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AVAILABILITY AND AWARENESS OF BANANA FIBER AS A SUSTAINABLE MATERIAL: A CASE STUDY OF KENYAN BANANA FIBER PRODUCTION

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Abstract: *Banana is a one of the important foods and cash crops in Kenya, yet its post-harvest byproduct, which includes the pseudo stem is largely underutilized. The limited utilization of banana pseudo stem poses a missed opportunity in promoting circular economy practices and reducing agricultural waste. This study sought to evaluate the availability of banana fiber in Kenya and assess stakeholder awareness and readiness for its sustainable use. A mixed-method approach was used, involving structured questionnaires, focus group discussions, and secondary data from agricultural agencies. Descriptive statistics were used to analyze production volumes and estimates of the potential for banana fiber extraction based on global standards undertaken. Based on 2023 data, findings indicated that Kenya has the potential to produce 2,800 metric tons of banana fiber annually. Awareness of banana fiber as a sustainable material was high (81%), with respondents recognizing its potential in eco-friendly products and agricultural waste reduction. However, significant gaps exist in hands-on training, policy support, and financial access for fiber-related enterprises. The study concludes that Kenya has untapped potential to scale up banana fiber production as a sustainable material. Bridging training gaps, enhancing supportive policy frameworks, and promoting circular economy initiatives are critical for unlocking this opportunity.*

Key words: *awareness; banana fiber; material; pseudo stem; sustainability*

1. INTRODUCTION

Banana is one of the the food crops recorded in New Guinea going as far back as 4000 BCE [1]; [2]. It was intitial cultivated as a source of food but later on used for paper and textiles. According to World data and statistics 2024, banana is one of the most often consumed fruit worldwide, which is a good source of energy and important vitamins. Considered a staple food in many tropical and subtropical areas, bananas are very vital for food security and stable prices of living. Over the years, banana production worldwide has been steadily rising; numerous nations lead

the charge in growing this important commodity. The top nations in the world producing bananas are India (15% of total production), China, Ecuador, Brazil, and Philippines (5–6% each). About 15 to 20% of the total banana production in the world is traded internationally with an annual value of about US $6 billion [3]. The major exporting countries are Ecuador, Costa Rica, Philippines, Colombia, Panama, and Honduras. The major importing countries/regions are the United States, Canada, European Union, Japan, Russian Federation, and the Near East [3]. According to [4]; [5], banana fibers which extracted mostly from the pseudo stems of banana plants (Musa spp.), have attracted increasing attention in recent years for their sustainability, strength, and versatility. Traditionally, in many Asian and African countries, banana fibers have been used for making ropes, mats, and textiles. Banana fiber, in particular, has emerged as a promising alternative among natural fibers due to its low density, high strength, and biodegradability [6]; [7]; [8]. Recent studies, however, have explored its potential in a broader range of applications, from eco-friendly textiles to biodegradable composites [9].

2. MATERIALS AND METHODS

2.1 Study Area and Data Collection

This study focused on the selected banana producing counties in Kenya which included Meru, Muranga, Taita Taveta, Kirinyaga and Kisii. The data for this study was collected using structured questionnaires and focused group discussion with several stakeholders who included farmers, college students, county and national government officers. Secondary data was collected from reports published by Kenya Agricultural and Livestock Research Organization (KALRO) and other government institutions which inclue but not liminted to Agriculture and Food Authority, Kenya (AFA) [10].

2.2 Characteristics of the Respondents

A total of 96 respondents filled the questionnaires. The gender distribution was 65% female and 35% male. Based on the main occupational distribution, 55.1% were youth and government workers, 30.5% were farmers and 14.4% were college students. Age-wise, the respondents were young with 56% being between 18 to 34 years. This is consistent with the Kenyan general demographic data, which has consistently reported a higher percentage of young people for the last 10 years.

2.3 Data Analysis

The data collected was analyzed using descriptive statistics to summarize production volumes of banana fruits and the sales value. The potential to produce fiber was calculated based on globally reported methods.

3. RESULTS AND DISCUSSION

3.1. Production of Banana in Kenya

According to the Kenya Agricultural and Livestock Research Organization (KALRO), One of the important cash food crops in Kenya is the banana, which ranks first in terms of both value and volume among horticultural crops accounting for 17.8% of the total value of domestic horticulture and 34.5 percent of all locally grown fruits. It is mostly farmed by small-scale farmers as a source of staple foods and as a business that generates revenue.

Banana cultivation has become more popular in recent years with an increase of 24% in production in 2020 compared to the previous year [9,10]. Accordingly, the sales value increased by 18% from KES 24.6 billion to KES 29.02 billion in 2020. Subsequent years have recorded marginal increases; the area under cultivation increased from 71,800 Ha in 2022 to 75,184 Ha in 2023 representing 4.7% percent increase while quantity-wise increase was 1.9 million MT valued at KES 35 billion down from 2.1 million MT valued at KES 27.5 billion in the previous year representing 8.3 percent decrease in volume and 31 percent increase in value respectively. In Table 1 a summary of banana production in Kenya from 2021 to 2023 is given, a notable increase in 2023 is recorded.

***Table 1**: Banana Production in Kenya between 2021-2023*

Area (Ha)			Volume (MT)			Value in Million (KES)		
2021	2022	2023	2021	2022	2023	2021	2022	2023
68,032	71,800	75,184	1,984,282	2,052,606	2,155,236	26,960	27,454	35,939

Source: AFA-Horticultural Crops Directorate

According to Table 2, the top counties in terms of production value in 2023 were Meru, Taita Taveta, Murang'a, Kirinyaga and Kisii accounting for 23.6%, 9.7%, 7.93%, 7.83% and 5.4% percent of the total value respectively. From the production data reported by Agriculture and Food Authority, Kenya (AFA), it can be deduced that Kenya has a potential of producing 2,800 MT of banana fibers (assuming all stems are used for the production of banana fibers. Compared to the potential of producing banana fibers in Pakistan (5,800 MT) and Uganda (300,000 MT) [3], Kenya lags behind but it can utilize its youthful population and arable land to increase its production.

***Table 2**: Kenyan Banana fruit production for 2021-2023 period*

County	Volume (metric tons)			County	Volume (metric tons)		
	2021	2022	2023		2021	2022	2023
Meru	14,209	14,660	14,453	Lamu	1,845	1,875	3,965
Murang'a	8,626	8,579	7,521	Kiambu	2,189	2,233	2,537
Taita Taveta	3,195	3,183	6,638	Kakamega	2,745	3,394	2,964
Kirinyaga	3,859	3,837	3,849	Siaya	1,873	2,255	1,939
Kisii	5,332	5,762	7,426	Bungoma	2,235	2,430	1,865

Source: Author elucidation based on AFA-Horticultural Crops Directorate data [9]

3.2 Production of Banana fibers and related products in Kenya

3.2.1 Awareness and Benefits of using Banana fiber

Kenyans reported a high level of awareness (81%) about the use of possible use of banana fiber as a sustainable textile material, where this practice has a positive impact on;

(i) Production of eco-friendly products
(ii) Reduction of agricultural waste and
(iii) Supporting of circular economy

3.2.2 Role of Policies of Regulations

Kenyans have a strong feeling that polices, and regulations should be used to; Subsidies eco-friendly manufacturing; Encourage public awareness campaigns; Provide tax incentives for sustainable products and Regulate use and manufacture of non-biodegradable products

3.2.3 Skills Gap training related to production and manufacture Banana fiber and related products

With respect to banana fibers, the training programs in Kenya, do not provide sufficient hands-on training, with 58.8 % of the respondents reporting that they have not participated in hands on training (Fig 1). Therefore, there is need for trainers to inculcate hands on training to bridge the skills gaps reported by the respondents. Specifically, the students listed the following as some of the key skills gaps that need to be urgently addressed; Policy and regulatory frameworks; Life Cycle assessment and Circular economy principles and Internship/apprenticeship.

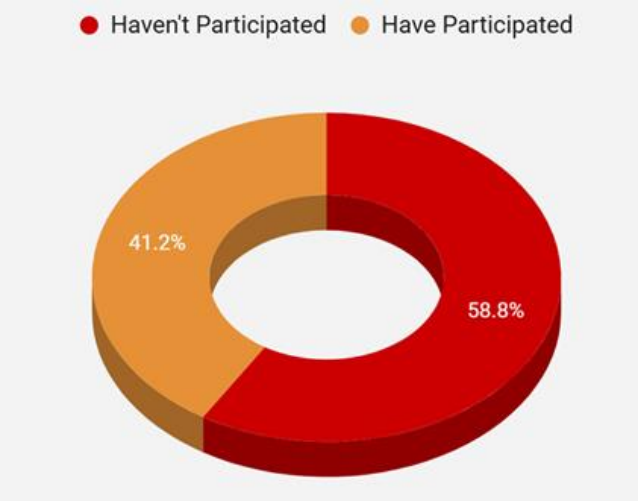

***Fig. 1**: Participation in Hands-on training*

3.2.4 Use of Banana fibers and other related products

As per the respondents, the two products from banana fibers that the respondents are likely to use were Hair extensions and T-shirts and jeans (see Fig 2). 84.6% of the respondents indicated a willingliness to use banana fiber for T-shirts and jeans while 15.4% indicated a likelihood. For application of banana fiber as hair extension, 50.8 indicated an outright use while 38.5 recorded a n likelihood. However, 10.8% of the responded recorded contrary in the application of banana fiber application for hair extension.

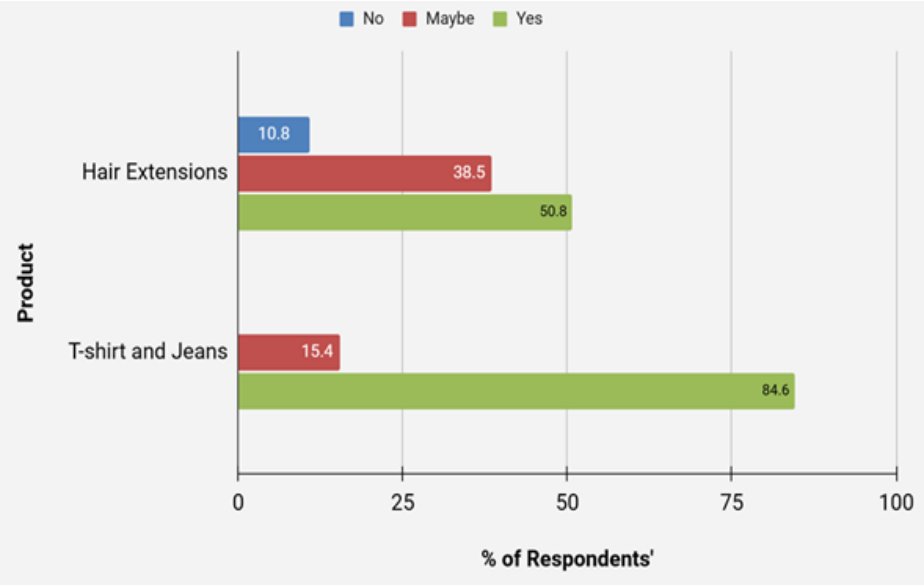

***Fig. 2**: Banana Fiber Products*

3.2.5 Size of land used for banana cultivation

Most of the farmers planted bananas on a small-scale farm, with the following land distribution; Less than 1 acres: 22.2%; 1-2 acres: 33.3%, 3-5 acres 27.8% and more than 5 acres: 16.7%

3.2.6 Access to financial empowerment

80.6% of the farmers and entrepreneurs reported that they did not get suitable financial products to enable them to carry out their business. This is due to high interest rates and requirements for collateral from financial institutions.

4. CONCLUSIONS

A study of the availability and awareness of banana fiber as a sustainable textile material was carried out, using questionnaires and focused group discussions (FGD). A total of 96 respondents were surveyed together with several FGD that composed of government workers, researchers, fashion and other stakeholders. Kenya's banana fiber industry is still in its infancy, with the optimal production capacity not yet fully realized. The potential exists for significant growth, especially considering the large quantity of banana stems that are discarded annually after the harvest of banana fruit. This research work confirmed that Kenya possesses both the capacity and growing awareness necessary to develop banana fiber as a sustainable material. While current production remains low compared to regional and global counterparts like Uganda and Pakistan, the high levels of awareness, favorable attitudes toward eco-friendly alternatives, and availability of banana biomass indicate strong potential. However, realizing this potential will require investment in hands-on training, supportive policies, financial access for farmers and entrepreneurs, and structured development of the banana fiber value chain. Harnessing Kenya's youthful population and expanding banana cultivation could position the country as a key player in sustainable fiber production within the region.

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