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Technological Modernization and Its Challenges in the Coir Industry in Alappuzha

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Abstract: On the international market, India is the biggest producer and exporter of coir and coir-related items. Kerala holds a significant portion of the nation's production and exports. Despite having great potential and high ambitions, the coir industry in the state is not progressing as rapidly as other sectors. Reluctance to implement automation on time was the leading cause of the industry's backwardness. Towards the end of the 20th century, Kerala's coir sector underwent modernization with the introduction of innovative technologies. However, there are still numerous reasons why the procedure is ongoing and has not been completed. The implementation of technological modernization has ramifications for disempowered workers in the industry. In addition, the prosperity or downfall of technical advancements holds great importance when considering the expansion of both the sector and the economy. This study examines the various plans and strategies for coir development and evaluates the overall application of the technical modernization scenario. It also highlights the automation issues with contemporary coir units. Additionally, the federal and state governments offer a variety of programs to advance the coir business, but the manufacturers were unaware of these initiatives. This report discusses the opportunities and challenges faced by Kerala's coir industry.
Keywords: Coir, Technological Up-gradation, Modernization, Coir Board, Geotextiles, Coir Pith

1. Introduction:

Kerala covers 39,000 square kilometers (Heller, 1996), of which 7,704.73 square kilometers are used for coconut cultivation [1]. Approximately 375,000 people in Kerala, primarily women, rely on the coir industry, one of the state's most significant rural enterprises, for their livelihood [2]. The coir industry has historically expanded in areas with a large number of coconut crops and readily available coconut husks. Therefore, it should come as no surprise that Kerala's old city of Alappuzha is the birthplace of the nation's coir industry. When Alappuzha is portrayed in literature or Malayalam films, the coir and coir workers are frequently seen in rural settings. The picturesque sights of peasants working to make coir would not have been missed by anybody who has taken a trip along Alappuzha's backwaters. In 1859, Mr. James Darragh, an American of Irish descent, and Henry Smail established the first coir factory in India, known as "The Darragh Smail & Co." Nearly 25 significant coir manufacturers, including William Goodacre & Sons [3], Volkart Brothers Company (established in 1869), Bombay & Co., and Madura & Co., were subsequently established in the town of Alappuzha. Fundamentally labor-intensive and conventional, the sector had a long time to adapt to modernization, which hurt its expansion and advancement. The structural changes that have occurred in the coir business over the final decade of the 20th century are described and explained in this article. By 1990, the Alappuzha district had 29 significant coir factories, each operating over 200 looms. Additionally, 450 registered coir units and 690 unregistered ones were active, primarily following small-scale or household-based production models. When compared to other industries in the state, the coir industry has failed to achieve progress, despite its high potential and hopes. The primary factor behind the industry's backwardness was its reluctance to adopt mechanization. Technological change is not merely a matter of finding new machines for old; it involves several other important social questions also [4]. Although the trade union movement was successful in defending mechanization until 1991,

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the industry's overall consciousness gradually changed due to the liberalization policies adopted by the central government. The coir industry was chosen for study due to its socio-cultural and political-economic importance. The industry employs the majority from the disempowered social sections, mostly of 'lower' and 'outcast' castes, and an overwhelming majority are women. The ongoing technological change has thus important implications for the marginalized sections of society.

2. Literature Review

The study on 'the problems and prospects of the Coir Industry in Kerala', conducted by Dr. M.V. Pylee in 1976, gives a clear picture of the problems faced by the industry at that time. The basic facts regarding the production of coconut, the process of fiber extraction, the production of coir, internal consumption of coir, and the world trade in coir were examined. The shortage of coir fibre was the primary cause of the crisis that developed in the Coir Industry in India during 1974. The reduced operation in the spinning and manufacturing sectors left a large number of workers unemployed. Especially in the spinning sector, many exporters were unable to execute not only export orders but also found it risky to accept foreign orders. The true nature of Kerala's historic coir business is revealed by T. M. Thomas Isaac (1991) in his paper "Evolution of Organization of Production in Coir Yarn Spinning Industry." He noted that the conventional coir business had a very different organization and a much longer production process. He promoted the rapid industrialization of the coir sector as a survival strategy to cope with the shifting global landscape. In 1992, another article, 'Class Struggle and Structural Changes: Coir Mat and Matting Industry in Kerala, 1950-80', analyzed the need and pattern of modernization in the industry in detail.

K. T. Rammohan (1999), in his paper 'Technological Change in Kerala Industry: Lessons from Coir Yarn Spinning, ' points out that technological backwardness is a crucial fact of Kerala's industrial life. The major industries in the State, including coir processing, handloom weaving, and beedi-making, are characterized by the use of low-productive technologies. Technological change is not merely a matter of finding new machines for old, but it also involves several other important social questions. The new techniques could be ideal from an efficiency point of view, but may be inappropriate for the social economy in which they are applied. The article concludes that the new technology may increase workers' income but also jeopardize employment. In another work (2008), 'Coir in India: History of Technology', he explains the history of coir production and its technology in detail. Kumarasamy Pillai (2005) in his article 'Towards Self-Reliance in Coir Fiber Production, stated that it might not be possible e to utilize the entire coconut husks produced in the country for coir production due to a variety of reasons such as lack of a well-defined mechanism for collection of husks, increased cost of transportation, lack of awareness among the coconut producers, dealers, and domestic households about the economic value of husk. Another article by Soundariya Preetha (2017) on "Coir Board Focuses on Value Added Products" analyzes that the future performance of the coir products chain, especially in coir pith, will be dominant in the future. Sudarshana Brodoloi (2020) in 'Productive Forces in the Coir Industry' examines the constraints and contradictions faced in the development of productive forces in the Coir industry. The study describes the simple labor process in the coir industry, including the nature of the means of production and the types of labor used. It also discusses the spatial organization of productive forces across Kerala and the coir belt, as well as the production and export trends of coir in/from India and Kerala. It also examines the levels of productivity, the state-initiated technological changes that promote productivity, and the contradictions surrounding these technological changes in the coir industry.

3. Methodology

In this conceptual study, both primary and secondary sources are used for data collection and analysis. The sources comprise articles, published press reports from the Coir Board, Coir News, and reviews from research journals, as well as data collected from web sources of the coir industry, Ministry of MSME reports, and daily newspapers and magazines. The primary objective of the study is to analyze the present status of technological modernization and its challenges in the coir industry.

4. Kerala and its Coir Industry

Keram, which means coconut palm, is said to be the source of Kerala's name [4]. Products such as carpets and mats are manufactured using coir, a fiber derived from coconut husks (Dictionary.com, 2014). According to KITCO (2009), the coir sector is Kerala's second-largest employment and a substantial source of income, particularly for those with lower incomes. It is unclear when exactly coir was first produced, although evidence

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suggests that it increased dramatically in the 16th and 19th centuries [5]. The present coir industry began operations in 1859 and underwent significant changes in structure and character throughout time. The coir industry's workforce and employment have shifted from traditional to mechanized periods, and it is now lucrative in terms of both labor and time. Machines are taking over tasks such as extracting coir fiber and creating mats, which reduces the need for human labor and intervention. The traditional coir workers and industry have left behind memories of a bygone era, as the next generation of workers with technological skills may now fit into this sector.

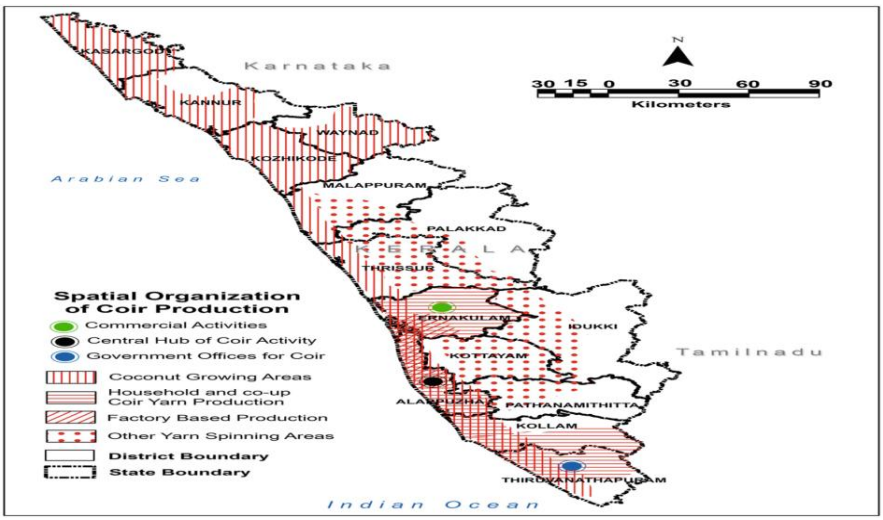

Figure 1: Coir Production Centers in Kerala

The coir industry in the country has experienced a steep growth in exports over the last three years, prior to the COVID-19 pandemic. In 2019, the country achieved a record export growth of Rs. 2,282 crores, whereas in 2018, it was Rs. 2,090 crores by value and 5,37,050 metric tons in terms of quantity. In this phenomenal growth, Kerala accounts for 74% of exports and 85% of production. Subsequently, the government has taken measures to support Export Market Development Assistance, which helps coir exporters market and sell their products. According to the Coir Board's report, 76.6% of coir production units operate on a small scale, while 18.1% function as medium-scale and 5.3% as large-scale industries. In terms of ownership, 57.3% of these units belong to the private organized sector, followed by 15.8% in the private unorganized sector, 3.5% under cooperatives, and 1.8% operated by self-help groups (SHGs). Household industries connected to cooperatives account for 1.2%, while those not affiliated with cooperatives comprise 6.4% of the total units.

Regarding production activities, 33.3% of the units focus on fiber extraction or defibering, 23.4% engage in traditional coir yarn production, and 35.1% have adopted modern or automatic methods for yarn production. Additionally, 13.5% of the industries produce frame-type coir mats, 6.4% handle coir pith processing, 1.8% manufacture coir geo-textiles, 1.2% use semi-automatic power looms, and 0.6% utilize automatic power looms. In terms of technological adoption, 33.3% of coir industries are fully mechanized, 36.8% are partially mechanized, and 29.8% continue to rely on traditional, non-mechanized methods—representing a lack of technological Modernization. Innovative technological development, as part of the modernization in the coir industry in Kerala, began in the last quarter of the 20th century. The oldest industry in Kerala is steadily embracing modern machinery, and the men overseeing the future of coir-making say there is no other way forward. Mechanization is the way to rectify a situation where a new generation is not taking to the industry, precisely because of the traditional methods used in the industry. De-husking and de-fibering are the two sections that are mechanized first as part of the modernization process. For decades, producing fiber from coconut husks was a tedious process. The husks would be kept in water for six months, during which time they would emit a foul smell, contributing to environmental pollution as well. For all this back-breaking work, the wages they got were a pittance - as little as 70 paise a day. Slowly, the fiber extraction process shifted to nearby states as workers left the job, as it was unproductive. Thus, the industry faced a shortage of coir fiber, and mechanization became inevitable. Similarly, gradual mechanization appears in each section of the coir industry.

The coir yarn production was first changed from hand twist to 'Ratt' and then to electronic 'Ratt' later. The loom work was also mechanized, and power looms were initially introduced in large factories. Due to substantial capital investments, small-scale and household units were not mechanized, as a consequence. However, medium and small power looms were introduced soon, and household units were gradually mechanized, especially women-driven loom units. To produce machines within the country for the industry, the Kerala State Coir Machine Manufacturing Co. was started at Adoor. The technological modernization improved production speed and quality, and also enhanced the financial return from the industry. However, it had a significant impact on the human workforce in the industry.

5. Results: Techno-Modernization: Is Desirable or Inevitable?

The question of technological modernization was a heated debate during the last decades of the 20th century. The traditional coir workers looked at it as a dire evil, while the pro-industrialists welcomed it as a 'gift and hope'. If it waits for the consent of the last coir workers in the handloom sector, there will be no coir industry left in Kerala. An industry that was once Kerala's pride is in big trouble over the issue of modernization. Exports have tumbled by roughly 45 percent during the 1990s. For instance, Coir is made from coconut husks, and Kerala still produces roughly 55 percent of the country's coir, but it has been steadily losing market share to other states. Kerala produced 1.25 lakh tonnes of husk in 1977; at the same time, the rest of the country (primarily the three southern states) then produced 10,000 tonnes. By the year 2000, the share of the other states had risen to nearly 70,000 tonnes, while that of Kerala had dropped to 75,000 tonnes. The state's share of coir fiber production has also dropped. The prime reason is that mechanized units in neighboring states have undercut Kerala's handmade fiber. In Kerala, coir is made by a month-long, labor-intensive process. On the contrary, this job is often completed in hours using machines in neighboring states and Sri Lanka. Consequently, the pro-industrialists have realized that unless they modernize, the industry is likely to shift to neighboring states.

Despite mounting opposition to the coir industry's automation, the industry's shifting environment and diminishing output forced mechanization to satisfy the expanding demand from across the world. To save costs, the 1991 liberalization program dismantled the State monopoly businesses and decreased bureaucratic control over financial markets; as a result, these businesses had to see earnings and market values as crucial performance indicators [6]. To satisfy the growing global demand, automation was introduced in the 1990s, which raised output and value [7]. The industry's disempowered workers are affected by the technological modernization that has been undertaken. Furthermore, from the standpoint of industry and economic growth, the success or failure of technical advancements is highly significant. Data on Kerala's SDP (2005), national GDP, coir exports, and income from the primary and secondary sectors in Kerala and India (2005) all showed the shift. The years 2003–2004 saw a notable expansion of the country. Therefore, it may be concluded that technical upgrading is both desirable and necessary for the sector.

6. Political Interventions

Talking about the modernization of the coir sector without mentioning the involvement of political parties is pointless. Due to protests over automation and militant trade unionism in the 1990s, Kerala's golden fiber—which employed around five lakh people in the state and played a crucial part in the development of its economy—lost its luster. Politics and trade unions have grown inextricably linked throughout time. Political parties utilize labor unions as sources of funding and vote banks. Kerala has been ruled mainly by the right-wing United Democratic Front (UDF), led by the Indian National Congress (INC), and the Left Democratic Front (LDF), comprising communist parties. Ramachandran (1997) noted that political parties play a critical role in bringing about changes in the state, including improved healthcare facilities, agrarian relations, mass literacy, the plight of the oppressed castes, and enlightened societal attitudes about females. However, because they feared losing the political backing of coir workers, these progressive political forces resisted modernization in the coir sector for decades. Kerala businesses have also seen lockouts and strikes as a result of the emergence of militant labor unions. According to Thomas (2003) and Jeromi (2005), industrial development has slowed due to labor disputes. A "bandh" can be declared by political parties for the entire state, a district, a town, or even a particular market area (Prakash, 1994; Jeromi, 2005). As a result, the political climate is not conducive to investment for new companies. Economic development was not a result of the government's initiatives (Ahluwalia, 2000). The economic circumstances in Kerala provide a chance to assess how well the coir sector is performing under the leadership of various political parties. The Center's Coir Board disapproves of the state's

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political strategy. "Quality control, mechanization, and modernization are urgently needed. A spokesperson for the Coir board stated that the state government and left-leaning unions are opposed to this. Political authorities and trade unions were ultimately compelled to permit mechanization in order to maintain the competitiveness of Kerala's coir sector, as the industry's steady shift to neighboring states, which supported mechanization, became increasingly apparent.

6.1 Up-Gradation in Existing Technology

The main challenge in technological modernization within the coir industry stems from an overemphasis on preserving traditional practices, including outdated equipment and methods that have been used for generations. Additionally, many workers have not received training in modern technology and lack practical skills in its application. Veteran workers often view modern, automated equipment and technology as unfamiliar and are concerned about job security, which can lead to resistance to technological advancements. Concerns also arise regarding the maintenance and repair of modern machinery, as well as the proper use of electricity, which further contributes to distrust in technological upgrades. Currently, coir production and coir yarn manufacturing remain only partially mechanized, with a significant reliance on skilled labor. Therefore, the government needs to prioritize modernizing equipment in these factories to boost production efficiency and reduce the dependence on a skilled workforce.

There are numerous mini, semi, and multi-stage high-power looms, as well as other equipment, developed by the research division of the Coir Board. The production of this machinery on an industrial scale and the proliferation of mechanization, which should be accompanied by acquiring workers' trust, should be the primary concerns for authorities and apex institutions in this field. The pith produced during the de-husking and de-fibering process remains underutilized. To address this, coir pith composting technology could be implemented, allowing the composted material to be used locally in greenhouses for vegetable cultivation. With the support of the agricultural department, this technology could be introduced, and greenhouse cultivation could become a viable activity using composted coir pith. In addition, other contemporary technologies that should be taken into consideration for increasing efficiency and modernizing the technologies in husk collection, coir fiber & coir yarn production, and creating value-added coir products in the nation include the automatic coconut dehusking machine, conveyor system, mobile fiber extraction machine, "Anuradha" loom for weaving geo-textiles, "Anupam" loom, frame mats, coir jewelry unit, coir composite gift article-making machine, automatic coir spinning machine, and dyeing unit. There are many uses for coir, and the newly created goods ought to be well accepted both domestically and internationally. To create new and improved coir products, it is also advisable to consult design colleges like NID and NIFT.

6.2 Technology Up-Gradation Initiatives

The Coir Board launched the "Coir Industry Technology Up-gradation Scheme (CITUS)," which aims to provide business owners with financial assistance for updating and modernizing their qualified equipment and plants, enabling them to establish a new company that can apply for larger investments in the Coir sector. The financial help provided under this program will cover a quarter of the total cost of the qualified "Plant and Machinery" items that the Coir units acquire. For each coir project or unit, the maximum financing available under this initiative will be Rs. 2.50 crores. Applications for the financial aid available under this scheme for modernization are open to all newly established coir production or processing facilities, as well as those registered with the "Coir Board" under the "Coir Industry" (Registration) Rules 2008 and possessing "Udyog Aadhar." The Nodal Agency is the Coir Board in Kochi. The applicant or beneficiary unit requesting aid under this program must submit an online application, along with the necessary supporting documentation, as outlined on the website. These are the project's primary goals:

1. The next generation of entrepreneurs will benefit from the provision of modern infrastructural facilities to the manufacturing units, which will increase quality and productivity.
2. Enhancing and modernizing the current coir units.
3. The establishment and support of new "state-of-the-art" coir processing units.
4. Advancing the creation and implementation of enterprise resource planning (ERP) and other IT technologies.
5. Introducing the sector to fresh, promising development areas.

6. Encouraging the improvement and use of the raw materials that are accessible.
7. Increasing job options, particularly for rural women.
8. By supplying contemporary technology, the coir industry will become more integrated and competitive.
9. Using technical developments to reach the goal of a coir industry free of pollution.
10. Assisting in the creation of valuable, customer-focused goods and services.
11. Promoting the use of environmentally friendly industrial methods.

Table 1: Technological Modernization Fund- Released and actual expenditure

Scheme/ Programmes	12th Plan Period (In Lakhs)	
	Fund Released	**Actual Expenditure**
Modernization of Production Process	2404.37	353.35
Development of Coir Machinery and Equipment		397.59
Product Development and Diversification		553.44
Development of Environment-Friendly Technologies		400.51
Technology Transfer, Incubation, Testing, and Service Facilities		746.32
Incentives for Using Natural Dyes and Incentives for IPR in the Coir Sector		00
Total	**2404.37**	**2451.21**

Source: Coir Board & CCRI

During the 12th Plan period, a total of Rs 2,404.37 lakhs was released under the plan program. 31.04 percent of the funds distributed throughout the plan period were utilized for technology transfer, incubation, testing, and service facilities, with the product development and diversification program accounting for 23.02 percent of the total [9]. Modernizing the manufacturing process (14.70%) was the second-largest use of funds granted during the plan period, followed by the development of coir machinery and equipment (16.54%) and environmentally friendly technologies (16.66%). During the plan period, no funding may be allocated for programs that offer incentives for the use of natural dyes and intellectual property rights in the coir industry.

7. Discussion: Modernization of Production Processes: Major Achievements

Development of Bio-Chem Treated Fiber:

A revolutionary technology known as "Biochem" has been developed to enhance the quality of machine-extracted coir fiber, resulting in retted-grade fiber. Janata mattresses and pillows, which are less expensive than rubberized coir foam mattresses, are made from bio-chem-treated fiber. For finishing purposes, the bio-chem can also be used on coir mats.

7.1 Effluent Treatment Technology:

For the extraction and processing of coir fiber, an economical effluent treatment technique has been created to reduce pollution. In coir fiber extraction facilities, the technique helps reduce pollutants.

7.2 Development of Machinery and Equipment:

The creation of a modified mobile fiber extraction machine is one of the key accomplishments in the field of creating new technology and equipment to increase productivity and decrease operational drudgery: The invention of a coreless coir yarn spinning machine called "Krishna," a preprocessing unit attachment for producing high-quality coir yarn, and a completely automatic coir geotextiles weaving loom prototype called Anugraha "Tejas" that can weave 400 square meters of coir textiles in eight hours (800 square meters per day) are all examples of Swarna-Nano [8]. The 'Anugraha' is a mild steel handloom that has been tested and designed for weaving coir geotextiles. A small, portable device that can separate coir fiber from dry or green husks at a rate of 5,000 husks every eight hours was also introduced. 'Vajra,' a coreless single-head single-ply spinning machine prototype, and 'Krishna,' a coreless double-head single-ply spinning machine that debuted in 2016, were both part of the development.In terms of product development and diversification, significant innovation

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was achieved in coir geotextiles with the creation of pockets woven into the fabric [10]. These pockets hold packing material, seeds, and manure, which can be placed inside before laying the geotextile, thereby eliminating the need to spread fertile soil over mine dumping areas. Another notable innovation is the circular woven coir geo-bag. Additionally, coir-polypropylene pots were developed as part of a collaborative project with CIPET, Cochin.

8. Challenges for Technological Modernization

The technological modernization of the traditional coir industry is the most important and, in fact, a challenging prospect today. Without this powerful tool, namely technological modernization, the promotion and placement of the coir industry within the global village concept would not have been achieved. Modernization creates the problem of a lack of proper machinery to increase production units, so the nonavailability of modern tools affects the development of mass coir production [11]. The significant challenges regarding faster technological modernization are as follows.

8.1 Non-availability of Skilled Labor

Technically skilled laborers are the essential prerequisite for technological upgradation. However, the workforce in the industry mainly consists of traditional workers who are aging and far behind the times. They must be equipped with technical skills immediately, or recruiting fresh, skilled labor is quite essential for the sake of modernization [12].

8.2 Limited access to Training

There is only one training center across Kerala that offers short-term training courses (10 Days) for coir workers in modern machinery. In the Coir Research & Development wing of the Coir Board, Kalavoor has limited capacity; hence, a rapid training drive is not feasible at present.

8.3 Production and Manufacturing of Machinery

The Coir Research & Development wing of the Coir Board has successfully invented many machines and tools for the modern coir industry [13]. However, the production of these items on an industrial scale has not yet begun. The private manufacturers who get consent for production are charging high rates for these items.
Capital Investment Problems among Small-Scale Units:
Even though technological modernization is a reality, coir units, especially those in small-scale and household settings, are facing serious capital investment problems due to the vast amount required for mechanization within a short period.

8.4 The problem of the availability of an uninterrupted Power Supply

Kerala, a state heavily dependent on hydroelectricity, was not an electricity-surplus state. Consequently, the tariff for industrial electricity use has been relatively high in the state. During the monsoon, due to heavy rainfall, and during the summer, water deficits in the dams create uncertainty in the state's uninterrupted power supply.

8.5 The problem of Political Will

Kerala has alternately been controlled by the right-leaning United Democratic Front (UDF), led by the Indian National Congress (INC), and the Left Democratic Front (LDF), which is composed of Communist parties [14]. As a result, the state's industrial department lacks a consistent policy for upgrading the coir industry's technology.

9. Conclusion

This study aims to highlight the opportunities and challenges currently facing the coir industry. Technological modernization is crucial for enhancing efficiency, reducing costs, and improving the quality of coir extraction on an industrial scale, ensuring a consistent supply of raw materials for coir-based industries and maintaining the industry's global reputation. Currently, the process of extracting coir and manufacturing coir products is labor-intensive, time-consuming, and largely manual, limiting the industry's capacity for growth and modernization [15]. To address these challenges, research and technological upgrades should be prioritized. The Coir Board plays a key role in offering solutions to end-users by disseminating new technologies and

helping workers develop the necessary skills. Coir has diverse applications, and new products should be extensively promoted both domestically and internationally. Awareness campaigns can help increase public knowledge of coir's multiple uses, while competitiveness can be boosted through improvements in design, quality, and technology.

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Data availability
The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent
Ethics approval was not required. All participants provided informed consent for participation and publication of anonymized data.

Competing interests
The authors declare no competing interests.

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