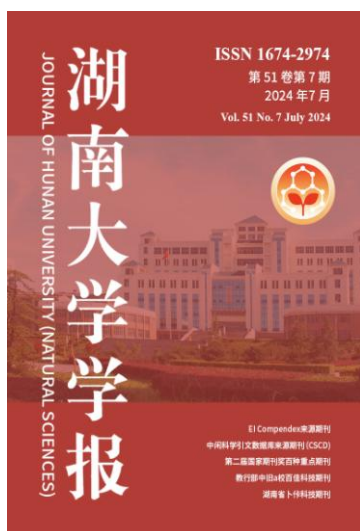




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Unlocking the Potential of Banana Fiber Exports from Bangladesh: A Comprehensive Marketing Strategy Analysis

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Abstract: Bangladesh possesses immense potential to become a leading global exporter of banana fiber, a versatile and eco-friendly natural fiber derived from banana plants. This study comprehensively evaluates the marketing and promotional strategies that can drive increased production capacity and export of Bangladeshi banana fiber. Through an extensive analysis of domestic production scenarios, competitive landscapes, international market trends, and stakeholder inputs, this research uncovers a positive correlation between strategic marketing efforts and manufacturing output and export potential. Key findings highlight the effectiveness of focused initiatives like identifying new buyers, deploying agents in target markets, investing in research and development, and nurturing customer relationships to



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stimulate demand for and awareness about Bangladeshi banana fiber globally. With abundant raw material availability, Bangladesh is estimated to produce 37,778 tons of banana fiber annually, potentially generating over \$94 million in export revenue. Although challenges related to cost efficiency, standardization, and scalability exist, collaborative efforts across government, industry, and research domains can address these hurdles. In an era marked by rising environmental consciousness, the global banana fiber market is experiencing a 5% CAGR, driven by the demand for sustainable materials in textile, packaging, and pulp industries. By capitalizing on strategic marketing and promotional tactics, Bangladesh can harness its untapped banana fiber production capabilities, diversify exports, generate employment, and position itself as a prominent exporter of this eco-friendly, renewable resource. This study provides a comprehensive roadmap for stakeholders to maximize the economic and ecological benefits of Bangladesh's emerging banana fiber industry through targeted marketing strategies. The novelty of this study lies in its integrated approach, which combines an analysis of marketing strategies with production capacity and export potential specifically for the Bangladeshi banana fiber industry. This offers original quantitative estimates of potential production and export earnings and uniquely frames the industry's development according to sustainable development and circular economy principles. The study's interdisciplinary perspective, connecting local production capabilities with global market trends, provides novel insights for positioning Bangladesh in the international banana fiber market.

Keywords: banana fiber; production capacity; export potential; international markets; marketing strategies

释放孟加拉国香蕉纤维出口潜力：全面营销策略分析

摘要：孟加拉国拥有成为全球领先的香蕉纤维出口国的巨大潜力，香蕉纤维是一种从香蕉植物中提取的多功能环保天然纤维。本研究全面评估了可以推动孟加拉国香蕉纤维产能和出口增长的营销和促销策略。通过对国内生产情景、竞争格局、国际市场趋势和利益相关者投入的广泛分析，本研究发现战略营销工作与制造业产出和出口潜力之间存在正相关关系。主要发现强调了重点举措的有效性，例如确定新买家、在目标市场部署代理商、投资研发和培养客户关系，以刺激全球对孟加拉国香蕉纤维的需求和认知度。孟加拉国原材料供应充足，估计每年可生产 37,778 吨香蕉纤维，可能产生超过 9400 万美元的出口收入。尽管存在与成本效率、标准化和可扩展性相关的挑战，但政府、行业和研究领域的合作努力可以解决这些障碍。在这个环保意识不断增强的时代，全球香蕉纤维市场正经历 5% 的复合年增长率，这得益于纺织、包装和纸浆行业对可持续材料的需求。通过利用战略营销和促销策略，孟加拉国可以利用其尚未开发的香蕉纤维生产能力，实现出口多元化，创造就业机会，并将自己定位为这种环保可再生资源的主要出口国。这项研究为利益相关者提供了全面的路线图，通过有针对性的营销策略最大限度地提高孟加拉国新兴香蕉纤维产业的经济和生态效益。这项研究的新颖之处在于它的综合方法，将营销策略分析与孟加拉国香蕉纤维产业的生产能力和出口潜力相结合。这提供了潜在产量和出口收入的原始定量估计，并根据可持续发展和循环经济原则独特地构建了该行业的发展。这项研究的跨学科视角将当地生产能力与全球市场趋势联系起来，为孟加拉国在国际香蕉纤维市场的定位提供了新颖的见解。

关键词：香蕉纤维；生产能力；出口潜力；国际市场；营销策略

1. Introduction

The global textile industry is increasingly seeking sustainable alternatives to traditional fibers, driven by growing environmental consciousness and the need for eco-friendly materials. In this context, banana fiber has emerged as a promising natural fiber with significant

potential for economic development in Bangladesh. This research aims to comprehensively evaluate the marketing and promotional strategies that can drive increased production capacity and export of Bangladeshi banana fiber.

Bangladesh, a predominantly agricultural economy

with extensive banana cultivation, generates substantial quantities of biomass from banana harvesting that have remained largely unutilized. However, the recent recognition of banana fiber's unique properties and versatility has opened up opportunities across various industries, including textiles, packaging, and paper production. Despite this potential, there is a noticeable gap in research that focuses specifically on the export potential and marketing strategies for banana fiber in the Bangladeshi context.

This study builds upon existing literature on banana fiber production processes and applications and extends the focus to analyze the correlation between marketing strategies and both production capacity and export potential. This approach addresses a critical research gap and provides valuable insights for stakeholders in the emerging banana fiber industry in Bangladesh.

This research employed a descriptive design based on secondary data sources, including government records, statistical reports, and published materials. The theoretical basis of this study lies in the marketing strategy and export development theories applied to the specific context of the banana fiber industry. The methodology involves a comprehensive analysis of domestic production scenarios, competitive landscapes, international market trends, and stakeholder inputs.

The expected outcomes of this research include identifying effective marketing strategies to boost banana fiber exports, quantifying potential economic benefits, and providing recommendations for industry development. These findings are anticipated to have significant implications for policymakers, manufacturers, and exporters in harnessing the untapped potential of Bangladesh's banana fiber industry.

By exploring this eco-friendly and renewable resource, Bangladesh can diversify its export basket, generate employment, and position itself as a prominent player in the global sustainable fiber market. This study provides a roadmap for achieving these objectives through strategic marketing and promotional efforts.

1.1. Objectives of the Study

The overarching goal of this research is to thoroughly evaluate the export potential and devise effective marketing strategies for banana fiber originating from Bangladesh, with the following specific objectives in mind:

- To conduct a comprehensive analysis of the domestic banana fiber industry in Bangladesh, including its production levels, utilization, and current export status
- To identify potential international markets and assess the competitive landscape and market trends for Bangladeshi banana fiber globally

- To explore the favorable factors supporting increased banana fiber exports from Bangladesh and the associated challenges

- To develop effective marketing strategies aimed at expanding the export market for Bangladeshi banana fiber by focusing on identifying new buyers, assigning agents, product diversification, and promoting eco-friendly and employment benefits

- To evaluate the proposed marketing strategies' impact on production capacity, scalability, and economic benefits (foreign exchange, employment) and develop recommendations for stakeholders to fully harness the export potential of the banana fiber industry

1.2. Criteria for Selecting Research Objects

To ensure meaningful research on banana fiber, this study considered the following criteria when selecting research objectives.

First, the focus should be on economic benefits such as industry growth, export diversification, and job creation for Bangladesh. Additionally, this research should explore the eco-friendly nature of banana fiber and its potential to contribute to a sustainable future. This includes assessing the global demand for sustainable fibers and Bangladesh's potential to meet it.

Furthermore, this research should investigate strategic marketing methods for promoting Bangladeshi banana fiber internationally. Innovation and ongoing research and development (R&D) are also crucial for the advancement of production and application. Finally, the study should consider the importance of informing government policies, identifying quality standards for global competition, and fostering international collaboration on technology transfer, market access, and best practices sharing.

1.3. Originality of the Study

This study breaks ground in exploring banana fiber in Bangladesh by incorporating several unique aspects.

First, the study's focus on Bangladesh provides a fresh perspective compared to prior research that examined banana fiber in other contexts. By homing in on Bangladesh, this study offers a comprehensive analysis specific to the country's situation.

Second, the study's originality lies in its integration of marketing and production analysis. It uniquely considers marketing strategies, production capacity, and export potential. This combined approach offers a holistic view of the Bangladeshi banana fiber industry's development prospects.

Third, this study provides novel quantitative estimates of Bangladesh's potential banana fiber production and export earnings. These original estimates provide a valuable baseline for future studies and policy decisions aimed at developing the banana fiber industry in Bangladesh.

1.4. Implications of the Study

This study highlights several key opportunities and considerations:

Industry development: Abundant raw materials and a rising demand for sustainable fibers create opportunities for Bangladesh to establish a strong banana fiber industry.

Export diversification: Banana fiber can diversify Bangladesh's export portfolio by reducing its dependence on garments.

Sustainable practices: Eco-friendly banana fiber production showcases Bangladesh's commitment to sustainability and attracts environmentally conscious buyers.

Employment generation: The industry can create new jobs, especially in rural areas with existing banana cultivation, thus contributing to poverty reduction.

Marketing strategies: Targeted marketing efforts like identifying new buyers and building strong customer relationships are crucial for export success.

R&D and collaboration: Ongoing R&D are needed to improve production processes, develop new products, and potentially involve academic institutions.

Policy and infrastructure: Government support through policies like export incentives, technology adoption subsidies, and skill development programs is essential. Additionally, developing efficient supply chains from farms to exporters is necessary for smooth operation.

Social benefits: Rural development, women's empowerment, skill development, sustainable livelihoods, environmental awareness, community cohesion, improved health and safety, and cultural preservation are the potential social benefits of a thriving banana fiber industry.

These implications provide a roadmap for stakeholders to develop the industry, leading to economic and environmental benefits.

1.5. Literature Review

The use of banana stems as a source of fiber declined after the popularity of other convenient fibers, such as cotton and silk, increased. However, in recent years, the commercial value of banana fiber has increased, and it is used all over the world for multiple purposes, including making tea bags, sanitary napkins, Japanese yen notes, and car tyres [3]. Kaur [3] presents an analysis of banana fibers, elucidating their historical applications, properties, extraction methodology, and potential utilization in the textile industry as an environmentally sustainable resource.

What was previously considered agricultural waste and a hindrance to farmers is now a raw material for high-quality silk-grade fiber yarn. This transformation pertains to banana fiber. Also known as musa fiber, it is

one of the strongest natural fibers. This biodegradable natural fiber, derived from the bark of banana plants, exhibits such durability that if currency notes were manufactured from it, they could remain in circulation for over a century. Its versatility allows applications ranging from the production of silk-grade saris to utilization in automobile tires [3].

Banana stem, previously considered a waste product, is now utilized to produce banana-fiber cloth, which exhibits varying weights and thicknesses depending on the specific part of the banana stem from which the fiber is extracted. The innermost sheaths yield the softest fibers, while the outer sheaths produce thicker and more robust fibers. Composed of thick-walled cell tissue and bound by natural gums, banana fiber exhibits similarities to natural bamboo fiber; however, its fineness and spinability surpass those of bamboo and ramie fibers. The primary constituents of banana fiber are cellulose, hemicellulose, and lignin [3].

Mostafa and Uddin [4] discussed the effect of banana fibers on global marketing strategies. The purpose of the experimental study was to evaluate the influence of banana fiber length on the compressive and flexural strength of GCEBs. The results presented in this study provide important insights into the influence of fiber length on the flexural and compressive strengths of GCEBs. In GCEB matrices, soil constituents, fiber content, chemical stabilization (OPC content), compaction effort, and curing conditions contribute to the mechanical properties. All these variables were kept constant throughout the study to enable observation of the influence of banana fibers on the flexural strength, compressive strength, and post-initial crack behavior of fiber-reinforced GCEBs [4].

On average, specimens reinforced with 50-mm fibers performed better in both flexural and compressive strengths than unreinforced specimens and specimens reinforced with 25-mm fibers. The highest flexural and compressive strengths were recorded at reinforcement with 50-mm fibers and 0.35% fiber content by weight. The results indicated that treated 50-mm fibers exhibited superior performance in this study. Specimens reinforced with 50-mm fibers at 0.35% by weight demonstrated 94% and 77% higher flexural and compressive strengths, respectively, than unreinforced specimens. The incorporation of fibers into the matrices prevented abrupt failure of the tested samples during the MOR test [4].

The material properties of banana-reinforced GCEB are largely influenced by fiber type, volume, geometry and length (aspect ratio), surface conditions, method of production, and matrix composition. All these factors were considered when selecting the engineered banana fibers. The findings show that with an adequate

understanding of GCEB specimens, these fibers can enhance the lateral load performance of earthen masonry. Consequently, experimental work and sample size will be increased to validate these initial findings [4].

Hossain and Majumder [5] highlighted the prospect of banana fiber production in Bangladesh. In Bangladesh, banana is a very popular fruit and cultivated almost everywhere round the year. Bangladesh ranks the 14th among the top 20 banana-producing countries in the world. It is a commercially cultivated fruit; however, in Bangladesh, its commercial production is limited to specific regions. The demand for bananas increases daily in Bangladesh. Thus, this paper attempts to identify an autoregressive integrated moving average (ARIMA) model that can be used to forecast banana production in Bangladesh. This study considered secondary data on yearly banana production from 1972 to 2013 in Bangladesh. The best selected ARIMA model for forecasting banana production in Bangladesh is ARIMA (0,2,1). The graphical comparison between the observed and forecasted banana productions indicates that the fitted model behaved statistically well during and beyond the estimation period [5].

1.6. Research Gaps

Limited studies on export potential and marketing strategies for banana fiber: Most studies have focused on the production and use of banana fiber, but very few have explored its export potential and marketing strategies, particularly in the context of Bangladesh. This represents a significant research gap that must be addressed.

Lack of comprehensive analysis of domestic production, use, and export data: Although the mentioned studies highlight the importance of analyzing the domestic production, use, and export data on banana fiber, they do not provide a comprehensive analysis of these data. Conducting such an analysis would help identify opportunities and challenges in the banana fiber industry and inform export strategies.

Need for in-depth market analysis, including international demand and supply: To assess the export potential of banana fiber, an in-depth analysis of the international market, including the demand and supply dynamics, is required. The literature suggests this as an objective, but it does not provide specific details or findings related to this analysis.

Exploration of international marketing strategies: The studies mention setting marketing strategies for exploring banana fiber in international markets as an objective. However, it does not provide any detailed information or recommendations regarding potential marketing strategies for the successful export of banana fiber.

Scalability and commercialization of banana fiber production: This section focuses on the potential uses and benefits of banana fiber, but it does not address the challenges and considerations related to scaling up and commercializing banana fiber production, which could be a crucial aspect for successful export and widespread adoption.

By addressing these research gaps, future studies can contribute to a more comprehensive understanding of the banana fiber industry, its export potential, and effective marketing strategies for exploring international markets.

1.7. Delimitations of the Study

This study focuses narrowly on Bangladesh's banana fiber industry at a specific point in time, limiting its scope in four key areas:

Global context: The analysis lacks comparative assessments with the global banana fiber market, thereby omitting crucial insights into Bangladesh's competitive advantages and long-term industry trends.

Impact of marketing strategies: This study did not precisely measure how marketing strategies affect production and export potential.

Technological and policy landscape: This does not extensively cover technological advancements or conduct an in-depth analysis of existing policies and potential policy reforms.

Stakeholder and environmental comprehensiveness: This study might not capture the perspectives of all stakeholders (farmers, workers, consumers) and lacks a comprehensive assessment of the environmental impact of large-scale production.

These limitations restrict this study's generalization and understanding of the industry's long-term prospects.

2. Methodology

This study investigates the marketing and promotional strategies, production capacity, and export potential of the banana fiber industry in Bangladesh. The research is entirely based on secondary data sources.

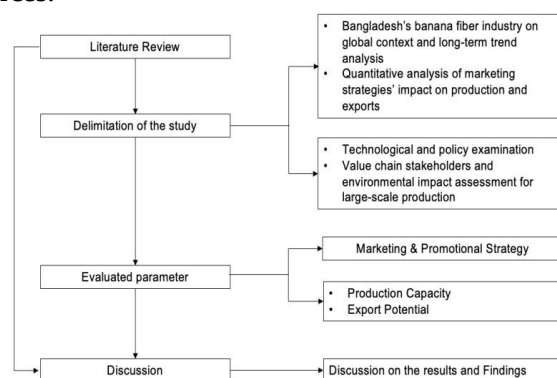


Figure 1. Research flowchart (The authors' elaboration)

2.1. Research Design

This study employs a descriptive research design to comprehensively investigate and conceptualize the domestic production level and utilization of banana fiber and marketing strategies for enhancing the exportation of banana fiber. This research examines the prospects and possibilities of the banana fiber industry in Bangladesh.

2.2. Data Sources

The study relies on various secondary data sources, including the following:

Government records: official writings, correspondence, reports, dispatches, resolutions on exports, confidential office records, and legislative proceedings

Statistical reports: census and industrial ministry reports and other relevant statistical data

Published materials: books, research articles, newspapers, speeches, addresses, and extracts related to the banana fiber industry

2.3. Stakeholder Involvement

To enrich the study and incorporate an indigenous professional perspective, active involvement of banana fiber manufacturers and exporters who are professionally engaged in and committed to increasing exports from Bangladesh was sought.

2.4. Evaluated Parameters

This study focused on three key variables:

2.4.1. Independent Variable: Marketing and Promotional Strategy

This variable encompasses actions or plans implemented by companies or the industry to influence or drive other factors, such as production capacity and export potential.

2.4.2. Dependent Variable: Production Capacity

This variable refers to the maximum output or quantity of banana fiber that can be produced given the current resources, facilities, and constraints. Production capacity was considered a dependent variable because it may be influenced or affected by the marketing and promotional strategies implemented.

2.4.3. Dependent Variable: Export Potential

This variable represents the potential or capacity of the banana fiber industry in Bangladesh to export its products to international markets. Export potential was considered a dependent variable because it could be influenced by the marketing and promotional strategies employed, which could increase global awareness, demand, and opportunities for exporting banana fiber products.

2.5. Data Analysis

The researchers reviewed and analyzed the secondary data sources to gain insights into the marketing and promotional strategies, production capacity, and export potential of the banana fiber industry in Bangladesh. The analysis identified patterns, trends, and relationships between the independent and dependent variables.

Through this methodology, the researchers investigated how different marketing and promotional strategies can influence changes in the production capacity and export potential of the banana fiber industry in Bangladesh.

3. Results and Discussion

Banana fiber, extracted from the pseudo-stems of banana plants, has emerged as a promising natural and eco-friendly material with significant potential for Bangladesh's economic development. Despite being an agricultural country with widespread banana cultivation, the extensive biomass generated from banana harvesting has largely gone unutilized. However, the recent recognition of the unique properties and versatility of banana fiber has facilitated the emergence of opportunities in diverse industries, including textiles, packaging, and paper production. This comprehensive article discusses the environmental impacts, cost effectiveness, local production scenario, import-export dynamics, competitive landscape, and marketing strategies surrounding the banana fiber industry in Bangladesh. By capitalizing on this abundant and sustainable resource, Bangladesh can diversify its export basket, generate employment, and contribute to sustainable practices while positioning itself as a prominent player in the global banana fiber market.

3.1. Banana Fiber Components

Banana fiber, also known as *musa fiber*, is considered one of the world's strongest natural fibers. This biodegradable fiber is derived from the stems of banana trees and exhibits notable durability. The fiber's structure consists of thick-walled cell tissue, cohered by natural gums, and is primarily composed of cellulose, hemicellulose, and lignin. Banana fiber shares similarities with natural bamboo fiber; however, its spinability, fineness, and tensile strength are purported to be superior. Banana fiber can be used to make different textiles with different weights and thicknesses, depending on the part of the banana stem from which the fiber was extracted. The thicker, sturdier fibers are taken from the outer sheaths of banana trees, whereas the inner sheaths result in softer fibers [1].



Figure 2. Simple sage organic banana fiber (The authors’ elaboration)

Table 1. Composition of banana fiber (The authors’ elaboration)

Component	Value (%)
Cellulose	53.52%
Hemicellulose	13.90%
Lignin	18.64%
Pectin	3.10%

Banana fiber is composed of cellulose (53.52%), hemicellulose (13.90%), lignin (18.64%), and pectin (3.10%) [2].

Table 2. Length and tenacity of banana fibers [7]

Criteria	Value
Length of ultimate banana fiber	0.25-1.30 cm
Diameter	14-50 microns
Fiber Tenacity	29.98 g/denier
Moisture	13%

An opportunity exists to address a portion of the raw fiber deficit through the extraction of banana fiber. Currently, this resource remains unutilized and discarded. Approximately 1% of the banana pseudo-stem consists of fiber. The length of the ultimate banana fiber ranges from 0.25 to 1.30 cm, and the diameter ranges from 14 to 50 microns. This fiber exhibits a tenacity of 29.98 g/denier and a moisture regain of 13% [2].

3.2. Production of Banana Fiber

There are a few steps in the banana fabric production process:

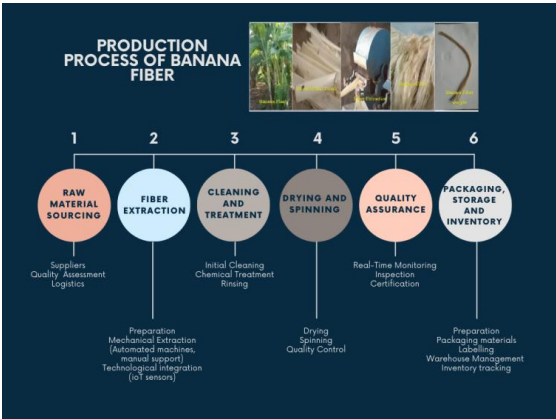


Figure 3. Banana fabric production (The authors’ elaboration)

3.2.1. Raw Material Sourcing

The initial step involves assessing and selecting quality banana plant and waste suppliers. The process includes evaluating the quality of the raw materials, negotiating with suppliers, and organizing efficient logistics for transportation to the production facility. Proper sourcing ensures a consistent supply of high-quality banana plants and waste for fiber extraction.

3.2.2. Fiber Extraction

The extraction begins by preparing banana plant materials. Mechanical extraction is subsequently conducted utilizing automated machinery, frequently supplemented by manual labor for tasks that machines are unable to perform. Modern facilities may integrate the IoT (internet of things) technology to monitor and optimize the extraction process, improving efficiency and quality control.

3.2.3. Cleaning and Treatment

The extracted fibers are initially cleaned to remove dirt and impurities. They are then subjected to chemical treatment to improve their properties and prepare them for further processing. After treatment, the fibers are thoroughly rinsed to remove any residual chemicals.

3.2.4. Drying and Spinning

The clean, treated fibers are dried using controlled methods to ensure optimal moisture content. The dried fibers are then spun into yarn or thread. Throughout this step, quality control measures are implemented to ensure the consistency and strength of the spun fiber.

3.2.5. Quality Assurance

This crucial step involves real-time monitoring of the production process, regular inspections of the fibers at various stages, and certification to meet industry standards. Quality assurance ensures that the final product adheres to the specified requirements and fulfills customer expectations.

3.2.6. Packaging, Storage, and Inventory

The finished banana fiber products are prepared for storage or shipment. This includes selecting appropriate packaging materials, accurate labeling, and efficient warehouse management. An inventory tracking system is implemented to monitor stock levels, manage orders, and ensure timely delivery to customers.

3.3. Use of Banana Fiber

The utilization of banana fiber varies significantly depending on whether it is derived from the inner or outer peel or stem lining. The inner lining exhibits a texture comparable to silk in its softness, and analogous to silk, banana fabric demonstrates high sensitivity and

fragility. Banana fiber serves as a substitute for garments traditionally constructed from silk, encompassing blouses, shirts, negligees, lingerie, slips, gowns, robes, eveningwear, and other similar apparel [2].

3.3.1. Use for Accessories

With respect to accessories, banana fiber is anticipated to be utilized more extensively in the production of scarves, hats, and gloves as sustainable, organic products gain increasing popularity [2].



Figure 4. Textile spotlight banana fabric [2]

3.3.2. Use in Industry and Decoration

Historically, the limited technological sophistication has restricted the utilization of banana fiber to rudimentary applications such as doormats, wall weaving, and ropes. In certain indigenous communities, banana fiber continues to be employed for these traditional purposes; however, applications of this fiber beyond the scope of wearable products are generally confined to tropical-themed decorative items [2].

3.4. Environmental Impacts of Banana Fiber

The process of producing bananas to meet worldwide demand has been environmentally destructive. In the late 1800s, entrepreneurs from Britain and the United States, using morally dubious means, obtained vast areas of largely unpopulated but rich and bio-diverse coastal rainforests. Subsequent to this period, banana cultivation has entailed the clear-cutting of primary rainforest areas to establish banana monocultures. These plantations are subsequently abandoned, and the process is reiterated once factors such as soil depletion or pest infestation commence to diminish crop yields [6].

Large quantities of pesticides, herbicides, fungicides, and synthetic fertilizers must maintain a banana monoculture. Most plantation owners spend more money on agrochemicals than on paying their workers. These are usually applied by aerial application or crop dusting—spraying agrochemicals from an aircraft. It is estimated that only 15% of these agrochemicals land on crops, while the remaining 85% land on workers and their homes and food. This process poses a threat to workers who lack appropriate safety equipment and the surrounding environment [6].

The agrochemicals used in banana cultivation can

damage the rainforests that border plantations. A study of spectacled caimans living near plantations in Costa Rica found traces of pesticides in their blood—several of which, like DDT, have not been used in the region for years. This is one of the ways in which aggressive farming practices can have a far-reaching and difficult-to-reverse impact on the environment. Because these alligator-like reptiles are at the top of the food chain in their ecosystem, the pesticide build-up in their bodies also reflects the persistence of these chemicals throughout other trophic levels. While the spectacled caimans in Costa Rica are not immediately threatened by the level of pesticides found in their blood, the study also found that living near plantations, as opposed to living in remote and relatively uncontaminated areas, had a negative impact on the caimans' health [6].

One of the agrochemicals commonly used in banana cultivation, dibromochloropropane (DBCP), was classified by the EPA as a probable human carcinogen and has been banned in the U.S. since 1979 however; it continues to be used extensively in Latin America. Numerous lawsuits have been brought against banana giants Dole and Del Monte over the use of DBCP, with workers claiming to have suffered serious health effects. They also claim that they were not given protective equipment or even made aware of the potential risks of exposure [6].

The features of banana fiber make it eco-friendly. Banana plants are available all over Bangladesh. Therefore, the raw materials for making banana fiber are easy to access for the manufacturers. The internal layer of the fiber exhibits a texture comparable to silk, while the external layer possesses a coarse texture reminiscent of burlap or cotton. The silky interior fiber is very delicate. At the same time, it is often more expensive to produce than silk. The fiber ingredients are rotting. Therefore, it is considered environmentally friendly.

3.5. Cost Effectiveness of Banana Fiber

High-quality, inner-lining banana fiber is typically associated with significant cost. Its production process is complex, and it possesses properties comparable to silk, resulting in a lustrous fabric with considerable market value. Rougher, outer-lining fabric is generally more economical. Additionally, opting for conventional fabric over organic alternatives may offer cost savings; however, this choice may expose individuals to harmful substances [2]. Normally, banana fiber can be produced by similar machines as in other natural fiber production. Such machinery is available in most yarn and fabric manufacturers in Bangladesh. The price and installation costs of the machines used for banana fiber production are reasonable. These resources will reduce plant installation costs.

3.6. Local Production of Banana Fiber

Bangladesh has a growing industry focused on the production and export of banana fibers. Table 5 lists some of the major banana fiber manufacturers and exporters in the country. Companies like Musa Banana Fiber and Modern Banana Fiber Company Ltd. export to regions like Eastern Europe, South America, Oceania, and Central America. Although the export volumes in some firms are relatively small (under \$1 million), there is significant potential for growth given Bangladesh’s large banana cultivation area of 133,305 acres and the vast biomass of banana pseudo-stems available annually. With an expected annual production of 37,778.74 tons of banana fiber, this renewable and sustainable resource could help meet the global demand for natural fibers given its favorable properties like high tenacity and cellulose content.

Table 3. Production volume of banana fiber in Bangladesh (The authors’ elaboration)	
Criteria	Volume
Annual banana acreage	133305 acres (53,970 ha)
Biomass of banana pseudo-stems	70 tons/ha
Total production of banana pseudo-stem biomass per year	3777874 tons
Banana fiber per year in Bangladesh	Expected quantity of 37,778.74 tons
Per-hectare expected banana fiber production	690 kg

The annual banana acreage in Bangladesh is 133305 acres (53,970 ha). The average banana pseudo-stem biomass is 70 tons/ha. The total banana pseudo-stem biomass production annually is 3777874 tons. Expected quantity of banana fiber per year in Bangladesh: 37,778.74 tons (20,9,881 bales, 180 kg = 1 bale). Per-hectare expected production of banana fiber: 690 kg [2].

3.7. Bangladeshi Exporters and Importers of Banana Fiber

Bangladesh has emerged as a significant player in the global banana fiber industry, with several major manufacturers and importers operating within its borders. These companies source banana fibers from various regions around the world, including North America, Eastern Europe, East Asia, South America, Southern Europe, Western Europe, Oceania, and Central America.

Table 4. Major banana fiber importers in Bangladesh [3]			
SL	Importer	Import Volume	Importing Countries
1	Shahi Banana Fiber Construction Industry	Below US\$ 1 Million	Eastern Europe, South America, Oceania, and Central America
2	Banana Fiber Limited	US\$ 0.6 Million	North America, Eastern Europe, East Asia, South America, Southern Europe, and Western Europe
3	Ozyear Banana Fiber	US\$ 0.8 Million	North America, Eastern Europe, East Asia, South America, and Southern Europe
4	Sahal Handi Craft	US\$ 1 Million	North America, Eastern Europe, East Asia, South America, Southern Europe, and Western Europe

The table highlights four prominent Bangladeshi enterprises engaged in the banana fiber trade, each with varying import volumes and sourcing locations. Shahi Banana Fiber Construction Industry, despite importing less than US\$1 million worth of banana fibers, has a diverse supply network spanning Eastern Europe, South America, Oceania, and Central America. Banana Fiber Limited, on the other hand, has a more extensive import volume of US\$0.6 million, sourcing from North America, Eastern Europe, East Asia, South America, Southern Europe, and Western Europe.

In addition, Table 5 highlights four banana fiber exporters and their markets: Musa Banana Fiber exports below US\$1 million to Eastern Europe, South America, Oceania, and Central America, indicating a smaller scale or diverse portfolio. Modern Banana Fiber Company Ltd. exports US\$ 0.4 million to Eastern Europe and South America and has a stable business model. Sohan Banana Fiber lacks detailed data, possibly indicating a new market presence or domestic focus. My Dream Banana Fiber exports US\$ 0.2 million to South America, Oceania, and Central America, targeting specific markets. The focus on Eastern Europe and South America suggests steady demand, whereas Oceania and Central America offer niche market opportunities. Export volume differences reflect various market strategies and stages of penetration. There are growth opportunities in active regions, and potential collaboration among manufacturers could enhance market reach and resource sharing, making the market competitive and ready for collaborative growth.

Table 5. Major banana fiber manufacturers and exporters in Bangladesh [7]

SL	Manufacturer	Export Volume	Exporting Countries
1	Musa Banana Fiber	Below US\$ 1 Million	Eastern Europe, South America, Oceania, and Central America
2	Modern Banana Fiber Company Ltd	US\$ 0.4 Million	Eastern Europe and South America
3	Sohan Banana Fiber	N/A	N/A
4	My Dream Banana Fiber	US\$ 0.2 Million	South America, Oceania, and Central America

3.8. Export Potential of Banana Fiber

There appears to be a significant opportunity for exporting banana fiber from Bangladesh for the following reasons:

Large production volume: The annual production of 37,778.74 tons far exceeds the current export volumes.

Surplus production: Given that the import values are higher than export values, it suggests room for import substitution and increased exports.

Established export relationships: Bangladeshi companies already export to various regions, including Eastern Europe, South America, Oceania, and Central America. This provides a foundation for expanding exports.

Potential for value addition: The domestic processing of raw banana fiber in Bangladesh has the potential to enhance the nation's export value.

Abundant raw material: Bangladesh has a favorable climate for banana cultivation, and the country produces a substantial number of bananas annually. The pseudo-stems, which are usually discarded as waste after harvesting the fruit, can be used as a source of banana fiber, providing a reliable and renewable raw material supply.

Eco-friendliness and sustainability: Banana fiber is a biodegradable and renewable resource, making it an environmentally friendly alternative to synthetic fibers. With growing global demand for sustainable and eco-friendly products, banana fiber can find a niche market in various sectors, including textiles, paper, and composites.

Textile industry: The textile industry in Bangladesh is a significant contributor to the country's economy and a major export earner. Banana fiber can be used to produce eco-friendly fabrics, yarns, and other textile products. The unique properties of banana fiber, such as its high tensile strength, moisture absorption, and breathability, make it suitable for apparel, home furnishings, and technical textiles.

Paper and packaging industry: Banana fiber can be used in the production of specialty papers, packaging materials, and pulp-based products. The strength and

durability of banana fiber make it an attractive alternative to wood-based pulp, promoting sustainable forestry practices.

Diversification of exports: By exploring the export potential of banana fiber and its derived products, Bangladesh can diversify its export basket and reduce its reliance on a few traditional export items, such as ready-made garments and jute products.

Employment generation: The cultivation, processing, and manufacturing of banana fiber products can create employment opportunities in rural areas where banana farming is prevalent, contributing to economic development and poverty alleviation.

Growing global demand: There is a global demand for natural fibers, and banana fiber has favorable properties such as high tenacity and cellulose content.

International market gaps: Banana fiber is now commercially produced in Australia, China, Egypt, India, Indonesia, Japan, Mauritius, Nepal, the Philippines, Rwanda, Sri Lanka, Uganda, and Vietnam. Banana plant fiber production is limited in Central, North, and South America and the Caribbean, with notable occurrences in Brazil, Costa Rica, and Mexico [8]. The concise introduction to banana fiber elucidates one of the numerous underexploited potential resources of Bangladesh. However, realizing this potential requires commitment to entrepreneurship and indigenous exercise. A sense of contribution to people's benefit through R&D remains indispensable [8].

Table 6. Export potential of banana fiber [8]

Criteria	Volume	Income in TK
Expected annual income from selling banana fiber	37,40,096 tons	TK 1496,03,84,000
Expected gross return from selling banana fiber and compost annually	46,60,000 tons	TK 2220,44,57,395

If we are able to produce banana fiber at the desired level, we anticipate an annual income of US\$ 9,444,468.50 (equivalent to TK 724,407,395 at a rate of TK 76.70 per US\$) from selling banana fiber at US\$ 2.5 per kilogram [4]. Additionally, we expect to produce 37,400,096 tons of compost per year after extracting fiber from banana pseudo-stems. The projected income from selling this compost is TK 1,496,038,400 at a rate of TK 4000 per ton [8].

The gross annual return from selling banana fiber and compost is Taka 2220,44,57,395. Banana fiber is used for yarn, fabric, apparel, handicrafts, paper, currency notes, security printing paper, craft paper, and plywood. The extraction of banana fiber will create new jobs in the agriculture, small industry, and business sectors [8].

However, to fully capitalize on the export potential of banana fiber, several challenges need to be addressed, such as developing efficient extraction and processing technologies, establishing quality standards, creating awareness about the benefits of banana fiber, and promoting product innovation and market development through R&D initiatives.

Overall, with its abundant banana cultivation, favorable climate, and growing demand for sustainable and eco-friendly products, Bangladesh has the potential to position itself as a significant exporter of banana fiber and its derived products in the global market.

3.9. Competitive Analysis

The banana fiber market is growing due to the demand for eco-friendly materials, with India as the leading global supplier taking advantage of its large banana production.

3.9.1. Market Overview

Although banana fibers extracted from banana plants have minimal uses for making certain composite materials, the benefits and properties of these fibers are recognized and appreciated, expanding their usefulness for making household furniture and garments [3]. Therefore, there are various industries where banana fibers are used:

- Textile industry
- Packaging industry
- Pulp and paper industry
- Many other industries

Thus, these textile fibers have numerous applications, including the production of ropes, string threads, paper cardboards, place mats, tea bags, textile materials, polymers, and absorbents [3].

3.9.2. Market Growth

Banana fiber extracted from banana plants has many unique properties, which make it useful in multiple industries. The versatility of banana fibers has prompted a massive demand for them in the market. Thus, the demand for banana fibers in the market has been fairly strong. The banana fiber extraction market has grown at a CAGR rate of 5 % from 2019 to 2023 [3]. An estimation has been made that in 2024, the banana fiber extraction market will achieve a market size of 117.97 USD [3].

3.9.3. Market Trend

With the growing awareness of the preservation of natural, eco-friendly, and biodegradable materials, the use of hazardous materials has decreased. Consequently, there has been a great increase in organic and eco-friendly materials. One such environmentally friendly material is fiber, which is extracted from banana plants. Banan fiber extraction is

highly recognized for its biodegradable and environment-friendly nature, multiple properties, and abundance. In addition, these banana fibers are removed from the pseudo-stems of the plants and leftover at the time of harvesting. The versatility of banana fibers has led to their use in multiple industries. Moreover, it acts as an excellent alternative for many such raw materials that are not eco-friendly [3].

Table 7. Distribution of the world banana fiber production averages [3]

SL	Country	% of average production
1	India	23%
2	Brazil	9%
3	Ecuador	9%
4	China	8%
5	Philippines	8%
6	Indonesia	6%
7	Costa Rica	3%
8	The Rest of the World	34%

At 28.4 million tons per year, India is the world’s largest producer of bananas, so it makes sense that this Asian country is also the biggest producer of banana fiber. The Philippines is no longer a banana fiber production hub; however, this fabric is still made for traditional purposes in small quantities in this island chain nation. Almost all banana fiber that reaches Western markets comes from India [2].

3.10. Marketing Strategies to Increase Banana Fiber Exports

To enhance the export market, banana fiber manufacturers and exporters must implement effective marketing strategies:

Searching for new buyers: Bangladesh is not currently able to export large volumes of banana fibers. Bangladeshi fiber manufacturers need to undertake comprehensive efforts to identify potential buyers in the Central, North, and South American countries as these nations lack the capacity to produce banana fiber on a large scale. The manufacturers can receive support from the government for initiating and implementing buyer search activities.

Assigning agents in target countries: Banana fiber manufacturers in Bangladesh may appoint sales representatives or agents in prospective countries who will be stationed in those nations. The assigned representatives will organize trade fairs, seminars, and other promotional campaigns there to promote Bangladeshi banana fibers to buyers. The agents can be set by the government or individual manufacturers.

R&D: In this competitive market, manufacturing companies should have R&D units for the continuous improvement of products and processes. Banana fiber manufacturing companies should establish R&D units to meet the current customer demands. This R&D is responsible for the continuous development of quality

fiber to meet the buyer's requirement efficiently and effectively [9].

Managing customer relationships with buyers: Customers should be accorded the highest priority. For expanding the market of banana fibers, the focus is on establishing relationships with respective buyers. Fiber manufacturers and exporters aim to cultivate positive relationships by fulfilling the desires and requirements of buyers. Trust and credibility are paramount in customer relationship management. Consequently, a loyalty program has been implemented, and repeat purchases occur [9].

Investing in scaling up production and processing capabilities:

- Upgrading machinery and equipment to increase efficiency and output
- Using more of the available 133,305 acres of banana cultivation to produce fiber
- Investing in R&D to optimize the fiber extraction from banana pseudo-stems
- Improving transportation and storage facilities to handle increased production volumes
- Providing workers with training on new technologies and best practices in banana fiber production

Focusing on quality control to meet international standards:

- Adopting internationally recognized standards like ISO 9001
- Establishing laboratories to regularly test fiber quality for strength, purity, and consistency
- Creating and enforcing strict guidelines for each step of the production process
- Internal and external audits to ensure compliance with quality standards
- Pursuing relevant industry certifications to increase credibility in international markets

Developing a holistic marketing approach to promoting Bangladeshi banana fiber in international markets:

- Identifying key target markets and understand their specific needs and preferences
- Creating a strong national brand for Bangladeshi banana fiber by highlighting its unique qualities
- Developing informative websites and utilizing social media to showcase products and reach global audiences
- Attending international trade fairs and exhibitions to showcase Bangladeshi banana fiber products
- Partnering with international designers to create innovative products using banana fiber, increasing visibility and demand
- Emphasizing the eco-friendly nature of banana fiber to appeal to environmentally conscious markets

Encouraging more domestic companies to enter the export market:

- Offering tax breaks or subsidies to companies that engage in banana fiber exports
- Streamlining bureaucratic processes to make it easier for new companies to start exporting
- Providing workshops and resources on international trade regulations, documentation, and best practices
- Organizing events where established exporters can share their experiences with newcomers
- Assisting new exporters in connecting with potential international clients through trade missions or B2B platforms
- Improving access to export financing and credit facilities for small and medium-sized enterprises

By implementing these strategies, Bangladesh can significantly increase its banana fiber production and exports. Investment in production capabilities will increase output, while quality control measures will ensure that the product meets international standards. A comprehensive marketing approach will increase awareness and demand for Bangladeshi banana fiber globally. Finally, encouraging more domestic companies to export will diversify the industry and increase export volumes. These combined efforts can help Bangladesh capitalize on its potential in the global banana fiber market.

3.11. Correlation Analysis

There appears to be a positive correlation between marketing and promotional strategies (independent variable) and both production capacity (dependent variable) and export potential (dependent variable) in the context of the banana fiber industry in Bangladesh.

Correlation between marketing and promotional strategies and production capacity: Effective marketing strategies, such as searching for new buyers (3.10.1), assigning agents in targeted countries (3.10.2), and R&D efforts (3.10.3), can increase the demand for Bangladeshi banana fibers. An increase in demand will likely lead to an expansion of production capacity to meet growing market needs. Therefore, there is a positive correlation between marketing and promotional strategies and production capacity. However, the degree of this correlation is not quantified.

Correlation between marketing and promotional strategies and export potential: There are several factors that contribute to the export potential of banana fibers from Bangladesh, such as abundant raw material (3.8.5), eco-friendliness (3.8.6), the potential for export diversification (3.8.9), and employment generation (3.8.10). Additionally, effective marketing strategies like searching for new buyers (3.10.1), assigning agents in targeted countries (3.10.2), and managing customer relationships with buyers (3.10.4) are mentioned as crucial for amplifying the export market of banana

fibers.

These strategies can help increase awareness, establish connections with potential buyers, and build trust and credibility, which are vital for increasing exports. Therefore, there appears to be a positive correlation between marketing and promotional strategies and the export potential of banana fibers from Bangladesh. However, the text does not quantify the degree of this correlation.

In general, effective marketing and promotional strategies are essential for creating demand, expanding production capacity, and increasing export potential for products, including banana fibers. However, the degree of correlation may vary, depending on various factors such as market conditions, competition, product quality, and overall business strategy.

3.12. Summary of the Findings

This study highlights a positive correlation between marketing and promotional strategies and both production capacity and export potential for the banana fiber industry in Bangladesh. Effective marketing strategies are essential for creating demand, expanding production capacity, and increasing export potential for this eco-friendly and versatile product. The key findings are as follows:

- Effective marketing strategies, such as finding new buyers, assigning agents in target countries, and R&D efforts, can increase the demand for Bangladeshi banana fibers.

- Increased demand likely necessitates an expansion in production capacity to meet growing market needs, indicating a positive correlation between marketing strategies and production capacity.

- Bangladesh has several favorable factors contributing to the export potential of banana fibers, including abundant raw material, eco-friendliness, export diversification potential, and employment generation.

- Effective marketing strategies like identifying new buyers, assigning agents in target countries, and maintaining customer relationships with buyers are crucial for amplifying the export market for banana fibers.

- These strategies can raise awareness, establish connections with potential buyers, and build trust and credibility, thus increasing export potential.

- High-quality inner lining banana fiber is costly to produce but commands a high market value, whereas outer lining fiber is more economical.

- Using existing machinery for other natural fibers can reduce production costs for banana fiber.

- Bangladesh can produce approximately 37,778 tons of banana fiber annually from banana plant waste.

- A few Bangladeshi companies import modest volumes of banana fiber from various regions.

- Banana fiber has applications in textile, packaging, and pulp and paper industries globally.

- Bangladesh could earn over \$94 million annually by exporting banana fiber at \$2.5/kg.

- The global banana fiber market is growing at a 5% CAGR, driven by the demand for eco-friendly material.

4. Conclusion

This study revealed considerable potential for generating over \$94 million annually through the banana fiber industry in Bangladesh. The findings indicate a positive relationship between marketing strategies and the potential of banana fiber. Bangladesh is capable of producing approximately 37,778 tons of banana fiber each year from banana plant waste, with the possibility of exports, using production capacities and export price of \$2.5/kg. The global banana fiber market witnesses significant growth fueled by the rising demand for eco-friendly materials, reflecting a 5% CAGR. Banana fiber exhibits notable versatility, with applications in the textile, packaging, and pulp/paper industries. Its production coincides with global sustainability trends and offers an eco-friendly alternative. Additionally, the growth of this industry could create substantial employment opportunities, especially in rural areas.

This study also confirms the results identified in other studies related to global sustainability trends. This growth in demand for sustainable fibers is consistent with the conclusions derived from global market analyses. The aim of this review is, therefore, to present available recent studies on the possible implementation or application of the circular economy in agriculture. These benefits are accompanied by a positive impact on rural employment, consistent with existing literature-based research on the socioeconomic returns of agro-based industry development in developing countries. Nonetheless, the present study provides a breadth of analysis on marketing strategies and effects on production capacity/export potential for banana fiber, which have not been extensively studied in the existing literature.

This study has broad implications. The banana fiber sector can provide Bangladesh with a way to decrease its reliance on traditional sectors and diversify its export basket. This agrees with world sustainability objectives, and it will project Bangladesh as an eco-friendly producer. The growth of the sector can have a huge impact on rural development and poverty alleviation because it can significantly contribute to creating job opportunities. In addition, interest in banana fiber can result in innovation in the agriculture, textile, and manufacturing sectors. The findings of this study may contribute to the formulation of policies that support and promote the banana fiber industry.

Based on these findings, several recommendations can be proposed. The government should consider implementing measures to enhance the economic viability of banana fiber production and exportation, such as subsidies, tax incentives, and export promotion schemes. There exists a necessity for investment in R&D to enhance production methodologies and product quality through the exploration of novel applications for banana fiber. It is imperative to implement skill development programs that focus on cultivating a proficient workforce for the industry. The study recommends consideration of the identified marketing strategies for acquiring new buyers and assigning agents to target countries. In this context, it is crucial that standards are established and enforced to ensure the quality of banana fibers being developed as these products enter international markets where competition will be intense.

For future research endeavors, it is recommended to conduct primary research involving industry stakeholders to obtain more current and detailed insights. Conducting a comprehensive environmental impact assessment of large-scale banana fiber production would be beneficial. Exploring the potential for value-added banana fiber products and their acceptance in the market could reveal new opportunities. Additionally, examining the integration of advanced technologies into the production and processing of banana fiber could improve efficiency and quality. Finally, a comparative analysis of banana fiber industries in different countries could help identify best practices and areas for collaboration.

The banana fiber industry offers a significant opportunity for Bangladesh to use its agricultural resources to promote economic growth, environmental sustainability, and social development. Through the implementation of strategic marketing initiatives and supportive policies, Bangladesh can become a major player in the expanding global market for sustainable fibers.

Declarations

Author Contributions

Conceptualization, M.A.K.; methodology, H.H.; validation, R.A.; formal analysis, R.A.; investigation, M.S.; resources, M.A.K.; data curation, R.A.; writing—original draft preparation, M.S.; writing—review and editing, H.H.; visualization, M.S.; supervision, M.A.K.; project administration, H.H. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest

The authors declare that there is no conflict of interests regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancies have been completely observed by the authors.

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