012) opined that because of the environmental benefits, there have been an increase in the usage of natural fibres as reinforcements for polymeric matrices. Environmental concerns and global warming have sparked a significant interest in utilizing natural materials to develop green products and minimize anthropogenic carbon dioxide emissions in any way possible.

Danielsson, (2017) implies that although environmental protection is critical for today's low-income countries, research on environmental policy formulation for these countries has been minimal thus far. However, environmental challenges frequently hamper progress, making low-income countries' struggles even more difficult. Several scholars are now calling for additional research on how to implement environmental policies in such countries.

The present annual global production of jute fibre is approximately 3.2 million tons, which is utilized for a variety of applications. The bag cloth sector is the largest consumer of jute fibres on the market. Jute bags have gained popularity as an eco-friendly alternative to both non-biodegradable poly bags derived from petroleum and paper bags that require significant amounts of wood. Every year, a large proportion of these jute fibres are wasted and discarded, either as slivers from the making of jute fabric or as used cloths following the end-of-life of the jute bags (Aly-Hassan, 2015).

2. Literatures Review

Jute, like cotton, is an important natural fibre crop. Jute and mesta crop are known as raw jute in trade and industry since their uses are nearly identical. Raw jute is crucial to the country's economy. Initially, raw jute was thought to be a raw material source only for the packaging industry. However, it has recently emerged as a versatile raw material for a wide range of uses, including textile and paper industries, building and automotive industries, use as a soil saver, decorative and furnishing materials, and so on. Because raw jute is a biodegradable and annually renewed resource, it is regarded as an environmentally benign crop that aids in the preservation of the environment and ecological balance. Jute, as a natural fibre, offers some distinct advantages. Its silky lustre, great tensile strength, low exhaustibility, significant heat resistance, and lengthy staple length are properties that synthetic fibre cannot match. Jute is also appealing because to its easy availability and inexhaustible supply at a lower cost (India, 2013).

Jute fibre is derived from two Corchorus species, C. capsularis and C. olitorius. Jute alternatives include Bimli (from Hibiscus cannabinus) and China jute (from Abutilon theophrasti). Jute fabrics were utilized in Biblical times as sackcloth and are

presently employed for wrappings, bindings, and other purposes (Aly-Hassan, 2015).

Aly-Hassan (2015) believed that Commercial jute fibre is made up of overlapping cells that are 0.08 inches long and 0.0008 inches in diameter (cells are not spherical; the corresponding diameter has the same cross-sectional area as the cell). When exposed to sunlight, the colour ranges from yellow to brown with varying degrees of greyness. The fibrous substance, like flax, surrounds the woody core and is entrenched in the non-fibrous layer beneath the bark. The strands closest to the bark run the entire length of the stem, while those further away from the bark become progressively shorter. Although retting removes the tissue that binds the fibre bundles together in the natural state, it usually does not separate the cells in each bundle.

Corchorus olitorius

Corchorus capsularis

2.1 Packing textiles

Jute has a long history of use in the packaging of various commodities, including food grains and high-end products. Jute sacks composed of sacking or hessian fabrics were the primary means of packing food grains all over the world until the development of poly (PE/PP) bags in the 1970s.

These sacks have a capacity of 100 or 50 kg. Jute bags are still the primary packaging material in India and various other nations, notably for food grains. Technology has recently been improved for making Food Grade Jute Fabric (FGJF) and then converting it to sack so that no odor of jute batching oil is there, and no toxicity occurs. Moreover, smaller sacks (bags) are nowadays made for packing rice, flour, fruits, and toilet items in small quantity.

Shopping Bags & Soft Luggage

Various types of shopping bags, sourvenir bags, soft luggage etc.

a) promotional bags

b) big shoppers and other shopping Bags

c) Sturdy suitcase, soft luggage, school bag, handbag, etc.

d) green bags: To overcome the environmental hazards associated with the plastic carry bags, attempts were made worldwide for developing and promoting eco-friendly bags for packing of commodities in the retail shops and super-markets as well as for carrying household items. Green bags out of cotton, polypropylene etc. are established in U. K. and Australia respectively.

2.2 Present scenario of technical textile

Horrocks & Anand (2000) stated that India is the world's second largest textile and apparel producer. The textile sector in India accounts for 14% of the country's GDP of USD 1.18 billion. Because this market is so large, there is significant potential for technical textiles as well. Currently, India's use of technical textiles accounts for barely 3% of total global consumption; nonetheless, it is rising faster than most wealthy countries. There are various causes for this market's poor penetration, including a dispersed industrial structure, insufficient research, and development (R&D), and a shortage of competent staff. Another significant factor is a lack of information about the benefits of utilizing technology textiles, which leads to low use. As a result, India must continue to establish its position in the global technical textiles market, implying that a vastly untapped market awaits exploration.

2.3 Globalization of technical textiles

Technical textiles are utilized for their technical performance and functional features, whilst traditional textiles are employed for aesthetic and furnishing purposes. In compared to the US$700 billion conventional textile business, which accounts for 78% of the entire market, the value of the technical textile market is approximately US$190 billion. This can be attributable to the growing demand for functional products in a variety of end-use markets, including personal safety, light weight metal

replacement materials, medical and health care, and industrial applications. Technical textiles represent 22% of total fibre consumption globally (Nawab, 2020).

2.4 Future of the technical textiles industry

The future of technological textiles encompasses a far broader economic field of activity than merely textile manufacture and processing. Raw material producers (both natural and synthetic), machinery and equipment makers, information and management technology providers, testing and certification authorities, consultants, and education and training organizations are among the industry's suppliers. Its customers and important specifiers include virtually every downstream business and field of economic activity, as well as the architects, engineers, designers, and other advisers employed by those companies. Many additional parties are involved, including environmental, health, and safety officials, business and free trade regulators, patent and intellectual property agents and lawyers, investors, bankers, regional investment agencies, and development aid providers. A rising number of specialty and generalist publications, as well as worldwide and local trade exhibitions, fairs, seminars, and conferences, are tasked with disseminating and communicating information to all of these organizations and individuals (Horrocks & Anand, 2000).

2.5 The economic importance of technical textiles

The new promise of technical and performance textiles is a new generation of products that combine the most recent advances in advanced flexible materials with advances in computing and communications technology, biomaterials, nanotechnology, and novel process technologies such as plasma treatment. These will eventually have a direct impact on all consumer textile markets, including clothes and furniture. The field of 'wearable electronics' has already captured the imagination of many researchers and large corporations, and while most products on the market today are relatively unsophisticated 'implants' of conventional electronics and wiring, the prospect of truly 'interactive textiles embodying sensors, actuators, and logic circuits built into the structure of the fibres, yarns, and fabrics themselves is not inconceivable (Annapoorani, 2012).

2.6 Present state of Jute in Nigeria

Cotton is the primary source of textile fibres in Nigeria. Textile manufacture was one of Nigeria's primary economic activities from the 1960s through the 1970s, accounting for more than 25% of the country's GDP. During this time, the textile industry employed over 700,000 people and provided for over 2 million family members. However, more recently, particularly in the 1990s, the sector faced a severe decline, resulting in the closure of textile mills across the country. In 2016, the mills, which numbered around 250 in the 1970s, had fewer than 25 operating processing facilities. (Ibrahim & Ogunwusi, 2017).

Awolehin et al. (2016) as cited in (Ibrahim & Ogunwusi, 2017) states that industry's fall is particularly regrettable, as cotton turnover has decreased from 8.2 billion naira in 1980 to 300 million naira in 2012. The capacity of existing ginneries has similarly decreased from 78% to 33%.

Among the major issues that contributed to the sector's demise were the availability of petrodollars as a result of the exploitation and export of large quantities of oil, a drop in national cotton production, and a general decrease in investment in processing activities in Nigeria. Most of the pioneer investors, primarily Lebanese and Chinese citizens, lost interest in the sector and, rather than modernizing the industry's equipment and facilities, left the old established facilities to decay. Today, most mills are ancient, and textile production technology is out of date. The situation is exacerbated further by the low-cost importation of inferior textile materials into the country. As a result, imports dominate the present domestic market size of cotton fabric, which is 1,200 million meters (Ibrahim & Ogunwusi, 2017).

2.7 Conceptual Framework

A conceptual framework is a tool that aids in the understanding of the relationship between concepts or variables in the real world. A conceptual framework, in simplest terms, explains or anticipates how essential idea variables will interact to inform the problem.

Ecological Economy theory will be used largely to help answer research issues. Ecological Economy is a field of Economics that examines the existing co-revolutionary interaction between global economic and global ecological systems. The term "Ecological Economy" refers to the economic tool used to optimally manage scarce resources. (Basiago, 1999).

Ecological Economy focuses on the interconnection and interrelationships of many functions of nature, a continual evolution between economy and environment that considers the complexity and uncertainty of the environment. The economic

approach to sustainable development is termed strong sustainability because it does not reduce living opportunities. (Shmelev, 2012).

3. Methodology

To construct technical textiles using jute fibres for packtech (packaging technology) production, the following steps were meticulously followed:

i. Weaving or Nonwoven Fabric Formation: There are two primary approaches to fabric formation for packtech applications:

a. weaving: Jute yarn can be woven into woven jute fabric on looms. To obtain the necessary fabric structure and qualities, different weaving techniques such as plain weave or twill weave can be used.

b. nonwoven: Jute fibres can also be turned into nonwoven fabrics. Nonwoven fabrics are made by attaching or interlocking threads together with procedures such as needle punching, heat bonding, or chemical bonding. Nonwoven materials include benefits such as high strength, breathability, and low cost.

ii. cutting and sewing: Cut the jute fabric into the shapes and sizes needed for packtech items such as bags or sacks. Sewing machines, adhesives, or other appropriate procedures are used to join the cut fabric pieces together. This procedure results in the finished jute-based packtech goods.

iii. quality control: implement strong quality control methods throughout the manufacturing process to ensure that jute-based packtech products satisfy the necessary standards. This includes performing strength tests, inspecting for flaws, ensuring dimensional accuracy, and evaluating adherence to certain performance requirements.

Plate 4.0 Cutting and Sewing in progress
Source: the researcher (May 2023)

Plate 4.1 Cutting and Sewing in progress
Sources: the researcher (May 2023)

Plate 4.2 Quality control check
Source: the researcher (May 2023)

Plate 4.3 Checking for machine default
Source: the researcher (May 2023)

Plate 5.0 Mesh preparation in progress
Source: the researcher (June 2023)

Plate 5.1 Mesh preparation in progress
Source: the researcher (June 2023)

Plate 5.2 Screen printing in progress
Source the researcher (June 2023)

Plate 5.3 Screen printing in progress
Source: the researcher (June 2023)

Plate 6.0 Displaying finished Jute products
Source: the researcher (June 2023)

Plate 6.1 Drying finished Jute products
Source: the researcher (June 2023)

Plate 6.2 Finished products
Source: the researcher (June 2023)

Plate 6.3 Packaging finished products
Source: the researcher (June 2023)

4. Discussion

Jute is an adaptable natural fabric that can be used to make a variety of technological textiles. Technical textiles are fabrics that are designed and engineered for special purposes that require functional features that go beyond the capabilities of standard textiles. Throughout the study, it was discovered that several strategies can be used to obtain a desired result.

Cutting and Sewing techniques was adopted by the researcher to cut the jute fabric into the desired shapes and sizes for packtech products like bags, the cut fabric pieces are then stitched together using sewing machines, adhesives, or other appropriate techniques.
Finishing treatments was another technique adopted by researcher for aesthetic appeal after weaving. The jute fabric undergoes screen printing finishing treatments to improve its properties. Screen printing enhance the aesthetic appeal of the fabric, while coating can provide added functionality such as water resistance or flame retardancy.

The choice of technique depends on the specific application requirements and the desired properties of the final textile product.

Screen printing on jute fabric is a popular technique used to apply designs, patterns, or images onto jute textiles. It involves using a mesh screen, a stencil, and ink to transfer the desired design onto the fabric. Here is a brief note on screen printing on jute fabric:

Screen printing, also known as silk screen printing or serigraphy, is a versatile and widely used method for adding decorative or functional elements to textiles, including jute fabric. The process involves the following steps:

- **Design preparation:** the first step was to prepare the designs for printing on the jute fabric. This could be a hand-drawn image, a computer piece of art, or a pre-existing stencil. Typically, the drawings were then copied onto a tiny mesh screen made of fabrics such as polyester or nylon.
- **Stencil creation:** after then, stencils were made by marking out sections of the screen that should not be inked. This is accomplished by either applying a stencil material by hand or by employing a light-sensitive emulsion that hardens when exposed to light. The stencil permits only the required portions of ink to pass through.
- **Fabric preparation:** to guarantee a smooth printing surface, the jute textiles were stretched tightly and secured in place. It is critical to pre-wash and iron the cloth to eliminate any dirt, wrinkles, or sizing agents that may interfere with the printing process.
- **Ink application:** the screen is placed over the jute fabric, and ink is put on its surface. The ink is then evenly distributed across the screen with a squeegee, forcing it through the stencil and onto the fabric below. To guarantee optimum ink penetration and coverage, the squeegee is moved across the screen with controlled pressure.
- **Drying and curing:** the jute fabric is left to dry once the design has been printed. Depending on the type of ink used, curing and bonding with the cloth fibres may require air drying or heat setting. To assure the longevity and washability of the printed

pattern, heat curing is frequently performed using a heat press or conveyor drier.

Screen printing on jute fabric offers several advantages. It allows for precise and vibrant designs with excellent color fastness. The natural texture of jute fabric enhances the visual appeal of the printed design, giving it a unique and organic look. Additionally, jute's high absorbency makes it suitable for screen printing as it readily absorbs the ink, resulting in good ink adhesion.

Overall, screen printing is an effective technique for adding custom designs, logos, or patterns to jute fabric, making it an attractive choice for various applications like bags, home decor items, promotional products, and fashion accessories.

5. Conclusion

Jute is a biomass resource that is renewable. It just takes 120 days from seeding to harvesting. Jute-based products and technology are green technologies with widespread uses that can aid in the mitigation, protection, and adaptation to the effects of climate change on ecosystems in the twenty-first century. Their eco-compatibility and economic sustainability have been highlighted in life cycle assessments.

Jute's adaptability enables for the creation of fabrics with specialized features such as high tensile strength, breathability, thermal insulation, and even flame resistance. Because of these characteristics, handwoven jute-based technical textiles are appropriate for a wide range of applications, including geotextiles, agrotextiles, car interiors, and home furnishings.

Furthermore, handwoven technical textiles made from jute fibre contribute to the textile industry's sustainability effort. The biodegradability and regenerative nature of jute correspond to the growing demand for environmentally friendly products. We can lessen our reliance on synthetic materials and reduce the environmental impact of traditional textiles by encouraging the use of jute.

6. Recommendation

To further promote the development of handwoven technical textiles using jute fibre, several recommendations can be considered:

- **Research and development:** Continued research and development efforts should be made to fully exploit the potential of jute fibre in technical textile applications. This includes researching various weaving processes, fibre mixes, and treatment procedures to improve the performance and utility of handwoven jute-based textiles.
- **Collaboration and knowledge sharing:** collaboration is essential among jute manufacturers, handloom weavers, textile designers, and technical textile experts. Sharing knowledge, skills, and best practices can lead to the development of novel products and increased design capabilities. Partnerships between industries and academic collaborations can be critical in establishing such cooperation.
- **Skill development:** training and skill development programs for handloom weavers and craftsmen specializing in jute weaving techniques can help them create high-quality handwoven technical textiles. Not only will this empower weavers, but it will also conserve traditional craftsmanship and support socioeconomic growth in jute-producing communities.
- **Market promotion and awareness:** raising awareness of the advantages of handwoven technical textiles made from jute fibre is critical for market acceptability and expansion. Marketing campaigns, trade exhibitions, and collaborations with and retailers can all assist to bring these fabrics' distinctive properties and prospective applications to a wider audience.
- **Government support:** governments can help by offering incentives, grants, and subsidies to encourage the creation and use of handwoven technological textiles made from jute fibre. This has the potential to encourage investment, innovation, and market demand, thereby promoting the growth of the jute industry and the technical textile sector.

By implementing these recommendations, we can unlock the full potential of handwoven technical textiles using jute fibre, fostering sustainable development, promoting traditional craftsmanship, and contributing to the circular economy in the textile industry.

References

Akter, S., Sadekin, M. N., & Islam, N. (2020). Jute and Jute Products of Bangladesh: Contributions and Challenges. *Asian Business Review*, *10*(3), 143–xxx. https://doi.org/10.18034/abr.v10i3.480

Aly-Hassan, M. S. (2015). A New Perspective in Multifunctional Composite Materials Natural Fibers and their Composites.

Annapoorani, Dr. S. G. (2012). *Technical Textiles and its benefits*.

Basiago, A. D. (1999). Economic, social, and environmental sustainability in development theory and urban planning practice. In *The Environmentalist* (Vol. 19). Kluwer Academic Publishers.

Danielsson, M. (2017). *The Plastic Bag Ban in Rwanda : Local Procedures and Successful Outcomes*. *January*.

Ejaz, M., Azad, M. M., Ur, A., Shah, R., Afaq, S. K., & Song, J. (2020). *Mechanical and Biodegradable Properties of Jute / Flax Reinforced PLA Mechanical and Biodegradable Properties of Jute / Flax Reinforced PLA Composites*. *November*. https://doi.org/10.1007/s12221-020-1370-y

Elbadry, E. A., Aly-hassan, M. S., & Hamada, H. (2012). *Mechanical Properties of Natural Jute Fabric / Jute Mat Fiber Reinforced Mechanical Properties of Natural Jute Fabric / Jute Mat Fiber Reinforced Polymer Matrix Hybrid Composites*. *January*. https://doi.org/10.1155/2012/354547

Horrocks A. R and Anand S. C. (2000). *HANDBOOK OF TECHNICAL TEXTILES Edited by A R Horrocks and S C Anand*.

Ibrahim, H. D., & Ogunwusi, A. A. (2017). Prospects for Kenaf Textiles Production in Nigeria. *7*(22), 22–28.

India, J. C. of. (2013). *Jute fibres*.

Islam, M. S., & Ahmed, K. (2012). The Impacts of Jute on Environment: An Analytical Review of Bangladesh. *2*(5). www.iiste.org

Meri, M. (2020). *Measures to reduce non-biodegradable waste*. *January*, 1–15.

Nawab, Y. (2020). Production and Export of Technical Textiles : Harnessing the Potential in Pakistan Author : Technical Review :

Shmelev, S. E. (2012). Ecological Economics: Sustainability in practice. In *Ecological Economics: Sustainability in Practice*. Springer Netherlands. https://doi.org/10.1007/978-94-007-1972-9

Tohora, S., Das, S. C., & Khan, M. A. (2020). *DEVELOPMENT OF SUSTAINABLE AND LOW COST JUTE -POLYESTER COMPOSITE : APPLICABILITY ASSESSMENT IN HOUSING SECTOR*. *February*, 1–9.