

# REPORT

## EVALUATION STUDY ON PLAN SCHEME SCIENCE & TECHNOLOGY



### COIR BOARD

(Ministry of Micro Small & Medium Enterprises, Government of India)

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Submitted By:



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A handwritten signature in blue ink, appearing to read 'Girija B. Nanda', with a horizontal line underneath.

**Dr Girija B Nanda**

**Director**

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## EXECUTIVE SUMMARY

The evaluation of the plan scheme on science and technology of Coir Board implemented by the research institutions CCRI and CICT under RTDE for the plan period 2012-17 provided with valuable insights on the efficacy of such programmes for the coir industry in particular and for any other industry or sector needing valuable research support to sustain and grow in the market. Analysis and evaluation of information gathered by way of the study show that the implementation has not achieved the targets that were set for the plan period in quantitative terms. However, the qualitative achievement especially in promoting the objectives for which the research institutes were set, have been met in the sense that there has been development and incorporation of newer technologies in defibering, husk utilization, coir pith utilization, developing new products for the market and consumers, attracting younger generation to the industry fold and striving for further improvement in this sector. These achievements itself, as well as the fact that these research institutes with their schemes are providing the much-needed research and technology upgradation support; necessitate that the S&T schemes should continue in the next plan period. At the same time however, it was noted that there is a lack of comprehensive approach, a common strategy, a goal and a scale of operation and implementation that is lacking in providing the necessary impetus and framework for the development of the coir sector and work in a mission mode to develop the coir sector by taking research, marketing, skill development, supply chain and distribution, advertising and brand building under one umbrella and make a comprehensive strategy for growth.

In order to achieve the objectives, the study has made the following conclusions and recommendations mentioned below:

### Key Findings:

India is a young country. Every year India adds more than five million people eligible for securing jobs. India's young demographic profile has placed the country favorably in terms of manpower availability. People can be turned to economic assets if they can be usefully employed. This demographic dividend requires engaging our youth in creative purpose through developing appropriate skills, including entrepreneurial skills in coir industry also.

With above facts India is also facing the problem of unemployment and poverty that continue to pose serious challenges to polity and economy of the nation. The need of the hour, therefore, is to create 'job providers' in large numbers rather than 'job seekers'. Coir sector provides scope for creating 'job providers' in the modern coir projects.

Development of the rural economy has been one of the prime concerns for Government of India. Accordingly, efforts have been made on a continuous basis for improving the economic and social well-being of people in rural areas on a sustainable basis. Despite the sincere efforts, the problems of poverty, unemployment, drudgery and migration still exist in rural economy. There is a need to address these problems by creating employment opportunities in the rural areas and this could be done by setting up of small enterprises in the Coir- based industry sector more so as nearly eighty percent of the workforce is women. There is ample scope for innovation, value addition and entrepreneurship development in this sector.

In this context, the role of research institutions in spearheading the development of the coir sector is much more essential than can be envisaged. The performance of the schemes in S&T has been beneficial for the coir industry in diffusing technology and processes for the betterment of the industry, provided newer technologies for de-husking, defibering, provided ideas for new products and developed the same, partnered with industry and research institutions in implementing the research outcomes under S&T scheme, provided mentoring and handholding support in incubation programmes under its supervision and provided all the necessary support to bring growth and spread of the coir sector by way of providing solutions in technological upgradation and product growth.

However, the projects and schemes that were earmarked for the plan period did not get completed during the period, the reasons for which have been discussed and analyzed. At the same time, the coir industry has also not been able to get the mass market position, even though it produces products that are counterpart of other mass market products like home furnishings, interiors, consumer goods, infrastructure equipment among others.

It is not that the schemes are not working on that front. But the fact is that the schemes and outcome have not got completed due to factors beyond the scope of the schemes or the institutions. However, it cannot be denied that the schemes had met their objectives to a great extent and are continuing to do so in the present scheme of things and arrangement. So, the implementation of schemes has been somewhat successful even though there is lot of scope and opportunity to further strengthen the scheme to bring about greater development in the coir sector. Important aspects of the development process that need constant implementation are being handled by the research institutions through their schemes in the form of providing handholding support, skill upgradation for overall development of products, processes and attracting the youth to the sector, mentoring industry members in technology incorporation and process improvement and providing overall support to the coir industry members.

The detailed conclusion on each aspects of the terms of reference for the study are mentioned below:

#### **Major Achievements – Project Head Cost and Benefit**

Fund released by the ministry under the scheme has been fully utilized in different five heads. The funds for using natural dyes and for IPR in coir sector were not utilized at all. Regarding the major achievements under each project head, the research institutes carried on their work on improving upon the technologies and products already developed in earlier years and in the process, improvised the products to make it more attuned to the end-users' requirements.

#### **Impact of Technologies Developed, on Coir Industry Workers, Operations and Output**

The responses from the sample group of workers show that the new technologies developed by the research institutes have helped increase the productivity of the workers by reducing drudgery and increasing the ease of operations, output of products and increase the safety levels at workplace. However, the technologies developed have managed to only provide solutions to the existing problems of the workers at the workplace. They have not helped the worker to gain expertise in product development or skill upgradation, or provided a comprehensive and technologically advanced process and system that will improve the profile of the workforce and help them graduate from their present level. The worker still today is that of people having familial connections with the coir sector and with low educational levels, both men and womenfolk. It is still an industry having two levels of stakeholders i.e. entrepreneurs, who many a times double up as managers, and the workers. There is no institutionalized managerial team,

both technical and marketing cadre, which the R&D through its S&T intervention could have helped in creating, by institutionalizing the process by introducing new technologies and systems.

### **Diffusion of Technology Developed by Research Institutes & Export Performance**

The technologies developed by the R&D institutes in defibering, de-husking and processing of coir fibre into yarn and coir pith into organic manure have been majorly accepted by the industry and a total of around 150 industries of various size as well as scores of individual entrepreneurs have availed of the technologies and products developed by CCRI and CICT. There has been an overall YoY growth in exports of coir and coir products in the financial year 2015-16 at the rate of 27.3 percent in volume exports and 20 percent in value exports. Here it is to be noted that the volume percentage in exports is higher than the value percentage growth. The inputs of the industry members on providing technology, process and products for manufacturing and selling value added products is important to note as by that way only the financial performance, market share and product profile of the coir products made in India will improve. So, the R&D institutes should focus on developed uniform yarn making technology and processes, value added finished products and blended yarns to improve the profile of the coir industry, inculcate interest in younger generation to work for the industry and improve the global and domestic market share.

### **Market Penetration of Products Developed by CCRI and CICT**

The new products like coir ply, C-Pom and geo-textiles have been tested and successfully transferred for industry utilization based on inputs gathered during field visits and interactions with stakeholders including the research institutes and industry members. Coir Board has initiated marketing of C-Pom through 17 manufactures registered under Coir Board for manufacturing and marketing the C-Pom. For geo-textiles, coir bhoovastra, the situation calls for interaction with the concerned decision making Govt Departments/Establishments like Irrigation, Roads and Highways, Port Trust authorities, Water Works, Construction and land scape, hotels and resort projects, Railways, Defence and other similar projects/organisations with a view to impress upon them the suitability of coir bhoovastra for permanent eco-friendly solution to soil erosion and other civil engineering problems. Interaction with the concerned authorities with a view to selling the concept and persistent efforts thereafter will definitely yield beneficial results.

Besides, seminars, preparation of manuals and guidelines conducting lab trial and field trial, collaborative research projects etc. should be undertaken to popularize the use of coir geotextiles, through awareness creation. The need for supplementing the effort through publicity needs no emphasis. Besides, there is enormous potential in the domestic market as is evident from the fact that already many synthetic geotextile manufacturers have entered the Indian market and many more are interested to enter the market.

The products have been developed as per innovative standards and are benchmark unto themselves. However, the input from the industry members point to the fact that propagation of the product benefits and its usage as supplements for synthetic products needs to be taken up by way of exhibitions, product demonstrations, tie-ups with large scale government body requirements to make them appealing to the customers and help in generating demand for such products.

### **Utilization of Coconut Husk**

A total of around twenty-six lakh Metric Tons of fibre were extracted during the plan period, and along with a substantive amount of husk was also generated. Earlier, coconut husk was treated as a waste product that used to rot and pose an environmental hazard. However, due to the breakthrough research of the R&D institutes in developing machine for fibre extraction, the scope of collection and utilization of husks has increased and the industry members as well as individual entrepreneurs have adopted the machine and the husk utilization technology. What is required now is to popularize the usage of MFEM by the R&D institutes with the end-users i.e. both small manufacturers, agriculturalists, conservationists, landscape designers, urban planners and agricultural research institutes through exhibitions, workshops, collaborative projects and product demonstrations so that the usage and utility of husk increases in the coming years

### **Role of R&D in Attracting Younger Generation to the Coir Sector**

The extent of induction of the younger generation in the coir industry is limited to graduation of younger members of the family connected with the industry as part of familial progression. This is because the skills needed for working in this sector is still based on traditional knowledge and the R&D has only been able to provide some spectacular standalone innovations like MFEM C-Pom, Anugraha etc, which are efficient and useful but have not provided solutions to the long-drawn process of coir extraction as well as provide a complete seamless process from extraction

of coir to its processing to form standardized yarns and raw material for developing different coir products. This will lead to rapid growth in scale of the industry to sustain a professional management and technical manpower system with well-defined job profiles and benefits to attract the youth and qualified young generation to this sector.

In essence, it can be concluded that the coir sector process is still managed through traditional processes with discrete technology interventions and the job requirements training is handled over to family members. Outside intervention an interest is not there because the process is traditional and the returns are low.

In such a situation, the focus of the R&D institutions should be to invest in studies to formalize and mechanize the coir extraction and processing on a large scale of industrial proportions so that the critical mass of raw material (coir yarn) is generated at optimum cost and time to create a market that will lead to creation of a technical and management cadre to attract the younger generation to the coir sector. In this endeavor, the research institutions can do collaborative studies with the IITs and IIMS to develop such systems. Also, to start with, they can source candidates from IITs, NITs and IIMS for research and managerial positions in their institutes.

### **Increase in Workers Income due to New Technology Infusion by R&D Efforts**

An overwhelming 92 percent of the workers said that there has been an increase in the income and wages due to adoption of new technology. The increase in wages has been minimum of above fifty percent and has touched 100 percent in many cases. So overall, the impact of R&D interventions on workers' wages and income has been very positive.

### **Research Institutes-Fulfilling of Objective**

The research institutes had many vacant positions during the plan period. The position of Joint Director, Research at CCRI is still vacant, apart from eight vacant positions in the engineering department, four positions in chemistry and testing department, one position in micro-biology department, a joint director position in micro-biology department, five positions in dye-house department and two positions in product development and diversification department of which one is a joint director position. In CICT, there are two vacant positions and three additional job

requirements in machine design and development department and two additional requirements in the testing department. In terms of infrastructure, there are three requirements in CCRI and one infrastructure related requirements in CICT. All the department should immediately fill up the HOD posts in CCRI and CICT, and also recruit a joint director research in CCRI. The ideal strategy will be to recruit young professionals from IITs and IIMs so that they bring in fresh ideas to develop the coir sector systems, processes, technologies, infrastructure and products.

Additionally, a Centre of Excellence as a nodal vehicle to coordinate and collaborate on breakthrough research on coir industry based technologies, foster partnerships with leading research institutions nationally and globally, should be established to infuse new ideas, technologies and processes to the coir sector.

### **New Areas of Research and Development in coir Industry**

The possible new areas in R&D in the Coir Industry for which proposals are being discussed and initiated, and are at various stages of consideration for implementation include developing technologies for generating Bio-Fuels from Coir Pith and Waste Fibre in collaboration with global research institutes for international collaborations include:

- *Centre for Environmental Research & Technology(CE-CERT) \ Bourns College of Engineering University of California, Riverside California, USA.*
- *University of Bourns 59190 Bourdes Sweden Swedish countries for resource recovery.*
- *Boeing-Embraer, Joint Research Centre, Sao Jose Dos Campos Technology Park which has opened a joint centre for collaboration research to establish aviation biofuel industry in Brazil.*

Other areas of international collaboration include developing bio-plastics from coir in association with research institutes include:

- *State University of New York, College of Environmental Science and Forestry, Syracuse, New York 13210, USA*
- *Centre for Bio Polymer Science & Technology (CBPST), Kochi, Kerala, India*
- *CSIR-NEIST, Thiruvananthapuram, Kerala, India*

and Coir Composites in collaboration with the following research institutes:

- *Wageningen University & Research, Wageningen University & Research, The Netherlands.*
- *Indian Plywood Industries Research and Training Institute Bangalore, India*
- *Indian Institute of Technology(IIT), New Delhi, India*
- *Society for Development of Composites, Bangalore, India*

Other proposals for research include research on developing coir composite products, coir geotextiles and coir machinery with the following arrangements.

- *Linkage Project with the Australian Research Council, Australia*
- *Indian Jute Industries Research Association, Kolkata, West Bengal, India*
- *Indo German Tool Room, Ahmedabad, Gujarat, India*
- *National Institute of Technology (NIT), Trichy, Kerala, India*
- *National Institute of Technology, Kozhikode, Kerala, India*
- *Maulana Azad National Institute of Technology, (MANIT) Bhopal, India*

Other possible research interventions in five of the six technology research intervention areas and development of infrastructure:

**(i) Modernization of Production Process:**

- **Improved MFEM:** Modification of MFEM to extract good quality fiber of uniform length and reduced impurities.
- **Improved Bio-Chem Treatment Process:** Development of technologies for quality improvement of coir fibre using Bio-chem treatment and enzyme treatment.
- **Fibre Quality Improvement Process:** Development of diversified products using a superior quality fibre such as Janata Mattress, superior quality coir floor covering that will result in increased production of new range of coir products which will be accepted both by internal and external markets

**(ii) Development of Machinery & Equipment's:**

- **Superior Weaving Machines:** Development of Plant Machinery and Control Systems to Spin Fine Quality Coir Yarn of Uniform Thickness and Reduced Hairiness for Weaving Superior Quality Coir Floor Furnishing Products and Shuttle Less Rapier Loom for easy weaving.

- **Improving Relevant Machines:** Improvement of machines like Pneumatic Anupam, machines for wrapping, Garden Article manufacturing, Coco-Log manufacturing, Multiple Head Curling machine and coir pith briquette machines will be undertaken to make these women user friendly, cost effective as well as more productive with better quality products.
- **Setting Up Tool Room:** A tool room will be set up/strengthened at CCRI for development-cum-repairing of different coir processing machines and for nurturing of coir processing workers to apprise them of maintenance and running the machine appropriately for maximum efficiency.

Apart from the above proposals, an anticipative planning on proposals for development of relevant machineries for the next twenty years have also been drawn up, the list of which is mentioned below:

- **Development of Rapier model shuttle less loom for weaving coir mattings in large quantity:** This project refers to the shuttle less power loom. At present power looms with the help of shuttle is being used in the industry for the production of coir mattings. The compressed wood used for the fabrication of shuttle makes huge noise while in operation. A shuttle less loom for weaving coir matting's will be eco-friendlier and help for huge production of continues coir matting's.
- **Development of fully automatic power loom for weaving thin variety of blended coir/natural fabrics:** At present, there is more demand for the thin variety of blended coir fabrics for producing diversified products but the production is limited due to the hand looms being used in the industry. By developing a fully automatic power loom for weaving more quantity of blended coir fabrics, it will be a boon to the industry.
- **Development of vertical Ring model coir spinning machine to spin different varieties of good quality of coir yarn for diversified use:** A good quality coir spinning machine to spin coir yarn with uniform thickness and reduced thickness is a long term need of coir industry. By this project, the issues related with the spinning sector of the coir industry will be solved
- **Development of drying machine for coir pith for logistics purpose for export:** A coir pith drier can be used for the drying of coir pith in bulk so as to compress the same for pith block for export purpose.

- **Development of fully automatic screen printing machine for PVC tufted mats:** The stenciling unit being used in the industry needs more man power for the operation, costly and time consuming. In this scenario, a fully automatic screen printing machine will be more benefit for the industry
- **Development of fully automatic fibre mat loom:** The production of fibre mat in the loom needs skilled labour, time consuming and production is very less. By this project, all of above problems can be solved
- **Development of fully automatic beaming device for warp coir yarn:** The winding of warp yarns in the beam for beaming operation is being done manual and the tension in warp yarn will be different which may affect the quality of the product. A fully automatic beaming device for winding the warp yarn will help to maintain the uniform tension in the each and every warp yarn as same
- **Development of modified version of bobbin winding machine for coir yarn:** At present, the bobbin winding machine being used in the industry is made out of heavy weight materials and it is costly, the maintenance is more. This project will help to solve the problems associated with the existing machine
- **Development of fully automatic rope making machine:** At present, the rope is making manually only. This project proposal is focused into the fully automatic version.

**(iii)Product Development & Diversification:**

- **Natural Dye Extraction Plant:** Operationalization of a natural dye extraction plant for production of naturally dyed coir product which will be 100% eco-friendly, is on plan.
- **Diversified Coir Products Plant:** Setting up of Pilot Plant for the production of diversified coir products which would increase the utilization of coconut husk for fibre extraction in all coir producing States thereby providing employment to rural youths which would prevent migration from rural areas to urban areas.
- **Extracting Sodium Lignosulphonate from Coir Pith:** Setting up of pilot plant for extraction of sodium lignosulphonate from coir pith as a demonstration for industrial application at CCRI as well as plans for diversified uses for cellulose and lignin from coir.

**(iv)Development of Environment friendly technologies:**

- **Eco-Lab:** Setting up of Eco lab at CCRI, Kalavoor with the State-of-art equipment will be beneficial to exporters in testing the parameters extending for them in time and Coir Board proposes to help the exporters for a long period as part of improving the export of eco-friendly coir products.
- **International Collaborations in Research:** International collaborations with countries where bio mass is being harnesses for energy generation. Countries like Denmark, Finland & the UN provide funding support accordingly:
  - 1) Centre for Environmental Research & Technology(CE-CERT)
  - 2) Bourns College of Engineering University of California, Riverside California, USA
  - 3) Swedish countries for resource recovery University of Bourns 59190 Bourdes, Sweden.
  - 4) Boeing-Embraer, Joint Research Centre, Sao Jose Dos Campos Technology Park which has opened a joint centre for collaboration research to establish aviation biofuel industry in Brazil.

**(v) Technology Transfer, Incubation, Testing & Service Facilities:**

- **ASPIRE:** ASPIRE, a scheme for providing incubation training on technology developed by the research institutes, being considered for implementation in CCRI & CICT where incubation training on the technology will be imparted.
- **Product Testing Centres:** A proposal for setting up testing centres and sufficiently equipped laboratories for carrying out the testing requirements of customers of various coir products to satisfy customer requirements and live up to their expectation standards.

Other initiatives include reinforcing and utilizing the research infrastructure facilities and implementing schemes in dissemination of technologies to the end-users.

There were valuable inputs from industry members on possible areas of research to improve the prospects of the coir industry, which include conducting research in efficient Extraction of Coir, development of Bleaching Process, establishment of Coir Research Institute, development of Coir Blended Fibres, development of Coir Spinning Sector and Coir Composite Products, value added products from coir pith besides dissemination of research output to public and consumers and recruiting qualified manpower for research institutes from top level educational institutions like IIT,NIT and IIMs.

## Need for Continuation of Scheme

There are many important research projects that are currently underway for the betterment of the coir sector that include projects and assignments on:

- ✓ Graft Co-polymerization of Methyl Methacrylate on to coir fibre for quality improvement
- ✓ Standardization of Binder-less Boards from coir pith that is an eco-friendly and cost-effective technology
- ✓ Operationalization of ASTM/Hydraulic lab and library of CCRI
- ✓ Modification of Coir fibre for value added applications
- ✓ Development of Lignin based glues for manufacture of process panel boards
- ✓ Development of flame retardant rubberized coir for cushioning applications in railways as per RDSO standards.
- ✓ Design and Fabrication of Garden article making machine with different set of dyes
- ✓ Manufacturing of five sets of home furniture requirements like kitchen cabinets, wardrobe, sofa-set etc
- ✓ Project on greenhouse cultivation of plants using coir pit as a medium of cultivation
- ✓ Development of compreg board for Indian Railways
- ✓ Project on application and testing of coir pith-plus
- ✓ Project on Development of Process and Machinery for Spinning Fine Quality Coir Yarn of Uniformed Thickness and Reduced Hairiness

Along with the ongoing projects, the two research institutes are spearheading incubation projects with 76 industry units as part of their objective of promoting intervention of science and technology with the industry peers for overall development of the coir sector that are at various stages of progress. Leaving them midway will not serve the purpose of the institute or the industry fraternity. The necessity of continuing with the R&D schemes is highlighted in the SWOT analysis of the Scheme where the gaps in institutional research requirements necessitate the continuance of the scheme, especially in developing the technology and system for large scale, efficient, standardized and qualitative output of coir as raw material and coir finished goods that will bring upliftment the industry to mass industry status and develop the managerial and technical cadre to attract the educated younger generation for a fruitful career in the coir sector, which is presently confined to cottage industry based time consuming low output physical process where the skill is confined to traditional families engaged in coir sector. Development of

technologies for creating the scale of operations will infuse new talent and develop the sector, in which the role of R&D schemes in spearheading it is of utmost importance.

<p><b>Strengths</b></p> <ul style="list-style-type: none"> <li>• S&amp;T Scheme is the only mode of imparting new technologies to the coir industry considering that the industry members are not big enough to conduct large scale and continuous research, which the research institutes by way of being state funded, can continue with their work of providing technological leadership</li> <li>• S&amp;T Schemes are a focused programme aimed at innovating and developing new products and processes as a rallying point for the industry, which no industry member can supplement.</li> <li>• The industry may lose identity and scatter away, and degenerate into a low-level sector without fresh inputs in technology, processes and products, which the S&amp;T schemes are providing at present.</li> </ul>	<p><b>Weaknesses:</b></p> <ul style="list-style-type: none"> <li>• The schemes are part of the routine government process and thereby experience the same procedural delays and elaborate decision-making processes that mar other government schemes, which stretches their implementation schedule.</li> <li>• The schemes are a top down approach at least in terms of implementation aspect, which creates gaps in implementation expectations and schedules.</li> <li>• The schemes are providing research solutions to some part of the coir extraction, coir and pith processing and other processes. They are not taking a comprehensive assessment of research and technology requirements, in which case the overall S&amp;T requirements for the sector may not come up, and gaps may still persist in research requirements</li> </ul>
<p><b>Opportunity:</b></p> <ul style="list-style-type: none"> <li>• S&amp;T Schemes under the aegis of research institutes can form a rallying point for consolidation of the industry in terms of spearheading standardization of processes and</li> </ul>	<p><b>Threat:</b></p> <ul style="list-style-type: none"> <li>• No Threats</li> </ul>

<p>products, which is a need for a sector to gain traction in mass market products</p> <ul style="list-style-type: none"> <li>• Presently R&amp;D's focus is on developing discrete tools and technologies to provide part solutions, though what is needed is development of comprehensive technologies encapsulating the total raw material production and processing for products technology. The gap in solutions provides huge opportunity for R&amp;D to conduct research to develop and implement viable technology process thereby create a paradigm shift in the scale, size and structure of the coir industry</li> </ul>	
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So, it is advisable to continue with the S&T schemes in the next plan period.

**Recommendations:**

The conclusions along with the information and evaluation done point to some prominent focus areas where R&D can play a very important role in changing the dynamics of the coir sector and providing it with the necessary impetus to make a paradigm shift towards a greater role in the economy and market of the country and the world. These provide the indicators to provide for some macro level strategic research recommendations followed by some operational level recommendations.

**Macro-Level Strategic Research Recommendations.**

**Improvement of Coir Extraction Process and Technology:** The first area is in improving the efficiency, cost infusion and quality of coir extraction on a large industrial output scale so as to provide a voluminous source of raw material round the year for coir based industries. The raw material for coir based industry primarily is coir fibre followed by husk. Presently, coir fibre has varied uses, but still more experimentation on uses can happen if good quality standardized coir is available readily in large amount at affordable prices. Presently, coir extraction is a laborious,

time-consuming, manual and annual process not being able to provide the scale and band-width for growth and modernization of the industry. So, the priority is to focus on research in this area so that the scale and complexity of operations in coir sector increases so that either the sector would look outwards from the family trade Coircle to look for talent to join operations or the younger generation themselves will get attracted to it for its scale of returns and the technological processes involved.

**Develop a Coir Industry Large Scale Process:** The second area of focus should be in streamlining the entire process from coir extraction to development of affordable quality coir as raw material and then provide the applicable technologies for developing products of different kinds i.e. pure coir products, coir as substitute product, composite coir products, blended coir products and infrastructural materials based on coir as raw material. In this way, a whole new administrative, technological and management workforce would be required to manage the scale and diversity of operations due to which the younger generation will get attracted to work for the sector

**Improve the Scope of Technology Intervention to IT and Automation Research:** The third focus area is to improve the level of technology involved in the R&D process. Presently, the focus of research is on developing varied products and processes in piecemeal basis to provide some spectacular solutions to a problem faced by the coir sector. The focus along with this, should also be towards developing systems preferably based on software systems to efficiently monitor quality, production processes, speed up and automate certain processes that are time consuming and costly among others. This will work towards improving the standardization, quality and output of products as well as both educate the present workforce and upgrade their skills and attract the educated and talented brains from top notch educational institutions to work in the coir sector

### **Operational Recommendations:**

**Shortage of Skilled Workers:** The study found that paucity of skilled workers is the most significant production problem faced by both small and medium size coir units of the study area, particularly with regards to adapting the new technologies developed by the research institutes, and which requires skilled manpower, who are not attracted to the industry due to its low returns. Many a times the units in order to manage / continue productions hire manpower with higher price. Hence, it is suggested that the state government as well as the Coir Board may encourage

the entrepreneurs to start manufacturing value-added coir products like mats, rugs, maurzouks, carpets etc., which will help them to earn more and enable them to pay attractive wages to their workers. If attractive wages are paid, more workers will be attracted towards the coir units even during the peak-agricultural seasons. Thereby, the major problem of shortage of workers may be solved. The Coir Board with the support of the State government may depute skilled manpower to get training from NCDTC or CCRI, Kalavoor in Kerala to get training in all diversified products. These persons after getting training may act as Master Trainers at the state level. The Coir Board through the State Government should conduct Demonstration and Production programmes continuously with the help of Mobile Coir Fibre Extraction Machines with the help of SHGs, NGOS, Artisans and Co-operatives. Coir Technology Incubation Centres may be established to provide training and create new enterprises. The schemes of National Skill Development Corporation and National Small Industries Corporations may be linked with Coir trade.

**New Product Design and Development:** Coir has to be made competitive through design development, quality upgradation and technological upgradation. Coir has multi various applications like door mats, mattings, carpets, Geotextiles, Rubberised fibre, Curled coir, Coir wood, Garden articles, handicrafts, etc. The new products may be popularized extensively in India and abroad. Aggressive awareness drives may be taken up to inform people about the multiple usages of coir products. It is also recommended design institutes such as NID and NIFT may be engaged to develop new and better coir products. The activities should be linked with National Manufacturing Competitiveness Programme (NMCP) for the MSMEs which aimed at improving the processes, designs, and technology and market access.

## CHAPTER -1: INTRODUCTION

### 1.1 Introduction:

India is the largest coir producer in the world accounting for more than 80 percent of global coir fibre production. Coir is popularly known as the golden fibre. It is a natural fibre extracted from fibrous husk of the coconut shell. The coir sector in India is diverse and involves households, cooperatives, NGOs, manufactures and exporters. The coir industry employs more than 700000 workers.

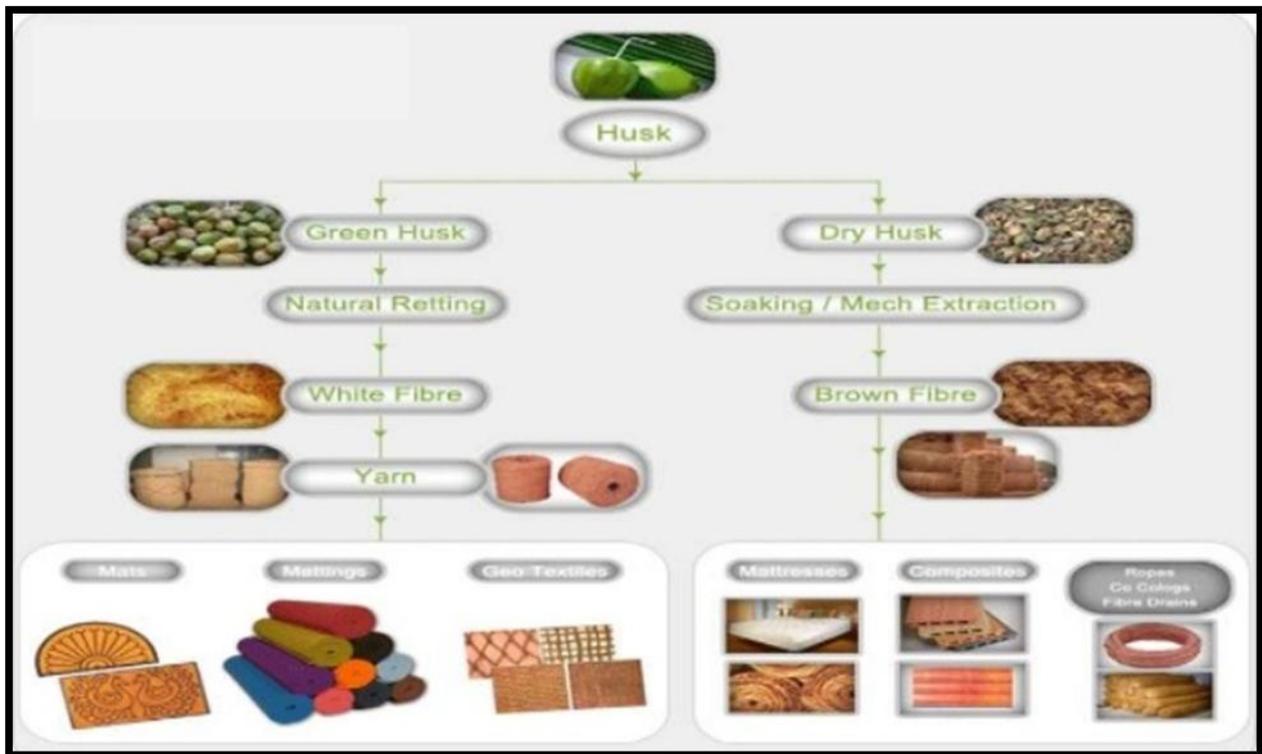
The first recorded history of coconut in the country dates back to Ramayana period. In the Valmiki Ramayan, there are references of coconut in the Kishkindha Kand and Aranya Kand. It is reported that Ramayana was written by the Valmiki sometimes in the third Century BC. Generally, it is believed that the coconuts were introduced in India during the post Vedic period. The coconut palm has been the subject of great adulation and admiration across the world and down the ages. This is perhaps the only tree that has a systematic recorded history dating back to nearly 3000 years before the birth of Christ. Botanists say that the coconut was domesticated in Neolithic, Stone Age, times. When the first Ice Age froze much of the waters of the world reducing the distance between the islands and continents, seafaring tribes found it easy to move between landmasses. They carried coconuts for food and water during their voyages and planted whatever was left over in their new home.

There are several legends associated with the origin of this wonder palm in many countries. The origin of coir industry dates back to pre- historic times, but it is only during the 19th century that coir products were increasingly introduced to the other parts of the world from the countries of their origin. In Indian mythology, it is believed that this is one of the five wish giving trees that emerged after the churning of the might oceans by the Gods.

According to the Indian Coconut Committee's "History and Home of Coconut" published in September 1954, the coconut palm originated in Sri Lanka. In another view, the coconuts drifted in the sea from Polynesia and found new homes in many parts of the world. According to early Greek Chronicles, it was Megasthenes, Ambassador of the Seleucos Nicator, who told the Indian

King, Chandra Gupta about the Coconut Palm, he found in Sri Lanka in 300 BC. Arab writers of 11th century AD referred to the uses of coir as ships cables, fenders and rigging. “Marco Polo’s celebrated travelogue of the 12th century mentioned on the uses to which coir fibre and mats were put in use in the sailing vessels of Arabs. He later saw the land where Arabs brought their coir and recorded how it was made out of the fibre from the coconut husk. During the 13th century there was evidence of coir yarn being used in building ships in the Persian Gulf. When Portuguese Admiral Vasco Da Gama sailed into Kerala, in the late 15th century, he must have seen this multipurpose fibre. Somewhere in the historical archives in Lisbon, there should be reference to coir. Coir is used for caulking, for sealing the space between the planks and for making ropes for sails and hawsers to tie ships and hold them during the tidal waves. The coir industry was in U.K before the 2nd half of the 19th century. In 1840 Captain Widely, in cooperation with Captain Logan and Mr. Thomas Treolar founded the well-known Carpet firm of Treolar and Sons in Ludgate Hill.

It is likely that both India and Sri Lanka were the first countries in the world to have discovered the multiple uses of coconut fibre: coir.



Coir fibre and yarn was therefore, known beyond the shores of India from ancient times. The coir industry, which forms the main plank of the economy of the coastal areas of Kerala, is one of the oldest and most traditional industries in the state. The geographical location of this area provides a salubrious climate for the large-scale plantation of coconut. One of the prominent centres of coconut based industries in Kerala is Alleppey, which is known as the Venice of the East.

Not that coir was something new to Alleppey, Coir had been in use in various forms and coir making was prevalent around the world from Belgium Congo to Guam and from Venezuela to Eritrea, a long time before Darrah's factory came up in Alleppey. The hop fields in England that provided raw material to the beer industry used coir ropes in large quantities on the farms, so did the olive oil presses in Turkey, bringing out the versatility of the coconut fibre.

The manufacture of coir fibre and coir yarn was a traditional old industry in the coastal areas of the native states of Travancore and Cochin and the coir was purchased and exported by the traders from the Calcutta port. Using handlooms used, the yarn was exported for the manufacture of cheap floor coverings in the schools for the blind. The golden textured Indian Coir Fibre, which earned it the unofficial brand name 'golden fibre', captured European and world markets in no time.

## **1.2: Coir Industry in India**

Coir industry in India gives livelihood for more than seven lacs of workers by utilizing the discarded material of coconut. The coir industry also fetches crores of foreign exchange by export of coir and coir products Government of India is providing a number of assistance to the coir units in the form of subsidies and training to the coir entrepreneurs for promoting coir industry in India. Coir industry is labor-intensive industry, coir industry provides self-employment opportunities to the people with small size of investment and little efforts and reduces unemployment and under employment problems. As per the Coir Industry (Registration) Rules -2008 the coir establishments may register with Coir Board within one month of the start of business. During the year 2015-16, 741 new coir units were registered under the Board. As per the coir board 2015-16 data, total 15976 registered in Coir Board. Coir industry is a great opportunity to the people for establishing as well as operating the industrial units without

experience. It creates a good amount of savings and entrepreneurial skill among the people particularly in rural areas. Coir entrepreneurs also improve social welfare of a country. Thus, large amount of human resources is not only mobilized but also utilized by the coir sector for emerging as well as promoting entrepreneurship especially in rural areas and thereby improving the country's economy. Income Generation Coir industry generates income to the people viz., owners and workers. It generates more income to the entrepreneurs with low capital investment and less training. Further, it also generates income to the people those who are engaged in coir industry. Out of 80 percent of the women workforce, a major portion of the women workers are economically very weaker sections of the society. In India, alone, about half a million people depend on this industry for their livelihood.

### **1.3: Genesis of the Coir Board in 1954**

Coir Board in India was established as there was a need at the time in the early fifties for the resurrection and growth of the Indian Coir industry. The fortunes in the industry at that time largely depended on the export market. During the years 1950 to 1953 the industry was hit by a serious depression. Production had dropped, prices slumped and unemployment mounted causing great hardships to the large population in the coastal districts of Kerala, which solely depended on coir industry for their livelihood. To assess the gravity of the problem the Government of India conducted a study the finding of which made the government realize that it would be disastrous to leave the industry to the vagaries of frequent fluctuations of the export market. To tackle this problem and for the development of Coir Industry, the Government of India passed the Coir Industry Act of 1953. Under this Act the Coir Board was set up in July 1954. The Coir Board thus became the official Organization to look after the progress of Indian Coir Industry by assisting producers and consumers' both at home and abroad.

### **1.4: Functioning of the Coir Board**

The main functions of the Board as laid down in Section-10 of the Coir Industry Act are given below:

1. It shall be the duty of the Board to promote by such measures as it thinks fit; the development, under the control of the Central Government; of the Coir Industry.

2. Without prejudice to the generality of the provisions of Sub Section (1) the measures referred to therein may relate to:

- (a) Promoting exports of coir yarn and coir products and carrying on propaganda for that purpose;*
- (b) Regulating under the supervision of the Central Government the production of husks, coir yarn and coir products by registering coir spindles and looms for manufacturing coir products as also manufacturers of coir products, licensing exporters of coir yarn and coir products and taking such other appropriate steps as may be prescribed*
- (c) Undertaking, assisting or encouraging scientific, technological and economic research and maintaining and assisting in the maintenance of one or more research institutes;*
- (d) Collecting statistics from manufacturers of, and dealers in, coir products and from such other persons as may be prescribed, on any matter relating to the coir industry, the publication of statistics so collected or portions thereof or extracts therefrom;*
- (e) Fixing grade standards and arranging when necessary for inspection of coir fibre, coir yarn and coir products;*
- (f) Improving the marketing of coconut husk, coir fibre, coir yarn and coir products in India and elsewhere and preventing unfair competition;*
- (g) Setting up or assisting in the setting up of factories for the producers of coir products with the aid of power;*
- (h) Promoting cooperative organization among producers of husks, coir fibre and coir yarn and manufacturers of coir products;*
- (i) Ensuring remunerative returns to producers of husks, coir fibre and coir yarn and manufacturers of coir products;*
- (j) Licensing of retting places and warehouses and otherwise regulating the stocking and sale of coir fibre, coir yarn and coir products both for the internal market and for exports;*
- (k) Advising on all matters relating to the development of the coir industry;*
- (l) Such other matters as may be prescribed.*

3. The Board shall perform its functions under this section in accordance with, and subject to such rules as may be made by the Central Government.

## 1.5: National Coir Policy

With a view to develop coir industry in a holistic manner, Coir Board has evolved a **draft National Coir Policy and Vision 2025**. The policy broadly defines the vision of the Government of India on Coir sector development and the targets to be achieved by 2025.

The National Coir Policy has the following aims and objectives:

- Enhancing the utilization of coconut husks available in the coconut producing states of the country for coir fibre extraction.
- Focusing on improving the quality of coir fibre, yarn and products manufactured in India.
- Women empowerment through value addition of coir products and coir pith.
- Zero wastage in the fibre extraction and manufacturing process.
- Inventions in product and process for use in betterment of river water, urban waste management, disaster management, urban environment benefit, Interventions in terms of avoidance of urban heat islands, rain water harvesting, avoidance of rain flood water, light weight roof lawns, use of urban walls for sound reductions and pollution,
- Improvement of quality of life in indoor of homes and office by gardens, In horticulture process for better water utilization and higher yields in vegetable production, popularization of production of organic vegetables by the application of coir pith and coir geo-textiles.
- Phasing out the traditional production process in the coir industry by replacing with modern equipment so as to eliminate drudgery in the production processes and enhance productivity and quality.
- Addressing the problem of infrastructure bottlenecks by providing assistance under the various schemes of the Union Government.
- Supporting modernization and technology upgradation of various segments of the coir industry to increase its competitiveness.
- Providing assistance for capacity building in both industry segment and human capital required for further processing the expected surge in the fibre production and its further processing.
- Providing full employment to the existing coir workers and generating additional employment to achieve “one million jobs” in coir sector predominantly for women.

- Undertaking vigorous research and development activities for finding new user areas for coir especially in soil bio-engineering applications and coir pith as a growing medium.
- Development of high productivity defibering units & mechanical spinning machines.
- Finding new uses for Coir Wood, Coir Pith and explore more business opportunities within India and abroad.
- Augmenting investment and providing support on both fiscal and non-fiscal front to increase fibre availability in the country and facilitate high growth and competitiveness of the coir sector.
- Developing domestic and export market of coir products so as to ensure remunerative returns to the producers of coir products and fair wages to the coir workers.
- Promoting Consortium approach in the production and marketing of coir products and implementing schemes for welfare of coir workers.
- Promoting towns of export excellence in coir in areas of coir production.
- Dovetailing various schemes under the Govt. of India for infrastructure development and modernization of coir industry

#### **1.6: Schemes of Coir Board**

- Coir Vikas Yojana
- Scheme of Fund for Regeneration of Traditional Industries (SFURTI)
- Coir Udyami Yojana
- Export Market Promotion Scheme
- Domestic Market Promotion Scheme
- Development of Production Infrastructure Scheme for Coir Units
- Skill Upgradation and Quality Improvement Scheme
- **Science and Technology Scheme**
- Personal Accident Insurance Scheme for Coir workers
- Trade and Industry Related Functional Support Services Scheme

#### **1.7: Science and Technology (S&T) Scheme**

The Scheme envisages extension of the fruit of research at the laboratory level for application at the field level and extension of testing and service facility. The Research and Development Centre for Market Research & Social Development

activities of the Board under the S&T Scheme are carried out through the twin research institutes; the Central Coir Research Institute (CCRI) , Kalavoor and Central Institute of Coir Technology (CICT), Bangalore. Identification of new user areas for utilization of coir and coir waste (coir pith), modernization of production infrastructure for elimination of drudgery in manual operation thereby attaining higher productivity and improvement in quality are integral parts of the research efforts. Collaborative research with research organizations, institutes, universities having proven records on varied applications of coir, development of new products, new machinery, product diversification, development of environment friendly technologies, technology transfer, incubation, testing and service facilities are the areas which are given priority consideration.

The Research and Development activities of the Board are carried out through the research institutes namely, Central Coir Research Institute (CCRI), Kalavoor and Central Institute of Coir Technology (CICT), Bangalore. The Central Coir Research Institute, Alleppey was established in 1959 and the Central institute of Coir Technology, Bangalore in 1980. The Director RDTE, who is heading the Research Institutes, CCRI & CICT of the Board, is the nodal officer of the S&T scheme. Whereas CCRI, Kalavoor concentrates on research concerning both the white and brown fibre sectors, CICT, Bangalore confines to the brown fibre sector. Identification of new user areas for utilization of coir and coir waste (coir pith), modernization of production infrastructure for elimination of drudgery in manual operation thereby attaining higher productivity and improvement in quality are integral parts of the research efforts. Research investigations in the Institutes have led to development of several new technologies for the coir industry and it has been awarded the prestigious National Research and Development Corporation (NRDC) Technology Awards thrice for innovations in 1999, 2002 and 2004. The recent achievements of the Board include development of a versatile loom, named as “Anupam”, for manufacturing various coir products with ease and higher productivity and development of a technology for pollution free retting and a mobile fibre extraction machine (SWARNA) which can be transported easily from one place to another according to availability of husk.

### **1.7.1: Programmes under Science & Technology (S&T) Scheme**

Extension of the outcome of the research at the laboratory level for application at the field level and extension of testing and service facility are two main areas of activity under the head. Collaborative research with research organizations, institutes, universities having proven records on varied applications of coir, development of new products, new machinery, product diversification, development of environment friendly technologies, technology transfer, incubation, testing and service facilities are the areas which are given priority consideration. Different programmes under the Science and Technology Scheme are:

- a) Modernization of Production Processes.*
- b) Development of Machinery and Equipment.*
- c) Product Development and Diversification.*
- d) Development of Environment Friendly Technologies.*
- e) Technology Transfer, Incubation, Testing and Service Facilities.*
- f) Incentive for using Natural Dyes and Incentive for IPR in Coir Sector.*

#### **Major Outcomes of the S&T scheme**

- *Popularization of Composting of coir pith*
- *Popularization of Bio-Chemical softening of coir fibre*
- *Setting up of a pilot scale plant for production of Bio fuel*
- *Setting up of a pilot scale plant for the manufacture of Bio oil*
- *Manufacture and popularization of „SWARNA“ mobile fibre extraction machine*
- *Production of solar powered spinning ratt using non-conventional energy*
- *Manufacturing of “VAJRA” fully automatic spinning machine*
- *Manufacturing of fine fabric using coir blended with other hard fibres*
- *Manufacturing of Umbrella, footwares, shopping /conference bags etc using coir*
- *Setting up of a processing unit for coir as a textile fabric*
- *Setting up of net houses*
- *Production of Natural dyes*
- *New machines developed for the Coir Industry*
- *Eco-friendly technology transferred to 120 entrepreneurs*
- *New coir clusters to be provided technological support*

- *New Technologies to be transferred to machinery manufacturers which lead to economic utilization of coir.*
- *Field demonstrations of technologies in coir producing areas*

## **CHAPTER -2: OBJECTIVE AND METHODOLOGY OF THE STUDY**

### **Purpose and Objectives of the Evaluation of Science & Technology (S&T) Scheme**

The main purpose to evaluate the scheme is to consider continuation of the scheme in the XIIIth five-year plan with the changing needs in coir sector to secure the life of coir workers. This Evaluation will also help the Coir Board to effectively implement the Scheme made during 12th Five Year Plan.

#### **2.1 The specific objectives of this evaluation study are:**

1. To study and enlist the major achievements under each project heads with particular reference to the cost benefit aspects. To study and report whether the quantifiable targets/objectives of the scheme has been achieved. If not, the reasons therefore.
2. To study and assess whether the technologies developed have helped to increase productivity of the workers, improve quality of the products, reduce drudgery of work, workplace safety, improve the health impact of the workers, reduce wastages, improve productivity and achieve cost effectiveness.
3. To study and report as to how far the technologies developed by the institutes are useful to the trade and industry and how far the R & D institutes succeeded in transferring the technology to the organization. To ascertain how far the R & D succeeded in the processing and production techniques has helped improve the organization domestic and export markets for coir products?
4. To study and assess to what extent the new products like Coir Ply, Coco lawn, C-Pom, coir-geotextiles etc. developed by the Institutes have made in-roads in to the market? Do these products require more improvements/standardizations to meet with the consumer tastes/demand?
5. To study as to what extent the utilization of coconut husks in the country has increased due to the introduction of new machineries and production techniques.

6. To study and assess what extent the younger generations have been attracted to the employment opportunities offered by the industries as a result of improved mechanization and factory like set up. How far the R&D efforts of the Board have succeeded in this regard.
7. To ascertain to what extent the income of workers in the industry have increased due to the R & D efforts of the Board.
8. To assess whether the Board's Research Institutes have been able to achieve the objectives for which these institutes have been established? To examine and assess whether adequate scientific/technical persons are available to undertake research and development programmes and to suggest measures for augmenting manpower if needed? Also, whether sufficient infrastructural facilities to carry out research programmes for the requirements under the coir industry are available in the R & D Institutes of the Board? If not, suggest additions to be made.
9. To study and report the possible new areas of R & D in the Coir Industry and suggest the names of collaborators competent to be associated with for the purpose. Suggest ways and means to collaborate with academia an industry for developing new products.
10. To evaluate the ongoing R & D project of CCRI and CICT and suggest the need for its continuation or otherwise of the Scheme along with justifications. To study and evaluate the results of the incubations being done in the Research Institutes and to suggest any modifications required.

## **2.2: Study Area**

The major chunk of secondary and primary data and information for the study has been collected from Coir Board, CCRI and CICT. However, to assess the impact of the S&T scheme, sample manufacturers, traders, entrepreneurs and coir workers have been interacted in three major coconut producing states of the country, i. e. Tamil Nadu, Kerala and Karnataka.

## States Covered for the Evaluation of S&T Scheme



The states that have been included for the evaluation study are Tamilnadu, Kerala and Karnataka. The rationale for including the three states in the study is there will be a comparatively higher concentration of workers and industries' members in these three states.

### 2.3: Methodology for the Study:

**2.3.1: Research Strategy and Application:** The study is based on the Explorative, Descriptive and Analytical approach to study the objectives in-depth with regard to the specific target respondents. The estimation of necessary statistics as desired in objectives have been done by employing Research Techniques in addition to statistical techniques for every concerned variable of the interest under the study.

The study has critically examined the process followed for approval of the R&D projects under the scheme, and how far the results of the R&D projects have benefitted the coir sector. The main source of data and information has been collected for the study is Coir Board, CCRI and Centre for Market Research & Social Development

CICT. Besides, sample number of traders, manufacturers, entrepreneurs and coir workers benefitted for the results of R&D activities have been interacted to assess the impact of the scheme on the coir sector. Information solicited from the scheme implementing officials on issues pertaining to implementation, supervision and monitoring of the performance of the scheme.

However, in order to measure the impact of the scheme on various indicators, a triangulation of research methodologies has been obtained both quantitative and qualitative information. Triangulation research method is the combination of multiple methods to gather data, such as documents, interviews, observations, questionnaires or surveys, when conducting primary research, at different times and in different places. Data triangulation validates data and research by cross verifying the same information. This triangulation of data has strengthened the findings of the study because of increased credibility and validity of data. Under triangulation method, documents, data and information pertaining to the study have been collected from Coir Board, CCRI and CICT; while information related to the impact have been collected from the traders, manufacturers, entrepreneurs and coir workers. The qualitative information also has been collected through in depth interviews with the CCRI and CICT researchers and scheme implementing officials at Coir Board. Also, during the field visit to the states, observations will be used as a method to gather information on the benefit for the results of the R&D activities. Focus Group Discussions will also be conducted with the end beneficiaries to assess the level of impact of the developed technologies.

The multiple objectives of the study dictate to adopt a triangulation of basic research techniques. The below mentioned methods for data collection have been employed keeping in mind the nature of the multiple objectives of the study. Both secondary and primary research have been undertaken to generate required information.

The present evaluation study is intended to bring out in qualitative and quantitative terms, the efficiency and effectiveness of the scheme towards to growth and development of coir industries as well as the impact of the scheme in achieving its stated objectives.

### **2.3.2: Secondary Research:**

The secondary sources have included the referring the necessary relevant literature pertaining to the scheme implementation. Secondary sources have been carried out to refine the objectives and provide lines of enquiry for the next stage. Specially, the desk research phase has gathered information on the implementation process of the scheme. All data, reports and statistics available at various sources have been procured / collected for undertaking in-depth analysis.

The data sources for the study were the various published and unpublished research inputs, statistics from various national and international magazines, reports, etc. Various records available with Coir Board, CCRI and CICT have been studied / examined to ascertain relevant information regarding implementation and performance of the scheme. Besides various reports and literatures available on the subject including project proposals of the CCRI and CICT, have also be thoroughly examined and relevant inputs have been made part of the report. In particular, the study has been undertaken on the following aspects:

***First Phase:** In the first phase, exhaustive desk research has been undertaken i.e. study of relevant background material on the scheme, fund released under the scheme, physical and financial achievement under the scheme, and other such material have been collected.*

***Second Phase:** In the second phase, field study has been carried out. The field study has involved in-depth interviews, interactions and discussions with the Coir Board Officials, Director of CCRI and CICT, scientists and researchers of CCRI and CICT working on the ongoing projects and feedback of the traders, manufacturers, entrepreneurs and coir workers. Relevant data particularly related to selection and approval of project proposals, research and implementation arrangements, monitoring system, results of the R&D projects and its impact, feed-back mechanism from top-to-bottom and bottom-to-top, etc. have been obtained from Coir Board, CCRI and CICT.*

### **1.10.3: Primary Research**

Under the primary research, we conducted two different modules i.e.

**Qualitative Research:** Qualitative Research method was applied that was aimed at gaining a deep understanding of the major achievements of each project, usefulness of technologies developed, broad impact on the coir sector. In the present context, the following data collection methods were employed:

- *In-Depth Interviews*
- *Focus Group Discussions*
- *Case Study*

- *Observation*

**Quantitative Research:** Quantitative Research was also conducted with the support of structured questionnaires to get desired data and information from the target respondents. The quantitative research method was used in order to gain a deep sense of understanding of the performance and effectiveness of R&D activities and impact of the results of new technologies on the coir industries.

While the face to face interviews were conducted with the officials to canvass research institutions (CCRI and CICT), questionnaire method was applied with the researchers to canvass researcher questionnaire, and with traders, manufacturers, entrepreneurs and workers to canvass related questionnaires.

### **Study Respondents**

- a) Coir Board Officials*
- b) RTDE Director and officials*
- c) Researchers and technical persons of CCRI and CICT*
- d) Traders*
- e) Manufacturers/ Entrepreneurs*
- f) Workers*

#### **2.3.4: Sample Size**

For qualitative studies, the sample size is a very important feature of the design but there are no precise rules to provide guidance. As both the data collection and analysis tend to be time consuming, hence study size are usually small. The sample size is flexible and is subject to hike as per the need determined during data collection process. The sample size for each category of the respondent is given in the following table

	<b>Category</b>	<b>Nos</b>
<b>1</b>	RDTE	1
<b>2</b>	Research Institutes (CCRI and CICT)	2
<b>3</b>	Scientists / Technical Persons	22
<b>4</b>	Traders	21
<b>5</b>	Manufacturers/ Entrepreneurs	46
<b>6</b>	Workers	311
	<b>Total</b>	<b>401</b>

## CHAPTER -3: FINDINGS & ANALYSIS

### 3.0 Introduction:

The study implemented the methodology proposed and approved for the work. As part of it, the team conducted research and field visits and collected information and data by way of field interactions, focused group discussions, interviews, spot visits, interaction with stakeholders and observations. It also conducted extensive literature review and research to find information needed to evaluate the performance of the S&T schemes in the plan period 2012-17. The information was analyzed as per the terms of reference pertaining to evaluation of the six intervention areas and related schemes for infusing new technologies to remove drudgery, innovate new processes and products and kindle interest in youth to join the coir industry. The analysis of findings pertaining to the requirements as per the terms of reference are discussed in the succeeding sections of the chapter.

### 3.1 Major Achievements – Project Head Cost and Benefit

Coir Board through its planned scheme on science and technology has six intervention areas. These are part of its strategy to infuse new technologies, processes and practices to improve efficiency, cut costs in production process, induce new generation and talent to look at the coir sector as a viable career option. It was also aimed to drive innovation in products and techniques to provide new products as well as substitute to prevailing products made from other raw materials like plastic or metal among others. The six intervention areas are focused on carrying out researches, studies and applications in (i) modernization of production process, (ii) development of coir machinery and equipment, (iii) production development and diversification, (iv) development of environment friendly technologies, (v) technology transfer, incubation, testing and service facilities and (vi) incentives for using natural dyes and incentives for IPR in coir sector.

The results of the evaluation of the six focused areas on the ten objectives of the study are mentioned in succeeding order.

## Plan S&T Physical Target & Achievement during the 12<sup>th</sup> Plan Year

**Table 3.1.1: Funds Received and Expended for S&T Schemes/Programmes: 2012-17 {In Lacs}**

Year	Fund Received	Actual Expenditure
2012-13	231.13	277.97
2013-14	650.74	650.64
2014-15	530.00	530.00
2015-16	300.00	300.10
2016-17	692.50	692.50
<b>Total</b>	<b>2204.37</b>	<b>2451.21</b>

Source: Coir Board and CCRI

- Under the plan scheme S & T, total amount of Rs 2204.37 lacs was released during 12<sup>th</sup> plan period, out of which Rs 2451.11 lacs was the expenditure under five different heads of the scheme.
- The extra expenditure amount of Rs 46.84 lacs incurred was carried forward from the previous plan period.
- Head wise expenditure of funds under the scheme in 12<sup>th</sup> plan period given in the following table:

**Table 3.1.2 Fund Released and Actual Expenditure**

Schemes / Programmes	2012-17 (12 <sup>th</sup> Plan Period)	
	Funds 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 Coir Sector		0
<b>Total</b>	<b>2404.37</b>	<b>2451.21</b>

Source: Coir Board and CCRI

- Technology transfer, incubation, testing and service facilities used 31.04 percent of the funds released in the plan period followed by product development and diversification programme (23.02%)

- Development of environment friendly technologies (16.66%) and development of coir machinery & equipment (16.54%) were the third and fourth largest users of funds released during the plan period followed by modernization of production process (14.70%).
- No funds could be released for programmes involving providing incentives for using natural dyes and for IPR in the coir sector for such activities in the plan period

**Table 3.1.3 Year wise and Head wise fund released and actual expenditure**

Schemes / Programmes	Financial Year 2012-13		
	Funds Released	Actual Expenditure	%age
Modernization of Production Process	231.13	13.59	5.9
Development of Coir Machinery and Equipment		33.4	14.5
Product Development and Diversification		56.73	24.5
Development of Environment Friendly Technologies		10.59	4.6
Technology Transfer, Incubation, Testing and Service Facilities		163.66	70.8
Incentives for Using Natural Dyes and Incentives for IPR in Coir Sector		0	0.0
<b>Total</b>	<b>231.13</b>	<b>277.97</b>	<b>120.3</b>
Schemes / Programmes	Financial Year 2013-14		
	Funds Released	Actual Expenditure	%age
Modernization of Production Process	650.74	73.99	11.37
Development of Coir Machinery and Equipment		116.42	17.89
Product Development and Diversification		247.61	38.05
Development of Environment Friendly Technologies		40.35	6.20
Technology Transfer, Incubation, Testing and Service Facilities		172.27	26.47
Incentives for Using Natural Dyes and Incentives for IPR in Coir Sector		0	0.00
<b>Total</b>	<b>650.74</b>	<b>650.64</b>	<b>99.98</b>
Schemes / Programmes	Financial Year 2014-15		
	Funds Released	Actual Expenditure	%age
Modernization of Production Process	530	121.78	22.98
Development of Coir Machinery and Equipment		46.65	8.80
Product Development and Diversification		66.01	12.45
Development of Environment Friendly Technologies		59.7	11.26
Technology Transfer, Incubation, Testing and Service Facilities		235.86	44.50
Incentives for Using Natural Dyes and Incentives for IPR in Coir Sector		0	0

<b>Total</b>	<b>530</b>	<b>530</b>	<b>100</b>
<b>Schemes / Programmes</b>	<b>Financial Year 2015-16</b>		
	<b>Funds Released</b>	<b>Actual Expenditure</b>	<b>%age</b>
Modernization of Production Process	300	59.21	19.74
Development of Coir Machinery and Equipment		46.43	15.48
Product Development and Diversification		108.29	36.10
Development of Environment Friendly Technologies		14.57	4.86
Technology Transfer, Incubation, Testing and Service Facilities		71.6	23.87
Incentives for Using Natural Dyes and Incentives for IPR in Coir Sector		0	0.00
<b>Total</b>	<b>300</b>	<b>300.1</b>	<b>100.03</b>
<b>Schemes / Programmes</b>	<b>Financial Year 2016-17</b>		
	<b>Funds Released</b>	<b>Actual Expenditure</b>	<b>%age</b>
Modernization of Production Process	692.5	84.78	12.24
Development of Coir Machinery and Equipment		154.69	22.34
Product Development and Diversification		74.8	10.80
Development of Environment Friendly Technologies		275.3	39.75
Technology Transfer, Incubation, Testing and Service Facilities		102.93	14.86
Incentives for Using Natural Dyes and Incentives for IPR in Coir Sector		0	0
<b>Total</b>	<b>692.5</b>	<b>692.5</b>	<b>100</b>

- Utilization of funds for developing technologies and processes for modernization of production processes were comparatively higher in the financial years 2014-15 (22.98%) and 2015-16 (19.74%) as compared to the other financial years. In the year 2012-13, the funds utilization was only 5.9 percent
- Utilization of funds for developing technologies and processes for development of coir machinery and equipment were comparatively higher in the financial years 2013-14 (17.89%) and 2016-17 (22.34%) as compared to the other financial years. In the year 2014-15, the funds utilization was only 8.80 percent, the lowest utilization in that financial year.
- Utilization of funds for developing technologies and processes for product development and diversification were highest in the financial years 2013-14 (38.05%) and 2015-16 (36.10%) and 24.05 percent in the year 2012-13.

- Utilization of funds for developing technologies and processes for development of environmental friendly technologies were highest amongst funds usage in the financial years 2016-17 (39.75%). That year the overall disbursement of funds to this category from among the six categories was also the highest at INR 275.3 lakhs in the entire plan period. However, in other financial years its funds utilization was either the lowest or the second lowest, like in 2015-16, it was only 4.86 percent, in 2013-14 it was 6.20 percent and in 2012-13 it was 4.6 percent
- Utilization of funds for developing processes for enabling technology transfer, incubation, testing and service facilities were highest in all categories in all of financial years in the financial year 2012-13 (70.80%) and the fund allocation was the highest that year at INR 235.86 lakhs in the financial year 2014-15. In fact, this category attracted the maximum funds disbursement and utilization in the plan period as compared to the other five programs
- There has neither been funds transfer and logically, utilization, in the category of providing incentives for using natural dyes and for IPR in coir sector, though funds were earmarked for this category during the plan period 2012-17.

There were some schemes that were devised for implementation in the plan period as part of the science and technology intervention by way of the six programme implementation areas. They are mentioned in the tables below.

**Table 3.1.4 Year wise and Head wise Target Vs Achieved**

Name of the Scheme/Programme	2012-13		2013-14		2014-15		2015-16		2016-17	
	Tar	Ach	Tar	Ach	Tar	Ach	Tar	Ach	Tar	Ach
<b><u>Modernization of Production Processes</u></b>										
(a). Modernization of Traditional Looms	1000 Nos.	1 No.	--	--	--	--	--	--	--	--
(b). New Machines to be Developed	--	--	5 Nos.	5 Nos.	5 Nos.	12 Nos.	2 Nos.	6 Nos.	4 Nos.	2 Nos.
<b><u>2.Development of Machinery &amp; Equipment</u></b>										
(a). Versatile spinning units set up	5 Nos.	5 Nos.	5 Nos.	--	--	--	--	--	--	--
(b). Eco friendly technology to be transferred to entrepreneurs	--	--	10 Nos.	10 Nos.	10 Nos.	12 Nos.	2 Nos.	6 Nos.	4 Nos.	2 Nos.

<b><u>3.Product Development &amp; Diversification</u></b>										
(a). Setting up of Net houses	1 No	2 Nos	--	--	--	--	--	--	--	--
(b). Technology to be transferred to machinery manufacturers	--	--	2 Nos	10 Nos	30 Nos	21 Nos	3 Nos	6 Nos	7Nos	6 Nos
<b><u>4. Development of Environment Friendly Technology</u></b>										
(a). Production of Natural dyes	450 kg	13.5 kg	--	--	--	--	--	--	--	--
(b). New coir clusters to be provided technological support	--	--	5 Nos	5 Nos	5 Nos	5 Nos	2 Nos	2 Nos	19 Nos	28 Nos
<b><u>5. Technology Transfer, Incubation, Testing &amp; Service facilities</u></b>										
(a). Technology transfer to coir clusters	1 No	28 Nos	--	--	--	--	--	--	--	--
(b). Field demonstrations of technologies	--	--	250 Nos	729 Nos	400 Nos	718 Nos	150 Nos	148 Nos	850 Nos	1324 Nos
<b><u>6. Incentive for using Natural dyes and incentives for IPR in coir sector</u></b>										
	--	--	--	----	--	--	1 No	--	1 No	--

As the information collected reveal, many of the projects are in the ongoing stage and will be completed in due course though it is now a fact that they have transgressed their allocated time frame. All the same it can be said that they are on course and will be giving results after their completion. The availability of qualified manpower and staff for implementing the programmes in the institutions were an issue and it is one of the prime reasons for the delay in implementing the projects and achieving the quantifiable targets envisaged in the plan period. However, in spite of the manpower constraints there have been some major achievements in the plan period under review. They are discussed in the succeeding sections under the six programme intervention areas.

#### **(j) Modernization of Production Processes: Major Achievements**

**Development of Bio-Chem Treated Fibre:** A new process for improving the quality of machine extracted coir fiber by developing an innovative technology nomenclature as “Bio-chem” which yields fiber of retted quality. Bio-chem treated fibre has been used for manufacture of Janata Mattress and pillows which are cost effective as compared to rubberized coir foam mattress. The bio-chem can also be applied to coir mats for finishing operations.

Discussion and information sharing revealed that an ecofriendly technology using a bacterial consortium “Coirret” was developed for reducing the period of retting of coconut husk and improving the quality of un-retted fibre. The technology was conferred NRDC Award as a Meritorious Invention for the year 1999. This coirret technology has been improvised as “Bio-chem” treatment for quality improvement of machine extracted fibre in 12 hours. As mentioned, the Bio-chem treatment can be treated on fibre as well as finished mats. Janatha mattress/ pillows have been developed which very are cost effective. The technology has been demonstrated to the industry & is being popularized in all coconut growing states of India. One large exporter M/s. TMMC, Cherthala is availing the facility of CCRI for the technology.

**Effluent Treatment Technology:** A cost effective effluent treatment technology has been developed for pollution abatement in coir fibre extraction / processing units. The same is being popularized extensively in Tamil Nadu & Kerala & awareness generation of the same through seminars/ EDP sessions continued in other coconut growing states of India. The technology is helping promote the reduction of pollution in coir fibre extraction units.

#### **(ii) Development of Machinery and Equipment: Major Achievements**

The major achievements in the category of developing new machinery and equipment to improve efficiency and reduce drudgery in operations include development of a modified mobile fibre extraction machine: -‘Swarna-Nano’, development of a coreless coir yarn spinning machine- ‘Krishna’, a preprocessing unit attachment for production of good quality coir yarn and a prototype fully automatic coir geotextiles weaving loom – Anugraha “Tejas” which can weave 400Sq.M of coir textiles in 8 hours (800SqM/day). The details are mentioned below:

- *A mild steel metallic handloom 'Anugraha' for weaving coir geotextiles was designed, fabricated and put to trial. The technology has been conferred NRDC Award as a Meritorious Invention for the year 2004. The loom has now in the year 2017 been upgraded as Anugraha-Tejus, a fully automatic loom with increased production & no drudgery.*
- *A Mobile Fibre Extraction Machine (MFEM): A compact mobile machine for instantaneous extraction of coir fibre from green/dry husk @ 5000 husks per eight hours. The MFEM has now been modified as “Nano” which is a compact version of the original with reduced noise & size & weight with the same output in the year 2016.*

- *A prototype of coreless single head single ply spinning machine (Vajra) was developed in the year 2013.*
- *A prototype of coreless double head single ply spinning machine (Krishna) has also been developed in the year 2015.*

Discussion with the officials revealed that all these innovations are at different stages of integration with the market and industry requirements in the form of technology testing, application and usage.

### **(iii) Product Development and Diversification: Major Achievements**

**Coir Cell Geo-Textile:** The major achievement in this category is that of developing a new innovation in the application of coir geo textiles in which the pocket is woven in the geo textile and holds the packing material, seed and manure and it can be inserted in the pockets before laying. It also avoids spreading fertile soil in the top of the mine dumping yards.

**Coircular Woven Coir Geo-Bag:** Coircular woven coir geo-bag is a new innovation in the coir industry. The Coircular woven fabric in the form of bags woven on coir looms eliminates the process of stitching the coir fabric into bags. The geo fabric woven in the form of bag is ready to use by onsite filling with sand or other filling materials available locally and is easily be used for the protection of banks of sea, river, canal, back water and mud wall reinforcement. The use of coir geo bags reduces the cost of heavy materials like rocks, concrete beams, logs and eliminates the drudgery of transportation of Coco-logs to the sites

Other diversifications in this category include development of coir cotton mix “Yoga Mats”, elegant coir jewellery, coir bags, footwear, jackets, binder-less coir composite boards, decorative coir polyester products, hygiene products like sanitary napkins and adult diapers using nanocellulose from coir-pith/fibres among others.

**Injection Moulded Chairs:** Another major product innovation is the development of



**Injection Moulded Chairs from Coir**

of injection moulded chairs from Coir and Poly Propylene. The Coir and Poly propylene were co-extruded with and without chemical modification. The extrusion was conducted at CIPET, Kochi. The chairs were injection moulded using the co extruded pellets. The environmental and cost reduction contribution of this technology is that the moulded chairs reduce the plastic consumption and cost by almost 25 percent and

reduce the carbon foot print. The Injection moulded Coir-PP chairs were launched by Hon. Union Minister for MSME, Shri Kalraj Mishra on 15.07.16 during the inauguration of IICF-2016 and exhibited in the theme pavilion of IICF-2016.

**Chess Board Coins from Coir:** The coir chess board and coins from coir composites were launched by Hon. Union Minister for MSME, Shri Kalraj Mishra on 15.07.16 during the inauguration of IICF-2016. The chess board and coins were exhibited in the theme pavilion of IICF-2016.



**Pantone shades in Coir**

**Pantone Shade Card; Pantone shades in Coir**

A shade card on Pantone shades in coir were developed. Since Pantone shades are accepted worldwide, in the recent past it is seen that there is requirement of pantone shades in the coir trade. The shades have now been developed in coir using the acid and direct dyes as per existing methods. The present shade card contains 96 random selected colours. The shade card can be used as a ready reference for shade matching in pantone shades. The shade card was launched by Hon. Union Minister for MSME, Shri Kalraj Mishra on 15.07.16 during the inauguration of IICF-2016.



**Injection Moulded Coir- PP Pots.:** Coir –Poly Propylene pots were developed as part of the collaborative project with CIPET, Cochin. The coir

and PP were co-extruded to get the pellets and the pellets were injection moulded to pots. The newly developed injection moulded pots were launched by Hon. Union Minister for MSME, Shri Kalraj Mishra on 15.07.16 during the inauguration of IICF-2016.

Other new products launched at the IICF 2016 were Yoga Mat made from Coir-silk, Coir Caps, coir folders & books made from coir handmade paper.

#### **(iv) Development of Environment Friendly Technologies: Major Achievements**

There has been major achievement in diffusion of technology involving effluent treatment using safe chemicals for pollution abatement in coir processing units. Krishi Mithra - A new innovative formulation developed by CCRI, intended especially for the cultivation of vegetables, is prepared by degrading coir pith using Pith-Plus (*Pleurotus sajor caju*), supplemented with Azolla & fish waste in place of urea, as nitrogen source. Comprehensive bio-composted coir pith named Krishi Mithra has been developed, by replacing urea with biological nitrogen supplements viz. Azolla, fish waste and Neem cake. NPK analyses were done and the results showed a better nutrient profile compared to the conventional C-POM.

**Technology Diffusion:** Field level demonstrations were carried out in different fiber extraction units in Kerala; Tamil Nadu & Assam to popularize the technology of Bio-chem treatment for quality improvement of coir fibre. Studies were also taken up by the institutes under review to develop a bioformulation of Bio-chem solution with addition of phenol degrading microflora for better improvement in coir fibre in terms of brightness, colour and softness

An eco-friendly technology using an edible mushroom spawn “Pith-Plus” & urea has been developed and patented (745/MAS/98 dated 6th April 1998). The technology has today been upgraded as “Coir Krishi-Mithra” which is without urea & uses only natural biological sources like fish waste, neem cake & Azolla for composting of coir pith in the year 2016.

**Development of Natural Dyes:** Coir is a natural eco-friendly material and was being dyed using synthetic colours which are derived from coal tar. Coir Board is extracting colours from natural plants like Pathimukham, Raktha-Chandanam, Kaduka, Henna, Turmeric, Tea and Coffee waste, Onion and Pomegranate peels and even from Coir Pith. These colours have been successfully used to dye coir in about 64 shades.



Diversified coir products such as jewelery, coir furnishing & apparel have been developed in CCRI as a part of studies for value addition of coir & by blending with other natural fibres viz. sisal, silk, banana fibre & jute.

**Coir for Paving of Roads:** With a view to popularize the use of coir geotextiles for strengthening the soft sub grade soil of rural roads and for evaluating the performance of coir geotextiles in the reinforcement of rural roads, Coir Board has implemented following collaborative research projects with, NIT, Trichy, College of Engineering Trivandrum and NIT Calicut in the states of Tamilnadu and Kerala. The roads were constructed under PMGSY scheme using coir geo textiles as the material for reinforcement and the performance of the roads was evaluated. Based on the performance evaluation reports of the technical agencies the accreditation from Indian Road Congress (IRC) for use of coir geotextiles in construction of roads has been renewed till 11.12.2017. From the field and laboratory experiments conducted on weak sub-grades with and without coir geotextile reinforcement, by NIT Trichy it is reported that reinforcement using coir geotextile is economically advantageous compared to required thicker sections and/or chemical/mechanical stabilization techniques. Compared to existing methods of stabilization which have practical difficulties in the field, the application of coir geotextiles is easier and more standardized. Action has already been in progress for inclusion of coir geotextiles in the manual of NRRDA and CPWD.

#### **(v) Technology Transfer, Incubation, Testing and Service Facilities: Major Achievements**

Various coir and coir products have been tested as per BIS/ASTM standards and issuing the test certificates as per the request from per the request from trade. The research institutes have

succeeded in providing the necessary technical support for the dyeing, shade matching and bleaching and the process related complaints as per the request from the industry.

The technology transfer on coir machinery in the year 2016-17 for example have been a total of six technology transfers of which there have been three technology transfers in the MFEM category followed by Anugraha loom in two categories and Vajra in one category.

Some details of the different technology transfers as well as incubation and development of new technologies for the betterment of the coir sector are mentioned below:

### Technology Transfer Programmes of CCRI and CICT under S & T Scheme

**Anugraha Tejas- Fully Automatic Power Loom for Geo Textiles:** CCRI has developed a



fully automatic power loom which can be used for production of more quantity of coir geo textiles which multiple designed in coir industry. In 2004 CCRI has developed a metallic pneumatic controlled handloom named Anugraha for weaving all the varieties of coir geo textiles but production was only 160 sq mtr in two shifts in a day. The newly developed fully automatic power

loom Anugraha Tejas. This upgraded version of Anugraha and can produce more than 800 sq mtr in 2 shifts in a day.

#### **Features:**

- *Output about 800sq mtrs in two shifts in a day.*
- *Cost Effective production*
- *Width of product is 1 meter and can be increased accordingly*
- *Different varieties can be produced*
- *Single person can operate – even a woman*
- *Produced fixed number of wefts per unit length which can be predetermined by a ratchet mechanism provided in the loom*

- *Low cost machine Approximate Rs-9 Lacs*
- *Winding carried out without stopping the weaving operation by ratchet mechanism.*

**Mobile De-fibering Machine ‘Nano’:** Husk collection is the major issue for the coir industry, utilization of husk is not being done of coir husk as expected. To minimize the husk collection process CCRI earlier developed Mobile Fibre Extraction Machine (MFEM). In year 2016 CCRI modified the MFEM and developed Mobile Defibering Machine ‘Nano’.

***Features***

- *No shade required*
- *Requires 3HP energy*
- *Length of fiber is good quality is obtained without breakage*
- *Machine weight is around 100kg only*
- *Dimension 100cm X 60 cm*
- *Low cost – Rs 75000/-*
- *Output 600 husk/per hour*
- *Save transportation charge of husk and efforts*
- *Can be transported by 2 persons*
- *Generate more working days in Rural areas*
- *Beneficial for micro and household units*
- *Less than 1000 ltrs water and noise is reduced in decibel range.*



**Coir Polyester Mouldings and Composites:**

A composite is a compound between a polymer (such as polyester or PP) and a fibrous material (such as glass, carbon or natural fibres). Composite products have good mechanical properties per unit weight, are durable and their technologies allow the manufacture of complex and large shapes. It is clear that composite technologies allow the

producer to add much more value to his product than the processing and trading of raw material. Discussions with the authorities revealed that polyester mouldings have been tested for their substitution value for different polymer products and are a positive step in sustainable production technology and practices. Composite articles can be manufactured from polyester and coir fibre/pith. The so produced composites are of high strength, water resistance, durability and transparency. The coir reinforcement should be dried properly before composite manufacturing.

Thermoset polyesters, such as those used in compression molding, are formed from linear, unsaturated, thermoplastic polyesters which are crosslinked during a cure reaction.

### Steps involved in the Production of Coir Polyester Composites.



1. Apply release agent to the mould and allow drying.



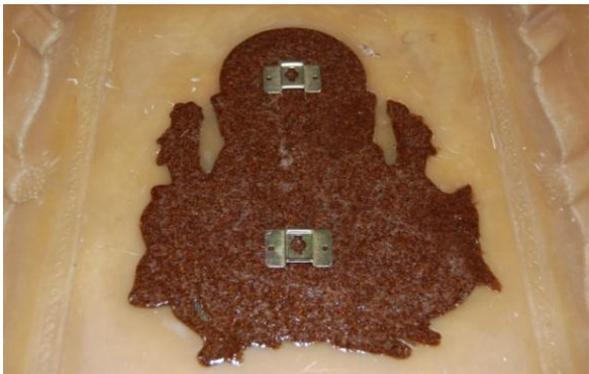
2. Mix the resin with cross linking catalyst and accelerator.



3. Add coir fibre/Pith to the resin and mix well.



4. Pour the mix in to the dye.



5. The mix is allowed to set.



6. Eject the product from the die.

- The technology requires less investment
- A lady entrepreneur can operate the process without skilled labour
- No heavy equipment or even electricity is required here

## **(vi) Incentive for using Natural Dyes and IPR in Coir Sector: Major Achievements**

Coir is a natural product and majorly, the extracted coir is also a natural product. However, in order to make various products from coir, there is association of different chemicals and mechanical processes, which becomes essential in the course of things. All the same, it is the endeavor of the research institutes to retain the eco-friendly nature of the sector that is an USP and therefore it is one of the focus of the S&T programme to promote the use of natural dyes and conduct original research to find natural alternatives to chemical dyes used in making coir products.

The research institutes (CCRI & CICT) have conducted some original research in this area during the plan period 2012-17. Some of their achievements are mentioned in detail below.

**Natural Dye Extraction Plan:** A Natural Dye Extraction Plan has been set up in Central Coir Research Institute (CCRI) in collaboration with IIT, New Delhi. The plant has yet to be fully operationalized and the process for the same is underway following which it is proposed to extract natural dyes from vegetable sources such as Henna, Turmeric, Walnut, Red sandal in bulk and apply the same to coir and coir products. The entrepreneurs who will be coming forward to avail the facilities of CCRI and manufacture naturally dyed coir products will be provided incentives from Coir Board and assistance will be extended to them from CCRI for securing IPR in coir sector. Accordingly, one advertisement was released through leading dailies and the Board's website to invite applications from coir entrepreneurs for availing the incentive. However, no response was received even after extending the period to January 2017. Notwithstanding the response, it is proposed to generate awareness on the economic benefits of production of naturally dyed coir products which will achieve the objectives as envisaged, and continue with the same.

**Coir-Krishi Mithra:** Coir Krishi Mithra is a technologically developed processed product providing solutions towards developing an Ecofriendly technology for value addition of coir pith by converting it into comprehensive bio-composted coir pith using Pith-Plus supplemented with Azolla, fish waste and Neem cake. This is named as "Coir-Krishi Mithra" and is used for Agri /Horti/ Floriculture applications. In this, NPK analyses were done on the same and the results

showed a better nutrient profile compared to the conventional C-POM. The technology of Coir Krishi Mithra has been standardized and demonstration of the same is continuing in all coconut growing states through demonstrations. The product developed by CCRI, intended especially for the cultivation of vegetables was launched in the Mega event, IICF-2016.

**Fibre Magic Treatment:** It is a pollution free method for development of qualitatively superior pollution free fibre with a pollution free method of quality improvement of Coir fibre (Green husk fibre & Dry husk fibre). This whole process and involved technology is known as fibre magic treatment. It is further developed through continuous research and is being popularized in all coconut growing states. The technology was also demonstrated to Central/State Ministers/VIP's / Coir Exporters/ Coir entrepreneurs. A total qty of 839 Litres of Biochem has been produced for the treatment of 83.9 MT coir fibres for quality improvement of the same.

**Coco-Lawn:** Coco-Lawn (viz. COCOLAWN<sup>TM</sup>) is an ecofriendly technology of ready-to-use lawn developed by the research institutes. The lawn is encased in a composite comprising a single or multiple layers of non-woven coir fabric embedded in coir netting. A layer of coir pith is placed on the non-woven layer/s. Grass slips are planted on the coir pith bed so made and C-POM is sprinkled thereon to form a thin layer. It is easy to shift the material from one place to another and can be rolled upon for transportation and is made available in the form of blankets.

### **Conclusion:**

The offtake of funds in the plan period 2012-17 has been fifty percent or less due to delay in processing requirements for release of funds. One of the prominent reasons for the delay and resultant stagnancy is the absence of key staff for such work due to vacant research positions in the research institutes due to which fresh research proposals could not be initiated for implementation. In fact, except for product diversification and technology transfer related research funds, the other areas of research like modernization of production process, development of coir machinery and equipment and development of environment friendly technologies could access less than forty percent of the funds earmarked for them. The funds earmarked for providing incentives for using natural dyes and for IPR in coir sector were not utilized at all. So, the overall average percentage of utilization of funds is less than 30 percent.

Regarding the major achievements under each project head, the research institutes carried on their work on improving upon the technologies and products already developed in earlier years and in the process, improvised the products to make it more attuned to the end-users' requirements as discussed above.

So, in conclusion it can be said that though the planned quantifiable targets under each project heads could not be achieved during the plan period, yet good progress was witnessed in improvising on technologies to increase their utility for the industry and consumers.

## **CHAPTER -4: IMPACT OF TECHNOLOGIES DEVELOPED**

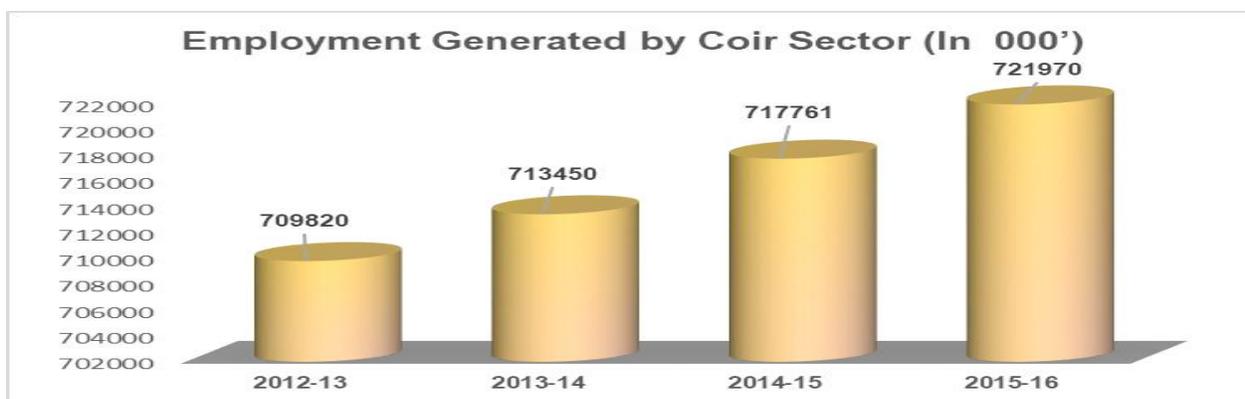
### **4.1 Impact of Technologies Developed, on Coir Industry Workers, Operations and Output**

Coir sector plays a vital role in employment generation and economic development of the country due to its diverse and dynamic nature as it involves households, co-operatives, NGOs, manufacturers and exporters in different stages of its value chain and also provides different varieties for domestic use and exports market. The private coir manufacturers are the major contributors to the exports of coir and coir products. Suffice it to say that the coir industry is a big employer of people at different stages of its processing, value addition, marketing and distribution as raw material, finished products and product derivatives. Some of the prominent aspects of the coir industry in the employment generation, providing social justice and rural employment generation are mentioned below:

- *It is estimated that the industry employs about seven lakhs of coir workers.*
- *Majority of coir workers are from rural areas belonging to economically weaker sections of the society.*
- *Women constitute more than seventy percent of the work force in the industry.*

The table below, mentions the data related to the number of employment opportunities generated by the coir sector in the five-year plan period (2012-17) under review:

#### **Figure: 4.1 Employment generated by coir sector**



**Table: 4.1 Employment generated by coir sector**

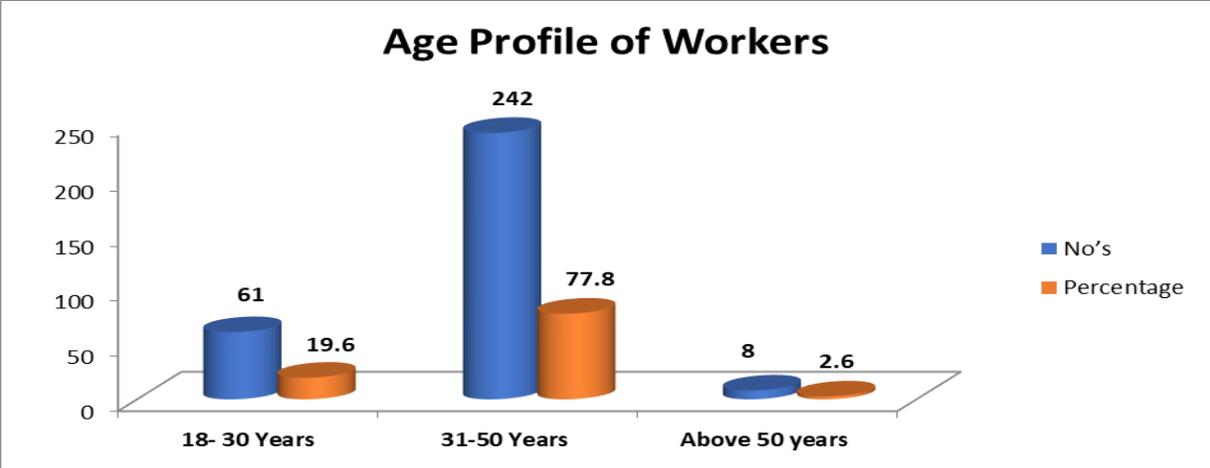
Financial Year (2012-17)	Employment Generated (In 000')
2012-13	709820
2013-14	713450
2014-15	717761
2015-16	721970

*Source: Coir Board*

The above table and chart show that employment generation levels have been steady during the plan period with sequential marginal increase in employment generation YoY in comparative terms but noticeable in absolute terms.

The study as part of its evaluation exercise, conducted a survey of a sample of workers to understand the impact of S&T schemes and programmes on their work environment, process, output and other aspects including scope for further employment opportunities. The details of the survey exercise are mentioned in the succeeding tables and charts.

**Figure: 4.2 Profile of the Workers Surveyed**

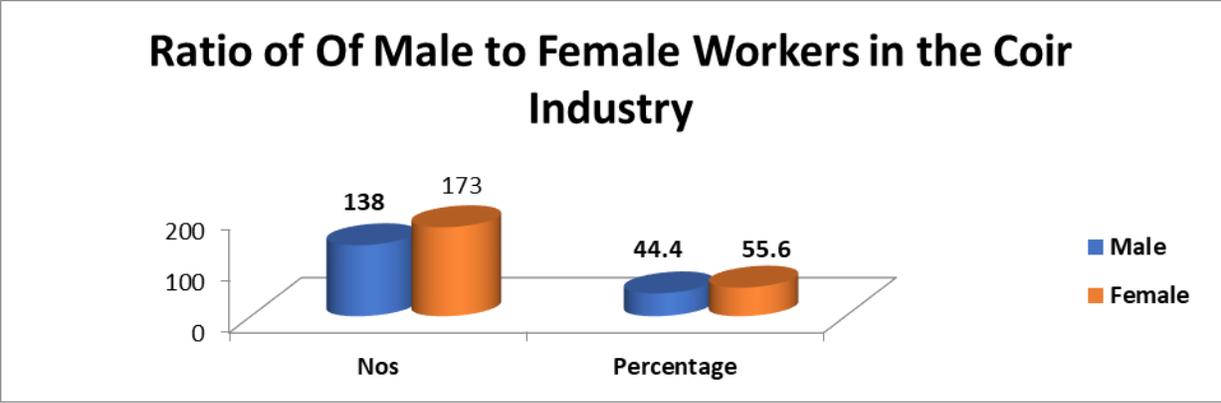


**Table: 4.2 Profile of the Workers Surveyed**

Age Group	No's	Percentage
18- 30 Years	61	19.6
31-50 Years	242	77.8
Above 50 years	8	2.6
<b>Total</b>	<b>311</b>	<b>100</b>

The responses from the sample group revealed that in the present context and during the plan period under review, the highest percentage of workers in the coir industry are from the age group of 31-50 years (77.8%) followed in a distant second, by the age group 18-30 years (19.6%). Though the percentage is high in the case of the younger age group, yet the range is also correspondingly high i.e. between 31-50 years. And the percentage in 18-30 years is also comparatively low. Yet, if it is assumed that there must be at least ten to fifteen percent sample in the age group between 31-36 years from the sample group 31-50 years, the it can be safely assumed that the percentage of workers in the age group 18 to 35 years is around 22 to 24 percent of the total workforce in the coir industry.

**Figure 4.3: Gender Representation in Workforce**



**Table 4.3: Gender Representation in Workforce**

What is the Male to Female Ratio of Of Workers in the Coir Industry	Nos	Percentage
Male	138	44.4
Female	173	55.6
<b>Total</b>	<b>311</b>	<b>100</b>

The ratio of male to female workers in the coir industry is 5.5:4.4 or 6:4., because the percentage of total male to female workers in the sample group comes to 55.6 percent and 44.4 percent. The main reason for the high percentage of female workers in the coir industry is the role of technology in reducing the drudgery and human force required to run machineries in the coir industry by introduction of new production methods and machines with better technology. Another factor that can be responsible for the almost equal percentage of male and female workers in the coir industry is that such industries are located to the areas of production and are within close distance of native places of the workers, which encourages women to take up employment in such industries. Also, a large amount of the coir extraction work is within the precincts of family enterprise, which also makes the womenfolk participate in the activity.

**Figure 4.4: Worker Experience in Coir Industry**

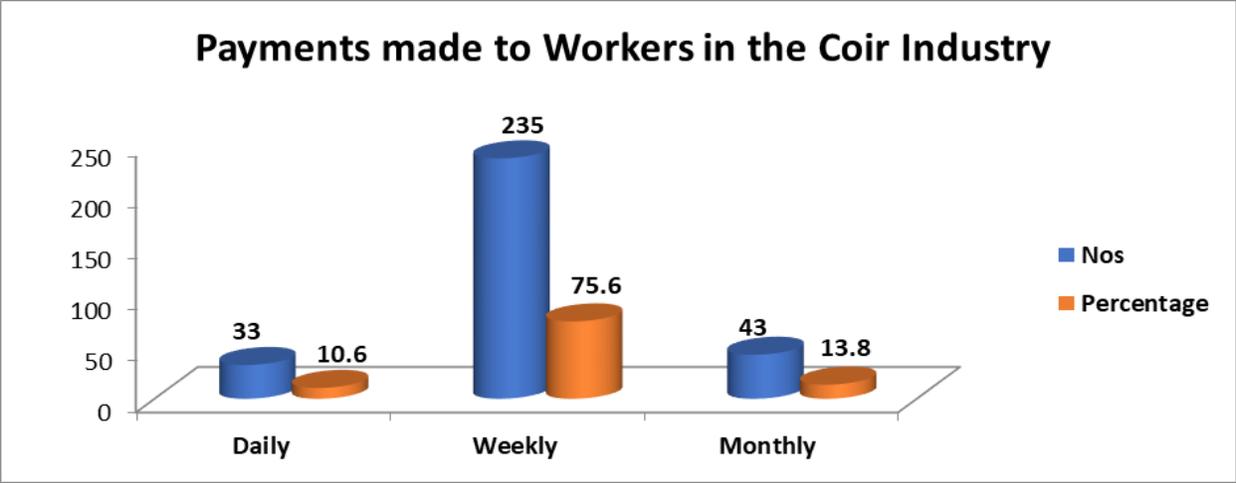


**Table 4.4: Worker Experience in Coir Industry**

What is the Overall Experience of Workers in the Coir Industry?	Nos	Percentage
Below 2 years	34	10.9
2-5 years	165	53.0
6-10 years	82	26.4
Above 10 years	30	9.7
<b>Total</b>	<b>311</b>	<b>100</b>

The response of the sample group reveals that almost 80 percent of the total workforce in the coir industry have an experience between two to then years with the major chunk i.e. around 53 percent having experience of between two to five years followed by 26.4 percent of them having an experience of between six to ten years. However, it is to be noted that the percentage of workers having experience below two years is 10.9 percent whereas the percentage of workers having experience of over ten years is around 9.7 percent, which means that the infusion of new workforce is almost same or slightly higher than the percentage of workforce who are growing in experience. This means that the rate of infusion of young generation members of the society in the coir sector is at a comparatively healthy percentage.

**Figure 4.5: Payment to Workers in Coir Industry**

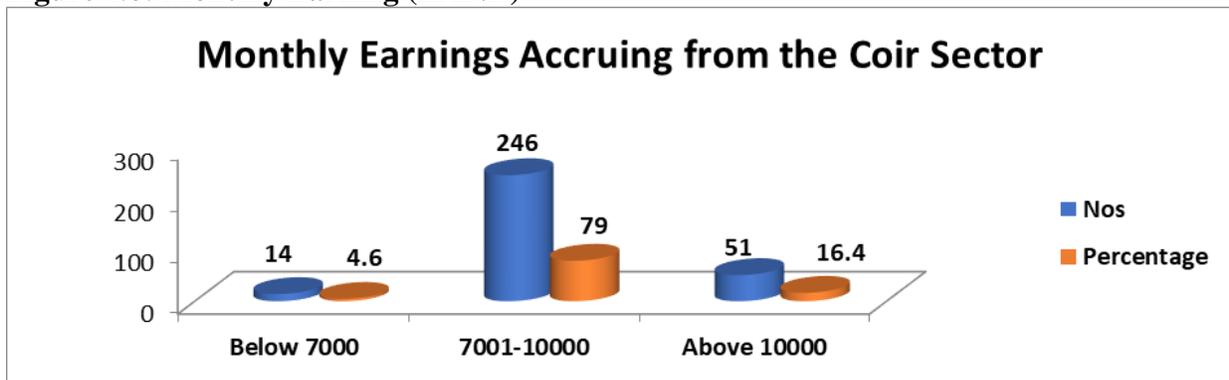


**Table 4.5: Payment to Workers in Coir Industry**

How are Payments made to Workers in the Coir Industry	Nos	Percentage
Daily	33	10.6
Weekly	235	75.6
Monthly	43	13.8
<b>Total</b>	<b>311</b>	<b>100</b>

Information received from the sample group show that majority of the enterprises in the coir sectors pay their workers on a weekly basis (75.6%) followed by monthly payments (13.8%). Only 10.6 percent of the workers said that they are paid daily wages. This means that the industries and organizations employing the workers have adequate work schedules with continuous and long-term strategies due to which they keep the workers engaged week on week basis. This augurs well for the coir industry It is also a testimony to the fact that the introduction of new technologies has helped the industry employ more workers as well as induce interest in the workers to work in the coir industry

**Figure 4.6: Monthly Earning (in INR)**

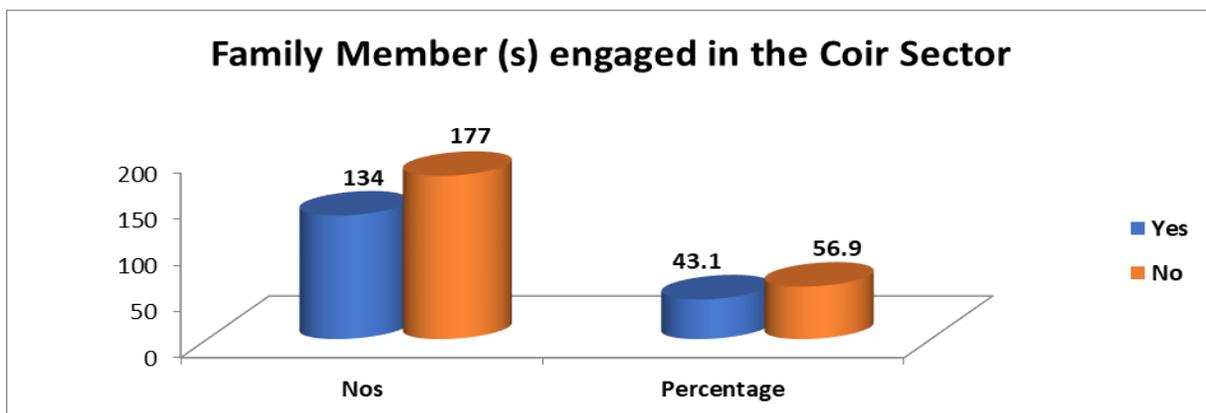


**Table 4.6: Monthly Earning (in INR)**

What is the Monthly Earnings Accruing from the Coir Sector?	Nos	Percentage
Below 7000	14	4.6
7001-10000	246	79.0
Above 10000	51	16.4
<b>Total</b>	<b>311</b>	<b>100</b>

Majority of the workers are paid a salary of between INR 7000/- to INR 10,000/- (79%) and around 16.4 percent of the worker are paid salaries above 10,000/- as the findings of the study revealed. Only 4.6 percent of the workers are paid a salary below INR 7000/-. So, if it is to be analyzed as to whether technology has increased or decreased the workers' wages, then the inputs reveal that though human intervention in running the machines has decreased with the introduction of new techniques by way of S&T interventions, yet, due to growth in output, the overall business income has increased and so the per capita wages of the workers. This is a positive outcome of technological intervention by the research institutes.

**Figure 4.7: Family members engaged in the coir sector**

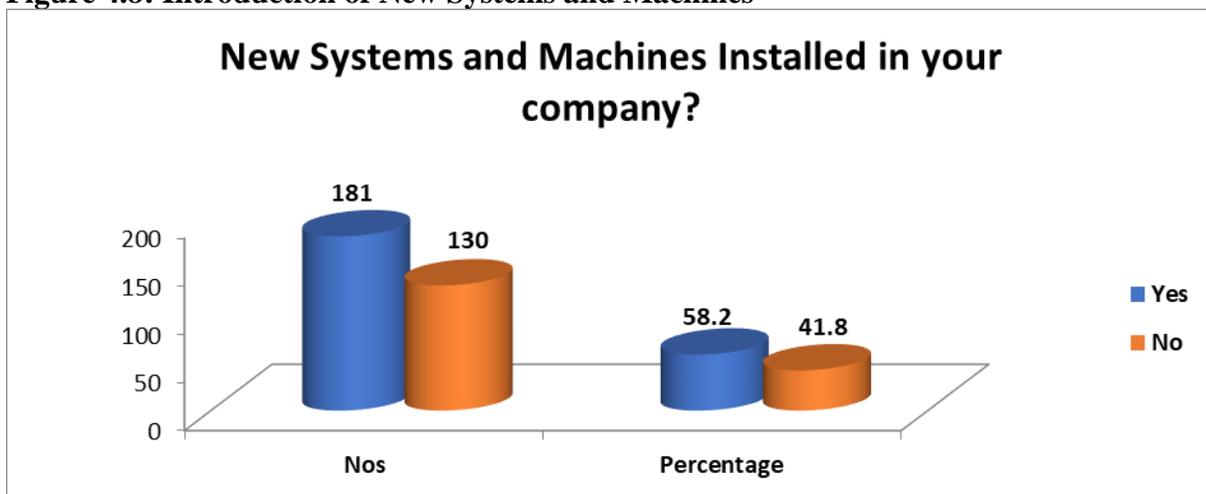


**Table 4.7: Family Members engaged in Coir Sector**

Are any Family Member (s) engaged in the Coir Sector?	Nos	Percentage
Yes	134	43.1
No	177	56.9
<b>Total</b>	<b>311</b>	<b>100</b>

Peer encouragement to enter the coir sector industries is lesser than expected as less than half of the sample group (43.1%) said that they encourage their family members to enter the coir sector. This can have two outcomes. The first outcome is that the workers may have higher ambitions for their children due to which they don't want them to enter the coir sector. And the second outcome stems from the first outcome i.e. the coir sector is still to generate high end jobs to attract the talented younger individuals or at least create a cadre of white collar employees. However, seen from another angle, if half the coir workers are able to attract their family members in their work it means that the sector also needs immediate manpower requirement and family members chip in. And with labor rates being high, family members are the most affordable source for this labour intensive industry. So, even though the industry does not have an educated professional workforce setup, yet the immediate nature of requirements do goad family members to chip in, which is why the family members induction to the industry is more than forty percent.

**Figure 4.8: Introduction of New Systems and Machines**

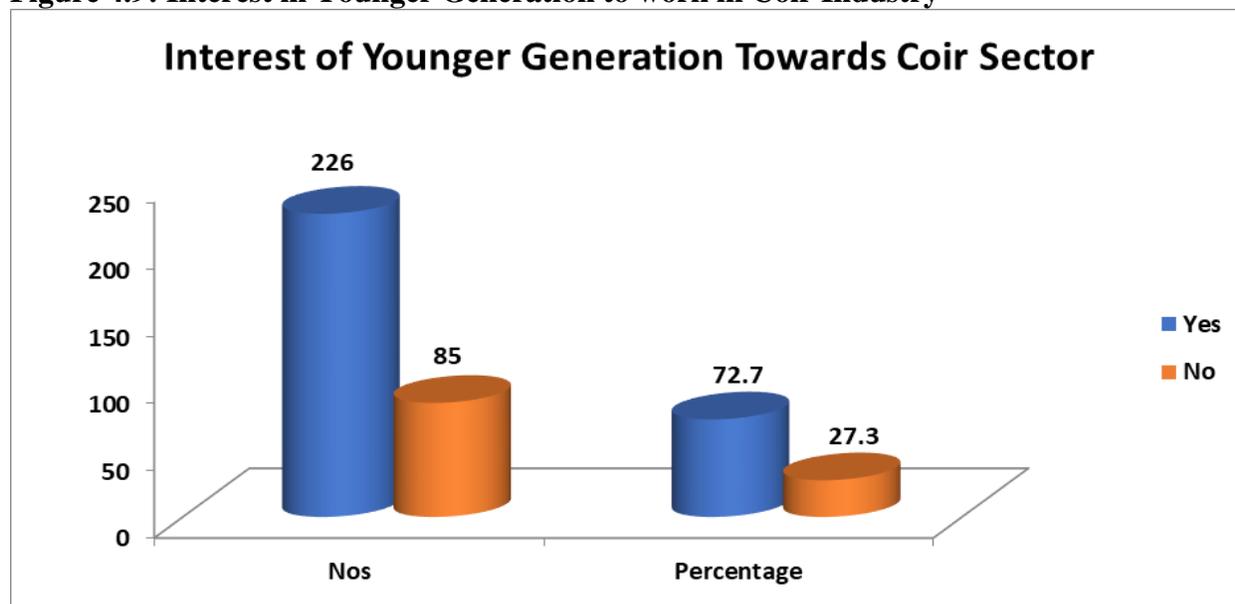


**Table 4.8: Introduction of New Systems and Machines**

Has New Systems and Machines been Introduced or Installed in your company?	Nos	Percentage
Yes	181	58.2
No	130	41.8
<b>Total</b>	<b>311</b>	<b>100</b>

The overall response (58.2%) from the sample group conveys that there has been installations of new systems and machineries in the institutions that the sample group works and come from. This is an indication that there is some diffusion of technology and processes developed by the research institutes to the market. However, it is to be seen whether these technologies have benefitted the workers in their operations and in reducing drudgery and have been a pull factor for the new generation to enter the coir sector industries for employment and career options. If the response is analyzed with the percentage of family members getting inducted into the industry (43.1%), then it shows that the first people to be influenced and benefitted from introduction of technology, are the family members and workers having close association with the coir units.

**Figure 4.9: Interest in Younger Generation to work in Coir Industry**



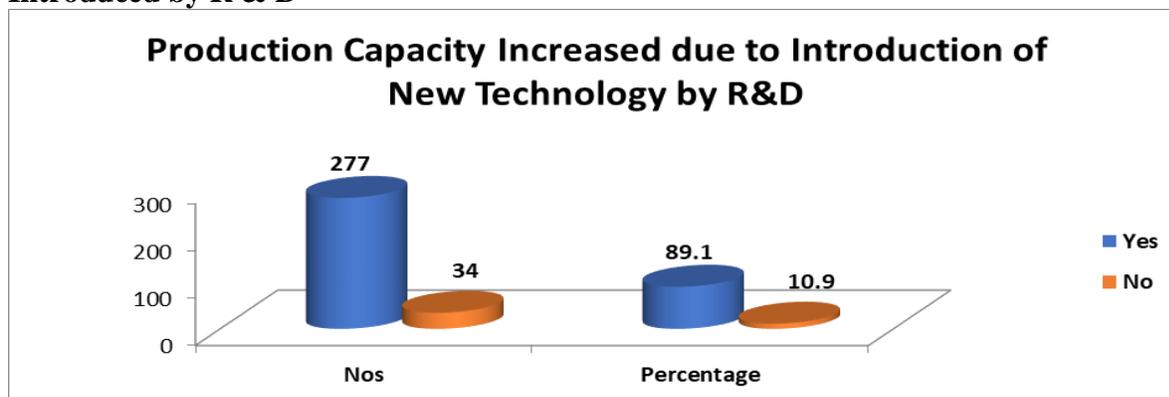
**Table 4.9: Interest in Younger Generation to work in Coir Industry**

Is There a Growing Interest in Younger Generation to Work in Coir Industry due to R&D Efforts in	Nos	Percentage
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<b>Introducing New Technology?</b>		
Yes	226	72.7
No	85	27.3
<b>Total</b>	<b>311</b>	<b>100</b>

Reports and responses from the sample group indicate that there is a growing interest in the younger generation to work in the coir sector and also there is a fair amount of representation of this generation in the sample group as the response to this question (72.7%) indicates. It is a fact that the coir sector is gradually and surely increasing its technological advancement process and the processes are getting mechanized to reduce drudgery, improve efficiency and introduce innovative products to increase the product and utility base of the coir sector. Also, due to new technology, the volume and quality of production and output has increased thereby generating the interest of the younger generation in getting associated with the coir sector.

**Figure 4.10: Increased Production on Coir Industry Due to New Technology / Process Introduced by R & D**



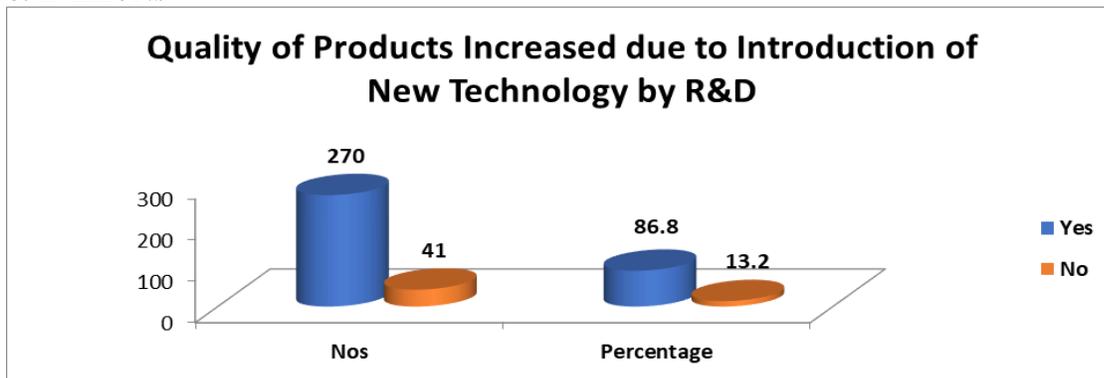
**Table 4.10: Increased Production on Coir Industry Due to New Technology / Process Introduced by R & D**

<b>Has Production Capacity Increased due to Introduction of New Technology by R&amp;D</b>	<b>Nos</b>	<b>Percentage</b>
Yes	277	89.1
No	34	10.9
<b>Total</b>	<b>311</b>	<b>100</b>

There has been increase in production capacity due to introduction of new technologies and processes. The responses of the sample group (89.1%) ratify this fact and this is certainly a positive outcome of the schemes and programmes implemented as part of science and technology intervention programmes in the plane period 2012-17. However, it is to be seen as to

whether there has only been an increase in volumes of production as compared to the previous situation or there has also been an improvement in product quality and aesthetics with corresponding increase in production volumes.

**Figure 4.11: Increase in Product Quality Due to New Technology / Process Developed by R & D Efforts**

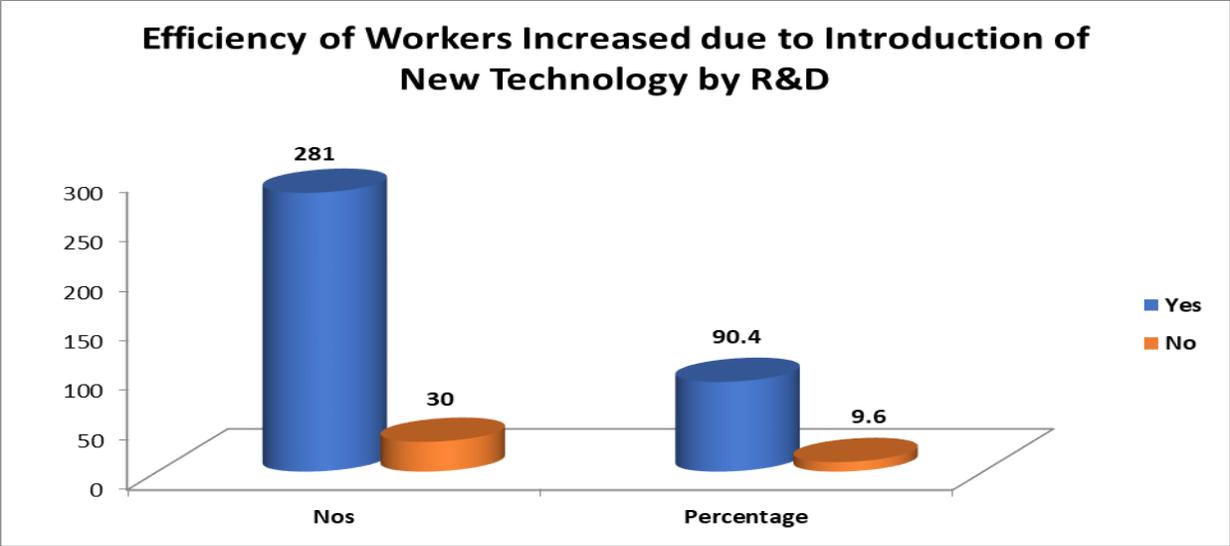


**Table 4.11: Increase in Product Quality Due to New Technology / Process Developed by R & D Efforts**

Has Quality of Products Increased due to Introduction of New Technology by R&D	Nos	Percentage
Yes	270	86.8
No	41	13.2
<b>Total</b>	<b>311</b>	<b>100</b>

The responses of the sample group (86.8%) show that there has been an almost corresponding increase in quality of products produced with new technology along with increase in volume of production. This means that there has been an overall increase in quality products bouquet in the coir sector due to intervention of science and technology applications in the coir sector spearheaded by Coir Board institutes. This is an indication that the efficiency in production process and quality has improved and there are lesser hiccups and delays in the production schedule. Overall it is a good indication of the contribution of the programmes in the coir industry. However, efficiency also includes other aspects of the industry including the processes that support the production processes, reduces the drudgery and increases the pace of handling work in order to increase per capita output of workers. This is important because it will lead to a corresponding increase in income of the workers in the coir sector units.

**Figure 4.12: Increase in Efficiency of Workers Due New Technology/Process Developed by R & D Efforts**

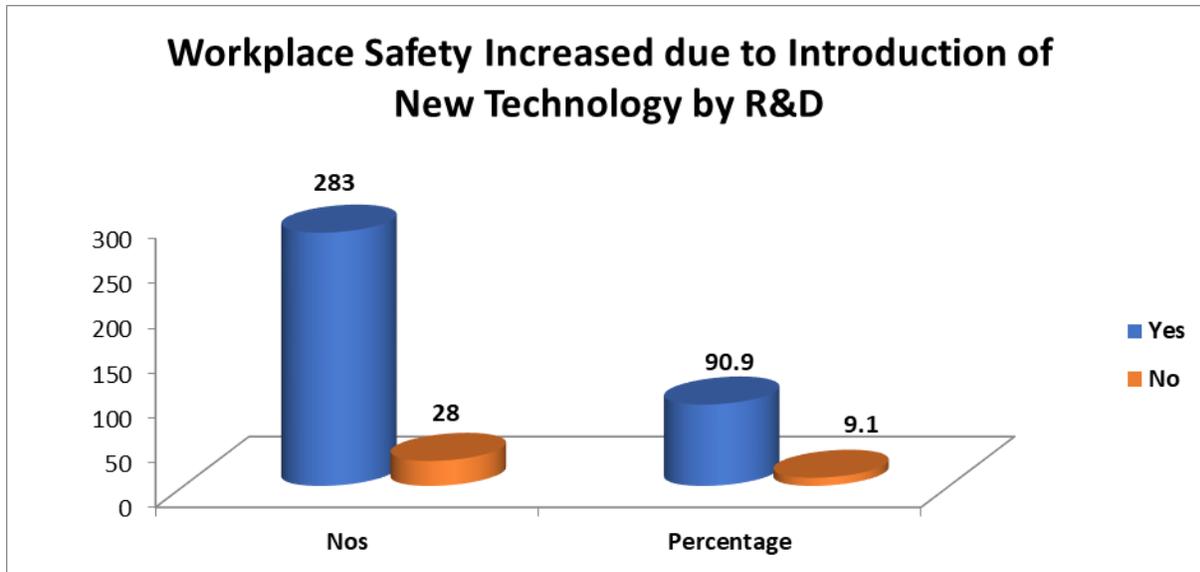


**Table 4.12: Increase in Efficiency of Workers Due New Technology/Process Developed by R & D Efforts**

Has Efficiency of Workers Increased due to Introduction of New Technology by R&D	Nos	Percentage
Yes	281	90.4
No	30	9.6
<b>Total</b>	<b>311</b>	<b>100</b>

Information and responses from the sample group reveal that the extraction of coir fibre from husk is made easier as a result of the technology developed by the institute. This is because an overwhelming 90.4 percent of the workers surveyed said that the installation of new system and technologies has led to increased efficiency in husk extraction. The drudgery in spinning of coir fibres can be reduced by the technologies such as fibre magic, vegetable oil treatment and bio-chemical treatment etc. The design and development of various looms can reduce the drudgery and improve the work atmosphere and could improve the productivity as the responses of the workers from the survey revealed. But has efficiency compromised on safety of workers? In other words, are the new technologies compromising on safety aspects of the handlers of the new processes and technologies i.e. the workers; in their zeal to improve efficiency and quality of products?

**Figure 4.13: Increase in Workplace Safety Due to New Technology/Process Developed by R & D**



**Table 4.12: Increase in Workplace Safety Due to New Technology/Process Developed by R & D**

<b>Has Workplace Safety Increased due to Introduction of New Technology by R&amp;D</b>	<b>Nos</b>	<b>Percentage</b>
Yes	283	90.9
No	28	9.1
<b>Total</b>	<b>311</b>	<b>100</b>

The responses of the workers in the sample group (90.9%) show that the aspects of the new technologies have adequate provisions of workplace safety and are perfectly safe in their application. This may be one of the many positive aspects of the new technologies that has attracted the workers to the coir sector units.

#### **Conclusion:**

The responses from the sample group of workers show that the new technologies developed by the research institutes have helped increase the productivity of the workers by reducing drudgery and increasing the ease of operations, output of products and increase the safety levels at workplace. However, the technologies developed have managed to only provide solutions to the existing problems of the workers at the workplace. They have not helped the worker to gain expertise in product development or skill upgradation, or provided a comprehensive and technologically advanced process and system that will improve the profile of the workforce and help them graduate from their present level. The worker still today is that of people having familial connections with the coir sector and with low educational levels, both men and

womenfolk. It is still an industry having two levels of stakeholders i.e. entrepreneurs, who many a times double up as managers, and the workers. There is no institutionalized managerial team, both technical and marketing cadre, which the R&D through its S&T intervention could have helped in creating, by institutionalizing the process by introducing new technologies and systems.

### **4.3 Diffusion of Technology Developed by Research Institutes and Export Performance**

Technological up-gradation takes place in various spheres as a part of the 'modernization' process. Like any other change, while cost consideration is the prime movers of such a change, the workers who depended on an earlier technology is likely to fall victims to the change.

The Task Force constituted by the government submitted the report in June 1990. The report emphasized on the importance of modernization of this industry. On the basis of the recommendations of the special task force, the National Co-operative Development Corporation (NCDC), Central Government and State Government, initiated a Joint Coir Developmental Plan. The Development plan aimed at increasing productivity, wages and value addition, assuring steady employment, and reducing backwater pollution due to retting. It envisaged technological reorganization of retting and defibering, the two important stages in the coir yam production.

Modernization and technology up gradation, encouragement to private investment, better utilization of husks and Coir pith, adopting scientific methods for collection of husks, focus on Coir geo textiles Coir composite boards along with identification of demand of the market will be the major thrust areas for the improved quality of life for the people depended on Coir industry.

Continuous efforts are being done by CCRI and CICT in the development and transferring technology to the machine manufactures as well as manufactures of coir industries. A list of the technology takers from the two research institutes during the plan period are mentioned bellow:

#### **List of Technology Takers from CCRI and CICT**

<b>Sl. No.</b>	<b>Name of Technology</b>	
<b>1.</b>	<b>Pith-Plus</b>	
	1	Cadila Pharmaceuticals, Ahmadabad
	2	M/s. Alghanim Sons Group General Trading and Contracting Co., Kuwait.
	3	M/s. Charankattu Coir Mfg. Ltd., Cherthala
	4	K.N. Bio Sciences (India) Pvt. Ltd. Hyderabad
	5	S. Prabhu, Coimbatore, Tamil Nadu (2014)

	6	Bio Gardener, Pollachi, Tamil Nadu (2014)
	7	M/s. Sambhu Coir Works, Neyyattinkara
<b>2.</b>	<b>Cocolawn<sup>TM</sup></b>	
	1	Cadila Pharmaceuticals, Ahmadabad (2002)
	2	M/s. Dee Estate & Properties, Rajaji Nagar, Bangalore (2005)
	3	M/s. Madh Mac Real Estate, Sharjah (2007)
	4	M/s. Charankattu Coir Mfg. Ltd., Cherthala (2007)
	5	M/s. Sevashram, Thrissur (2008)
	6	Shri.S.Prabhu, Coimbatore, TN (2014)
<b>3.</b>	<b>'Anugraha' Metallic Handloom</b>	
	1	M/s. Ananteswar Engg. Works, Coir Manufacturer, Orissa.
	2	Sukumar Engg. Exports, Erode
	3	Khanikar Fabrication, Guwahati
	4	Accurate CNC Tool Room, Bangalore
	5	Soorya Ravi, Bangalore
	6	Soorya Engg. Works, Bangalore, Karnataka
	7	Coiracwell Engineering Works, Pollachi.
	8	M/s. A One Green Energy, Regd. Office, Meenakshi Heights, Vihar Chowk, Hadapsar, Pune-4121 028
		Dr. Anand Krishna. P., IIT, Jodhpur, Rajasthan
	9	Kerala State Coir Machinery Manufacturing Co., Alappuzha
	10	M/s. C.M. Industries, Nazareth West, Kochi-682 002.
<b>4.</b>	<b>Coir Composites</b>	
	1	M/s. Jiten Plywood Industries, Tumkur, Karnataka
	2	M/s. Venkateswara Fibre Udyog, Bangalore
	3	M/s. 2M Engineers, Bangalore
	4	M/s. Universal Electro Hydraulics, Bangalore
	5	M/s. Karnataka State Coir Development Corporation Ltd., Bangalore
	6	Mr. Ajay Jain, National Handmade Industries, Haryana
	7	Tengina Narina Kushala Kaigarika Sahakara Sanga Ltd., Karnataka
	8	Karnataka State Coir Development Corporation, Channapatna Coir Cluster, Karnataka
	9	Foam Mattings India Pvt. Ltd., Alleppey, Kerala
	10	Indian Coir Products Cluster(Erode)Pvt. Ltd., 150, Palanipuram Bhavani, Tamil Nadu
	11	M/s Gain Corporation, Mumbai
	17	M/s Adhiamman Coir pvt ltd, Pollachi
	18	M/s Mahadeswara Plywood and coir products, Channapatna
	19	M/s Sangameswara Enterprises, Belagaum
	20	M/s CIPL Resurge Pvt ltd, Bangalore
	21	M/s Value Ventures and services, Mysore
	22	M/s Nirantara Scientific Solutions pvt ltd, Bangalore
<b>5.</b>	<b>Anupam loom</b>	
	1	National Coir Research & Management Institute, Govt. of Kerala
	2	S.Rajarithinam, M/s.Vanangamudi Industries, 66/21, Old Hospital Road, Arantangi, Pudukkottai – 614 616
	3	M/s.Accurate CNC Tool Room, Plot No.388, 10 <sup>th</sup> Cross 3 <sup>rd</sup> Main, 4 <sup>th</sup> phase Peenya Industrial Area, Bangalore -560 058
	4	M/s. Karnataka State Coir Development Corporation, Bangalore
	5	Monarch Engineers, Kochi

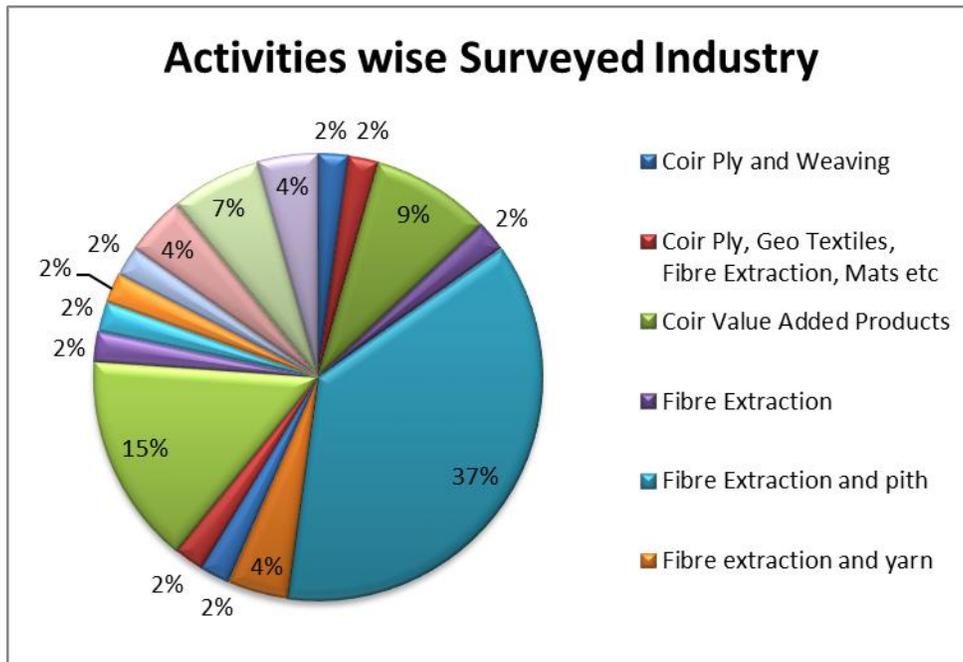
	6	Alleppey Coir Cluster Development Society, Alleppey
	7	Suniti Computers & Telecom, Tripura
	8	M/s. Suresh Engineering Works, Kochi-16
	9	M/s. Ananteswar Engineering Works, Sakhigopal, Puri Dist.
	10	M/s. Metal Forms, Pallakkad, Kerala
	11	Kerala State Coir Machinery Manufacturing Co., Alappuzha, Kerala
	12	M/s. C.M. Industries, Nazareth West, Kochi-682 002.
<b>6.</b>	<b>Mobile Fibre Extraction Machine</b>	
	1	Karnataka State Coir Development Corporation, Bangalore
	2	M/s. Sunity Computers & Telecom, Tripura
	3	M/s, Mangalore Engineers & Consultants, Mangalore
	4	M/s. Monarch Engineers, CCXVII/1737 – B, Mundamveli. P.O, Kochi – 682 507. Ph.: 0484 – 2232529
	5	Kerala Automobiles Limited, Aralumood. P.O, Neyyattinkara, Trivandrum. Ph.No.0471 – 2229131, 0471 – 2490146
	6	M/s.Green World Coir Exports, 1/335, Rose street, Fort Kochi – 682001.
	7	M/s. Mat India Trade Company, Thannermukkam. P.O, Cherthala.
	8	M/s. Orissa Agro Machinery, AT RCMS Campus, P.O, Sakhi Gopal, Puri, Orissa.
	9	Shri. Swapna Ghosh, M/s.Coir Village, 41, Mukherjee Para Lane, 3 <sup>rd</sup> floor, Flat.No.301., Serampore, Hoogly, West Bengal
	10	Shri. Sivasubrahmanian, 14-65, Manian Vilai, South Soorankudy. P.O, Kanyakumari, Tamil Nadu – 629501, Ph.8903452837
	11	Shri. Durai Arasan, M/s.Sri Neelakandan Engineering Works, D.No.335 A, Pallivasal Building, Thanjavoor, Tamil Nadu – 61.
	12	M/s. Sri Durga Industries, No.49 <sup>th</sup> Cross, Rajagopal Nager Main Road, Ganapathy Nagar, 4 <sup>th</sup> phase, Peenya, Bengaluru – 560 058.
	13	Shri. Sanjay Kumar Yadav, M/s. Kitaab Traders, 12 VN, RGT Road, Near LG Service Centre, Port Blair, Andaman Nicobar
	14	Shri. Sevji Agro Processing and Service Pvt. Ltd, 1 <sup>st</sup> Floor, Jayanta Commercial Centre, Panchavati, GNB Road, Guwahati – 781003.
	15	M/s. Allied Engineers, Soheli Nivas, Chatribari Road, Guwahati – 781 001.
	16	M/s. Sukumar Engg Exports, 168 A, Kangeyam Main Road, Velliyankiri Pudur, Arachalur. P.O, Erode, Tamil Nadu.
	17	Shri. K. M. Krishna, Director, Saravana Fibre Pvt. Ltd, R.S.No.385/3, Jonnada – 542942
	18	Shri. A.S. Madhusudan, Partner, M/s.2 M Engineers, D – 427, 10 <sup>th</sup> Main, Iind stage, Peenya Industrial Area, Bengaluru.
	19	M/s.Sri Ram Machine Works, Kondarasam Palayam, Dharapuram, Tiruppur, Tamil Nadu.
	20	M/s. Accurate CNC Tools, Plot No.388, 10 <sup>th</sup> cross, 3 <sup>rd</sup> main, 4 <sup>th</sup> phase, Peenya Industrial Area, Bengaluru.
	21	M/s. Southern Metal Crafts, Thiruvampadi, Alappuzha.
	22	M/s.New India Agro Industries, Industrial estate, Kuttamperoor.P.O, Mannar, Alappuzha – 689 623. Ph.No.0485 – 2830008 9846503823
	23	Shri. K.S. Shoukkath, Madathil House, Mannarkadu, Palakkad
	24	M/s. Bharath Engineering Works, Fabricators & machinery manufacturers, Unit of Laxmi Saw mills, Syed Arif, Gandinagar, Karnataka
	25	Shri. S.K. Gowthaman, M/s.Sree Kumaran Industries, Makkinampatty, Pollachi, Coimbatore.
	26	Shri. P. Thangavel, M/s. Tamil Nadu Coir Corporation Unit No.20, Sajakthi Industrial estate, Pollachi, Coimbatore.

	27	P.S. Kouzhik, M/s. The Sun Coir, 236, Big Bazar Street, Dharapuram-638 656
	28	Amrish Engg' Works, Thattampalli, Alappuzha, Kerala
	29	Shri. Aboobacker Haji, Chairman, GCC Coco-lawn, TPA House, 19 Mile, Chavasserry, Muttannoor, Kannoor, Kerala
	30	The Regional Agro Industrial Development Co-operative of Kerala Ltd., Palakkadu
	31	Mangala Devi, Madharkdhara, Visakhaptnam - 530007, Andhra Pradesh
	32	M/s. Auto Cast Ltd, Cherthala
	33	Govt. Tool Room & Training Centre, Bengaluru-560 010
	34	Mangireesh Agro Industries(P) Ltd., Pune
	35	Shri. K.P. Sasidharan, Soorya coir products
	36	M/s. Goutham Extracts & Oil, Palakkad
	37	P. Vasudeven, 329/4, Periyar Nagar, Near Gandhi Gramam, Karur-4, TN
	38	M/s. C.M. Industries, Nazareth West, Kochi-682 002
	39	Dr. Palanisamy, Dean-Advanced Research Institute, Dr. M.G.R. University, Chennai.
<b>7</b>	<b>SPINNING MACHINE</b>	
	1	M/s. Metal Forms 9/36, Krishna Garden, Chandra Nagar, Palakkad -7
	2	Prem Kiran, 2 M Engineers, D 427, 10 <sup>th</sup> main, 2 <sup>nd</sup> stage, Peenya Industrial Estate Bangalore - 58
	3	PON SRI RAMAN Dharmapuram, Eatham Mozhy – 629 501 Kanyakumari dist. Tamil Nadu
	4	M/s.Sri Ram Machine works, C.Harihara Moorthi 104/1 <sup>a</sup> , Vengipalavam P.O, Tirupur (Dt) Tamil Nadu
	5	VKS Industries, 109, KRB Farm, Civil Aerodrome Road, SIHS Colony Coimbatore -641014
	6	LIBY Bonny Monark Engineering, Mundamveli P.O, Ernakulam
	7	Sri.Durga Industries, No.4, 9 <sup>th</sup> Cross, Rajagopal Nagar Main Road, Ganapathi Nagar, 4 <sup>th</sup> Phase, Peenya, Bangalore -560 058
	9	New India Agro Industries, Industrial Estate, Kuttan Perur, Mannar, Alappuzha -689623
	10	Shri. S.K. Gowthaman M/s. Sree Kumaran Industries, Makkinampatty, Pollachi, Coimbatore
	11	M/s. Duinkop Enterprises pvt. Ltd., Shri. M. Jayachandran, SF No.58, Pulladan, Pollachi Main road, Palayam P.O, Coimbatore
	12	Shri.P.Sreenivas, Professor, College of Engineering Pallippuram P.O, Cherthala
	13	M/s. Ashok Steel Industries, Mini Industrial Estate, Kadakkarappally P.O., Cherthala-688 529.
	14	Sr. Kantharaja, PRS Industries, Vivekanandha Nagar Ext.Behind Patteeswara Apartment, Singanallur Post, Coimbatore -641 005
	15	M/s. Jincy Engineers, Bapoore, Calicut
	16	M/s. Ananteswar Engineering Works, Sakhigoal, Puri Dist, Odisha
	17	Federation Of Indian Coir Exporter's Association Business Development Centre, Coir Shippers Council Compound, Mayithara P.O, Cherthala
	18	M/s. Suresh Engineering Works, Kochi-16
	19	M/s. Musliar College of Engineering, Pathananhitta
	20	M/s. Plant India Agro Machineries, Kochi
	21	Annai Theresa & Co., St. Xavier Service Station Campus, 83, B2, Vinayagar Street, Chettikulam Jn, Nagercoil-629 002
	22	M/s. C.M. Industries, Nazareth West, Kochi-682 002
	23	Dr. Palanisamy, Dean-Advanced Research Institute, Dr. M.G.R. University, Chennai.
<b>8</b>	<b>MOTORIZED RATT UNIT</b>	

		Braman Fabrication, Guwahati
<b>9</b>	<b>COIR POLYSTER MOULDING</b>	
	1	M/s. Coir City Consortium India Pvt., Ltd., Coimbatore
	2	M/s. Ashok Steel Industries, Cherthala
	3	M/s. Sukumar Engineering Exports, TN
	4	M/s. Thenkud Coir Training Centre, Tamil Nadu
	5	M/s. Vanith Service Sangam, Kalavoor
	6	Vishal Patel, Gujarat
	7	Prashant Koushik, Odisha
	8	Jaya Rajaji, Ranni, Pathanamthitta
	9	Simi. T.S., Ranni, Pathanamthitta
	10	Anitha. M. Nair, Ranni, Pathanamthitta
	11	Usha. P.K. Ranni, Pathanamthitta
<b>10</b>	<b>UV UMBRELLA CLOTH</b>	
	1	M/s. Asha Rub Tech., Coimbatore
<b>11</b>	<b>Mini Coir-PVC Tufting machine</b>	
	1	M/s. Hosur Coir & Coir Products Industries Association, Tamil Nadu
	2	M/s. Thirupur District Coir Yarn Manufacturers Association, Tamil Nadu (Kankayam Coir Cluster)
	3	M/S. Salem Coir Mat Consortium, Tamil Nadu
<b>12</b>	<b>Softening of coir fibre and manufacture of coir pillows, rugs and cushion for School children</b>	
	1	Karnataka State Coir Co-operative Federation, Bengaluru
	2	Antony.M.M.,23/118A, Mampuzhackal House, Chagampuzhanagar Post, South Kalamassery 682 033, Ernakulam Dist. Kerala
<b>13</b>	<b>Handmade grade paper from coir</b>	
	1	Hosur Coir & Coir products Industries Association, Tamil Nadu
<b>14</b>	<b>Fast composting of coir pith hillocks</b>	
	1	T.S. Kidingannappaa, Gubbi Coir Cluster, Karnataka
<b>15</b>	<b>Coir Geo bags</b>	
	1	Suresh Engineering Works, Kochi (2014)
<b>16</b>	<b>Protection of clay embankment using coir geotextiles</b>	
	1	T.S. Kidingannappaa, Gubbi Coir Cluster, Karnataka (2014)
<b>17</b>	<b>Coir Ply Board</b>	
	1	Salem Coir Ply Board Cluster, Tamil Nadu (2014)
	2	Dindigul District Coir Cluster. Tamil Nadu. (2014)
	3	Coir City Consortium India Pvt. Ltd, Pollachi, Tamil Nadu. (2014)
<b>18</b>	<b>Willowing Machine</b>	
	1	Mangireesh Agro Industries(P) Ltd., Pune
<b>19</b>	<b>Corridor Mat Frame</b>	
	1	Mangireesh Agro Industries(P) Ltd., Pune

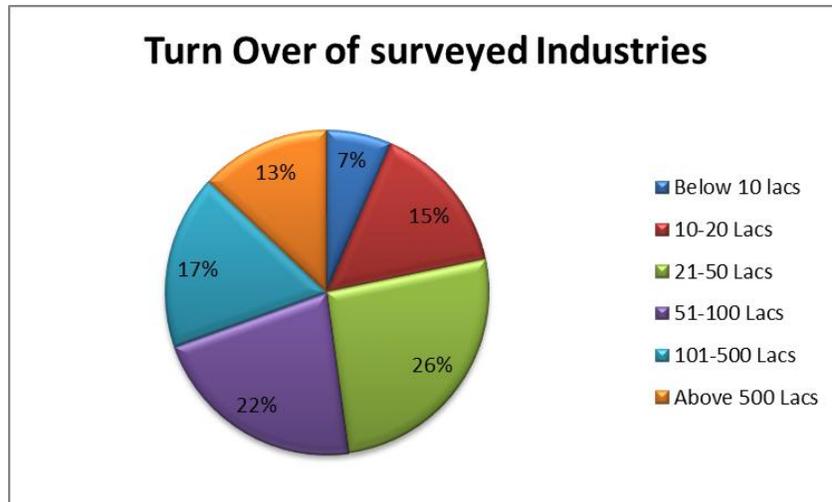
The study team during its field visits interviewed members of the management and workers of various type of coir industries in Kerala, Karnataka and Tamilnadu and took their views on R & D activities of CCRI and CICT in order to evaluate the diffusion of technology developed by the research institutes to the industry and the way it has influenced the development of products and processes in the coir industry. The percentage of responses of these sample group of people associated the coir industry are mentioned below:

**Figure: 4.14 Activity wise surveyed industries**



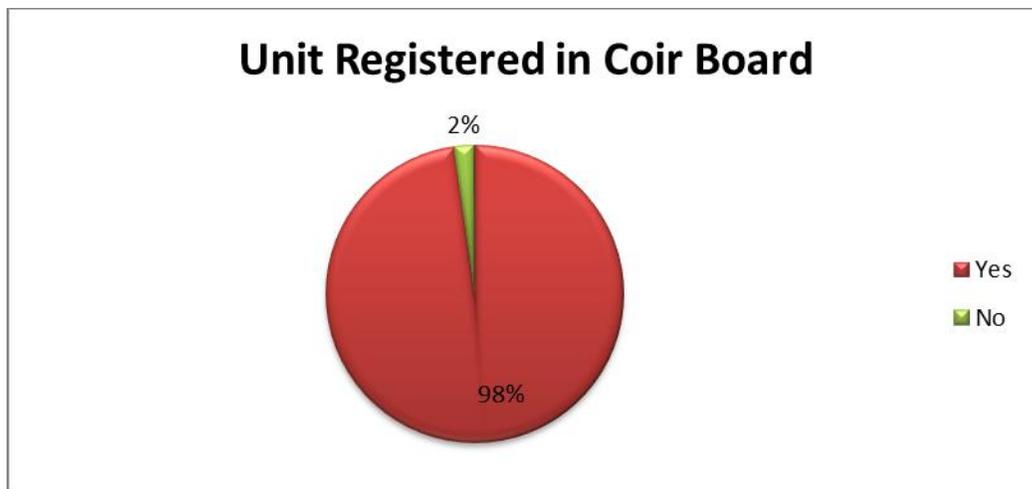
The percentage of industries surveyed activity-wise is depicted in the chart shown above. Most of the units interviewed were members of the fibre extraction and pith units in the surveyed states followed by units producing coir value added products and fibre extraction units exclusively. The data shows that composite unit having both fibre extraction and pith utilization units have grown during the plan period.

**Figure 4.15: Turnover of surveyed industries**



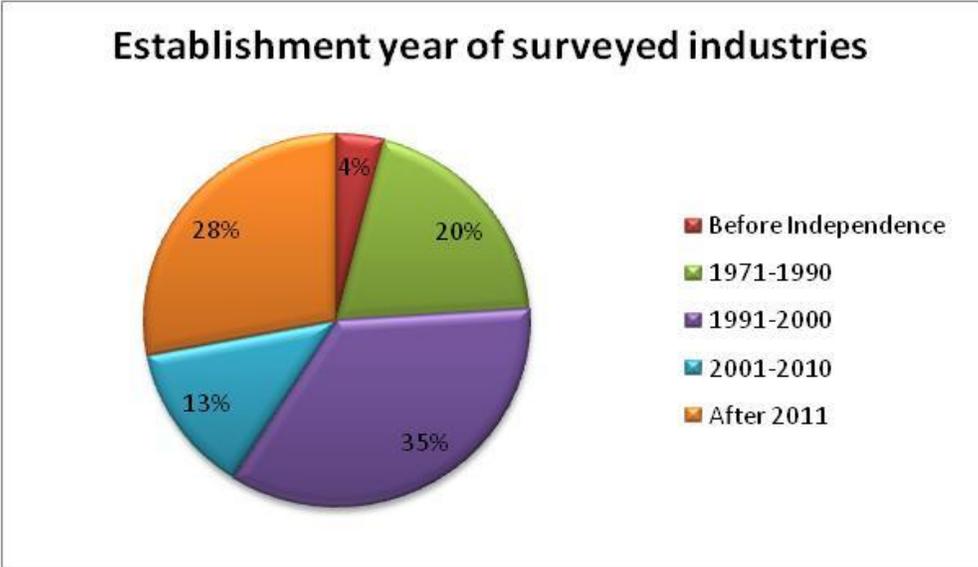
The turnover of majority of the units surveyed (26%) is between INR 21 to 50 lakhs followed by 51 to 100 lakhs (22%) and 101 to 500 Lakhs (17%). Units with turnover of 500 lakhs and above constitute 13 percent of the units surveyed and units of turnover of 10 lakhs and below constitute only seven percent of the units surveyed.

**Figure 4.16: Unit registered in coir board**



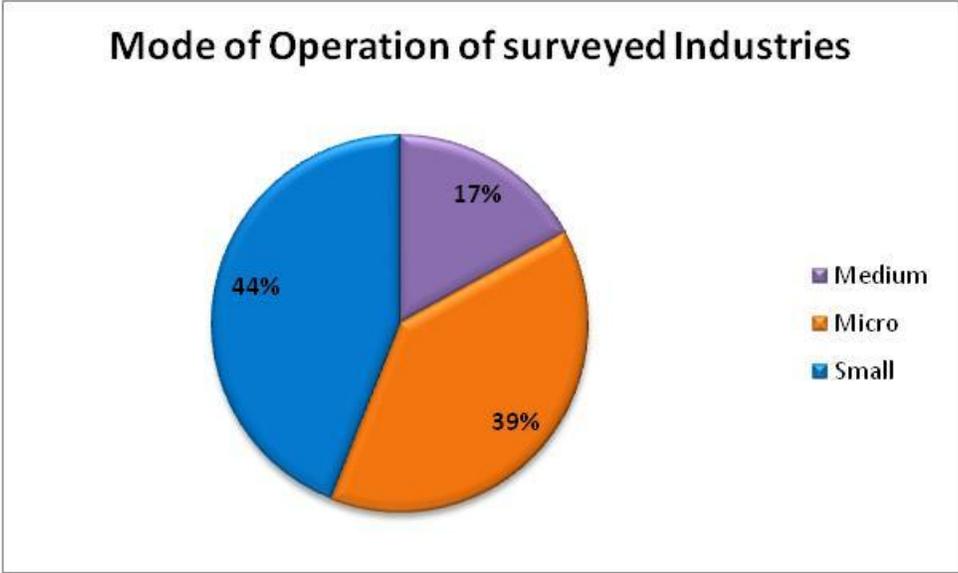
Almost all units surveyed (98%) are registered with the Coir Board thereby indicating the importance coir industry members have towards the Board and also the level of reach the Board has within the coir industry fraternity.

**Figure 4.17 Establishment year of surveyed industries**



Most of the industries surveyed are established within the time period 1991-2000 (35%) followed by units established after 2011 (28%) and between 1971 and 1990 (20%) and 2001-2010 (13%). This shows that the surge in establishment of coir industries in the surveyed region started in 1971 and continued to maintain its trend till the first decade of the current millennium.

**Figure 4.18: Mode of operation of surveyed Industries**



Most of the industries surveyed (44%) fall in the micro industry category followed by the units in the small industry category (39%) and medium industry category (17%). No industry in the

large-scale category could come under the survey design thereby indicating that the coir sector in these states is largely dominated by micro and small industry units

## CHAPTER -5: CASE STUDIES

**Case Studies in Technology Diffusion:** In order to get a better perspective of the percolation of technologies and other support of the institutes R&D and related activities in the industry fraternity, the study has highlighted some individual cases from the survey list that are mentioned in the pages below.

### **Case Study 1- 2M Engineers Bangalore – Coir Machine Manufacturer**

2M Engineers Bangalore was established in 1991 by Sri. B. Manjunath Shayer and Sri. A.S. Madhusudan and from 1998 onwards the company has diversified its business to manufacturing of machines for the coir industry with technical guidance from the CCRI and CICT. Both CCRI and CICT have recognized the development and achievements of 2M engineers and awarded it for its unique invention for the best efforts in the developments of coir processing machinery category for the year 1999-2000 at the International Coir Fair held at Kochi during October 2001. Continuous machine design and development is being done with the guidance of CCRI and CICT here and they are playing a very positive role in terms of development and mechanization of coir industries. At present the company turnover is about three crores and it has about 25 employees. The machines shown below have been developed under guidance of CCRI and CICT and supplied to coir industries during the period 2012-17 which have helped to developed coir industries in terms of production, product quality, cost minimization, workers health and safety as reported.



SN	Machine	Nos
1	Mini Coir Fiber Extraction Machine	25 Nos
2	Coir Spinning Machine of All Kinds	3000 Nos
3	Coir Willowing Machine	200 Nos
4	Non-Woven Coir Needle Felt Machine	25 Nos (To Both Domestic and International)
5	Rubberized Coir Mattress Unit	05 Sets
6	Coir Panel Manufacturing Plant	07 Sets
7	Coir Molding Hot Press	10 Sets

2M Engineers considers itself as a machinery manufacturer for coir sector in which its R & D department under guidance from CCRI and CICT has successfully developed various machinery like coir spinning machine, coir non-woven needle felt machine, adoptee new technology in rubberized coir mattress industry and coir composite panel manufacturing set up that has immensely helped the coir fraternity in making value added products with increased productivity with reduction in labor and power. Along with it, their intervention has also helped coir entrepreneurs get more margins compared old technology based machines and products. Its R & D process and output under guidance of CCRI and CICT has greatly helped the coir labours who were toiling in dangerous working conditions earlier. It has been somewhat eliminated in present day technology driven units producing various coir products. 2M Engineers is of the view that with further continuing technological, financial and raw material support from CCRI and CICT, it can be successful in conducting more R & D for the development of coir industries in India.



### **Case Study 2- Sri Chamundeshwari Coir Products**

Sri Chamundeshwari Coir Products Chennapatna, Karnataka, established in 2002. It is fiber extraction and rope unit being run as proprietorship firm by Sh Muni Venkattappa. It is small coir industry. In 2015 industry has adapted new machine and technology. Changes and development given below.

Particulars	Before	At Present
Husk utilization	5000 daily	15000 daily
Production	200-300 kg daily	1 ton daily
Worker safety	Low	Better
Product Quality	Average	High
Turn Over	10 lacs	40 Lacs
Profit margin	Rs 1.5-2.0/ kg	Rs-3.0/ kg
Worker Earning	Rs 200/-per day	Rs- 400/-perday

As reported by Mr Muni Venkattappa, after adoption of new machine and technology, production, quality, worker's safety, turn over, profit all have increased. He is happy with R & D efforts are being done in CCRI and CICT and suggested that more R & D may be done in area of cost reduction in manufacturing process.

### Case Study 3- Amish Coir Mats



Amish Coir Mats, Pathirapally Alleppey Kerala, established in 1990 and registered with Coir Board. It is a micro fibre mats unit and being run as proprietorship firm by Mr Sugadhan. In 2014 industry has adapted new machine and technology of semiautomatic loom “Uday” Changes and

Particulars	Before	At Present
Production (1 machine)	6 Sq Fit	10 sq Fit
Worker safety	Low	High
Product Quality	Low	Good
Hard Labour	Very much	Less hard labor
Turn Over	2 Lacs	4 Lacs
Profit margin	10-15%	20-25%
Worker Earning	Rs-360/- per day	Rs-550/- per day

development given below.

As reported by Mr Sugadhan, after adoption of new machine and technology, production, quality, worker’s safety, turn over, profit all have increased. He is happy with R & D efforts are being done in CCRI and CICT and suggested to more R & D may be done in area of cost reduction in manufacturing process.

### Case Study 4- Arun Coir Works



Arun Coir Works, Alleppey, established in 2013. It is fiber extraction unit and being run as proprietorship firm by Mr Vishwnathan KV. Earlier he was extracting fibre manually and from the CCRI but he purchased MFEM and stated a micro unit for fibre extraction.

Particulars	Before	At Present
Husk utilization/production	120 daily	4000 daily
Worker safety	Low	Good
Product Quality	Average	High
Turn Over	4 lacs	10 Lacs
Profit margin	10-15%	30%
Worker Earning	Rs 100per day	Rs- 350/-perday

Changes and development summary are given below.

As reported by Mr Sugadhan, after adoption of new machine and technology, production, quality, worker’s safety, turn over, profit all have increased. He is very happy with mobile fibre extraction technology (MFEM) and he said fibre extraction become very easy because of MFEM technology and it is very good for poor people like him and collection/extraction has become easy with the technology.

**Export of Coir Products in the Plan Period 2012-17:** The export of coir products during the plan period was maximum during the last two years of the plan period i.e. the financial years 2015-16 and 2016-17. The list of the products exported during this period with their quantitative and value figures and percentage growth are shown in the table below:

<b>EXPORT STATISTICS</b>						
<b>Comparative Statement of Export of Coir Products from India For the Years 2016-17 and 2015-16</b>						
<b>Q = Quantity in M Tonnes</b>			<b>V=Value in Rs. Lakhs</b>			
<b>Item</b>	<b>April 2016- March2017</b>		<b>April 2015- March2016</b>		<b>% Growth</b>	
	<b>Qty</b>	<b>Val</b>	<b>Qty</b>	<b>Val</b>	<b>Qty</b>	<b>Val</b>
Coir Pith	490552	90539.11	408897	68808.56	20	31.6
Coir Fibre	370357	53913.63	255293	41767.11	45.1	29.1
Tufted Mat	51718	48442.83	45770	44316.03	13	9.3
Handloom Mat	20143	21316.31	20386	22279.96	-1.2	-4.3
Geo textiles	6219	4481.04	4520	3531.72	37.6	26.9
Coir Yarn	4426	2948.32	4134	2820.82	7.1	4.5
Curled Coir	10356	2419.3	9470	2510.07	9.4	-3.6
Handloom Mattings	1272	1535.25	1706	1968.78	-25.4	-22.0
Rubberized Coir	888	1295.64	678	971.74	30.9	33.3
Coir Other Sorts	256	416.59	46	94.79	451.9	339.5
Coir Rope	484	388.5	517	396.61	-6.3	-2.0
Coir Rugs & Carpet	205	271.92	307	282.5	-33.1	-3.7
Power loom Mat	166	196.38	280	367.35	-40.5	-46.5
Power loom Matting	0	0	16	26.48	-	-
<b>Total</b>	<b>957045</b>	<b>228164.82</b>	<b>752020</b>	<b>190142.5</b>	<b>27.3</b>	<b>20</b>

*Source Coir Board; Subject to E & O.E*

Coir (other sorts), rubberized coir, coir pith, coir fibre and geo textiles witnessed healthy percentage growth in exports during the period under review both in value and quantity terms. Coir pith exports was the highest in terms of absolute quantity terms in both the financial year periods followed by coir fibre. Tufted mats made of coir also witnessed healthy export performance during the period under review as also handloom mat and curled coir. A noticeable de-growth in exports during the review period was witnessed in the power-loom mat and matting category as well as coir rugs and carpets. However, there has been an absolute growth in exports in terms of quantity (27.3%) and value terms (20%), which needs to be maintained and improved in the coming years.

Inputs from the industry members revealed that presently they are only exporting coir as a raw material for finished products made in foreign markets and re-exported to India. If the R&D provides them the technology and process to develop export oriented finished products of global standards, then their market reach and income would treble and also the profile of the coir industry in the global area will increase in stature and actual market share terms. Apart from this, the industry members said that the coir yarn should be uniform in texture and quality specifications so that they can develop products akin to international standards both for domestic and foreign market consumption. Presently, there is no uniformity in the development of coir yarn, which the R&D institutes, can help the industry achieve it, they said. Apart from uniform yarn, the industry members said that the demand and popularity of blended yarn and products developed with other natural fibres is rising and therefore the R&D institutes can also work on developing such blended yarn for them so that they can produce and sell products made from them in the domestic and international market.

#### **Findings:**

The technologies developed by the R&D institutes in defiberizing, de-husking and processing of coir pith into yarn have been majorly accepted by the industry and a total of around 150 industries of various size as well as scores of individual entrepreneurs have availed of the technologies and products developed by CRI and CICT. There has been an overall YoY growth in exports of coir and coir products in the financial year 2015-16 at the rate of 27.3 percent in volume exports and 20 percent in value exports. Here it is to be noted that the volume percentage in exports is higher than the value percentage growth. The inputs of the industry members on providing technology, process and products for manufacturing and selling value added products is important to note as by that way only the financial performance, market share and product profile of the coir products made in India will improve. So, the R&D institutes should focus on developed uniform yarn making technology and processes, value added finished products and blended yarns to improve the profile of the coir industry, inculcate interest in younger generation to work for the industry and improve the global and domestic market share.

## Market Penetration of Products Developed by CCRI and CICT

Traditional knowledge about the usage of coir in day to day life of people in India pointed to the fact that coir was only used only for manufacture of floor coverings. Therefore, it is no brainer to say that at least the Implementation of the S&T scheme has led to development of the new technologies using coir fibre and coir pith. The products developed from the new technologies are being popularized through Coir Board extensively which has led to awareness generation of the general public on the diversified applications of coir. Some of the products made from application of new technologies developed by the research institutes have already been transferred to the industry and are being marketed by them. Others can still be improved & standardized to meet with the consumer tastes and demand for which research is and can be further continued. The prominent new products developed and shared with the industry for their marketization and consumer usage are mentioned below:

**Coir Ply:** The R&D efforts of the Coir Board of India were successful in developing a coir composite that can substitute wood, plywood and MDF boards. The composites are made out of a combination of two or more materials to achieve superior properties than that of its components. Here coir fibre and phenolic resoles are used to make the ply of any desired density. Based on the density the ply can replace plastic boards, MDF boards, or hard board made out of wood. The coir ply can be reinforced with plantation wood like rubber wood veneer, for better properties and without destroying natural forests. They are resistant to termite and borer attacks, flame retardant are boiling water resistant, and free from fungal growth. The nail holding properties are better than MDF, because of the long staple and normal carpentry tools are good enough to work with. The coir ply has been standardized under BIS (IS: 14842-2000). It has obtained necessary approvals for use in the Indian Railway, Defense, CPWD, State Road Transport Undertakings, HUDCO, Rajiv Gandhi Rural Housing Corporation, State Housing agencies, etc. This technology is now available for commercial exploitation. Once it becomes popular, its contribution to save the tropical forest timber would be phenomenal. It is estimated that 40 cubic meters of coir ply can save about 26.4.ha of forest per annum form deforestation, assuming 250 trees per ha and each tree producing 1.80 cubic meters of wood.

Wood panel industry has a huge footing in Indian market. There is an enormous demand for wood panel products in India. Wood panel based products help in saving a considerable amount

of scarce wood when compared to solid timber products. Because of their versatility in application and efficiency in wood raw material utilization, the wood panel products have, to a great extent replaced solid wood in both structural and non-structural uses.

The primary advantage of the coir wood composites is due to the coir, which is natural, eco-friendly and abundantly available material. Coir is very strong due to its high content of crystalline alpha cellulose (40%) and highly resistance to borer, termite, water and other natural elements due to high lignin content (45%). The coir fibre being very strong and flexible, it can easily replace the glass fibre or can be hybridized in required ratio with the glass fibre. The coir reinforcement fibre could be of coir felt, coir rope or coir sliver etc. Additional reinforcement fibres such as glass, bamboo, and jute fibre could also be used for improving the structural performance. The resultant coir fibre composites offer several advantages such as light weight, high strength and stiffness, non-corrosive, water resistant, long durability, low cost etc. Coir composites are highly suitable for building and construction for door, furniture and other joinery work and transportation application for cost effective replacement to wood and timber. The country is facing major environment problems due to the reduction of the forest cover. This type of coir composites made by using alternate layers of coir and rubber veneer using phenolic resin can be used like plywood in paneling, false ceilings, partitions, furniture etc

One model innovative Coir Wood House has been erected by the Board at the Town Square, Alappuzha, Kerala on an area of 340 sq ft. for demonstration and publicity of Coir Ply. It has been proved by the R&D wing in order that these ply boards can be effectively and economically used for manufacturing doors, windows, wall panels, false roofing, furniture and the other varied end uses replacing plywood and wood. The Board has already succeeded in developing knock down furniture, ready to shift wood houses using coir wood panels.

In order to promote and propagate the use of eco-friendly coir wood in the market, a designing consultant viz M/s. Innovative Management Consultants (IMC), Kochi, who has made some innovative models in this area, approached the Board seeking assistance for undertaking the project “Prototyping of different types of Knock down furniture using coir wood panels for demonstration purposes”. The project has been implemented at CICT, Bengaluru from June-2017. The technology has already been transferred to M/s Natura, Bengaluru and is being

marketed through them. Action has also been initiated for production of Coir “Compreg” boards for application in the railways sector.

The opinion regarding the natural fibre is found to be very much encouraging. The market is having a high regard for eco-friendly natural fibre based products. However, though majority of vendors and builders have used natural fibre in their construction activities and finishing, their opinion is that most of the customers are not much aware of such a product and its advantages. So, consumer awareness in the form of large scale exhibitions with product demonstration sessions in different places should be spearheaded by the R&D institutions under the banner of Coir Board to apprise the consumer about their utility and usage.

**Coir Pith Organic Manure (C-POM):** CCRI has developed a technology for the bioconversion



of coir pith into organic manure which has applications both in the agriculture and horticulture fields. Coir Pith, one of the largest agro-wastes is a by-product of coconut husk processing industries. Coir pith constitutes 70% of the husk and is a fluffy material thrown out in the process of separation of fibre from the coconut husk. Accumulation of coir pith forms coir pith hillocks which are common in the neighborhood of fibre extraction units. The problematic

waste (Coir pith) is a potential wealth and can be converted into valuable organic manure by microbial degradation. The technology has been developed by Coir Board for composting coir pith and converting it into rich natural organic manure. Pith-Plus, a mushroom spawn speeds up the composting process of coir pith and leads to 42 percent reduction in volume of coir pith. The mushroom belongs to the fungal group ‘Basidiomycetes’ that is capable of detoxifying phenolics and producing bio-polymerising enzymes. Cellulosic compounds present in coir pith support the initial growth of this fungus and act as co-substances for lignin degradation. The degradation of coir pith by Pith-Plus is marked by the increased evaluation of carbon dioxide. Coir pith organic manure has been found to be superior to other organic manure which has been hitherto used for horticultural purposes. They have the following environmental friendly characteristics:

- *Excellent air porosity*

- *Excellent water retention*
- *Irrigation efficiency*
- *Faster germination time and quicker seeding rotations*
- *Suitable for soil remediation*
- *Provides phytohormones*

An Ecofriendly technology for value addition of Coir pith by converting it into Comprehensive bio-composted coir pith using Pith-Plus supplemented with Azolla, fish waste and Neem cake was developed which is named as “Coir-Krishi Mithra”; for Agri /Horti/ Floriculture applications. NPK analyses were done on the same and the results showed a better nutrient profile compared to the conventional C-POM. The technology of Coir Krishi-Mithra has been standardized and demonstration of the same is continuing in all coconut growing states through demonstrations. The product developed by CCRI, intended especially for the cultivation of vegetables was launched in the Mega event, IICF-2016.

Organic products are now gaining popularity worldwide in the wake of humanity’s devastating experiences with chemical farming. All the states are readying itself for the next phase of the green revolution “organic farming”. Many nations which are committed to socially responsible, ecologically friendly and economically self-sustainable development.

Coir Board has initiated marketing of C-Pom through the following manufacturers who have been registered under Coir Board for manufacturing and marketing the C-Pom. The list of the partner manufacturers is mentioned below:

<b>Sl. No.</b>	<b>Name and Address of the Party</b>
1.	M/s Kerala Organic Manures and Fertilizers, Perinad P.O. Kollam. Mob. 9447044455
2	M/s.Amрут Organic Fertilizers, Onampallil kadavil, Keerikadu South, Kayamkulam. Mob. 9447390500
3.	M/s.Lakshmi Organic Manures, Alappad,Karunagappally, Kollam. Mob.9447955177
4	M/s.Theertham Fibres,Chunangad P.O,Palakkad-679511 Mob. 9446237399
5	M/s.Parvathy Organic Manures, Olikkarakadavu, Kanjavelly P.O, Kollam-691602 Mob.9847894860
6	M/s.Sree Agro Products,Door No.1-183, R.S No.52/1, NH-5,Near Tole Gate Tanuku, Peravali-534328, West Godavari Dist (A.P)
7	M/s.Farmguide Associates, Chozhiakkad, Vandithavalam P.O. Palakkad-678534, Kerala. Mob.9544564708
8.	M/s. Gramajyothi Organic manure unit, Pasukadavu, Kozhikode

9	M/s.Orgafert, M/s.Bismi Trading Company, EEC Market, Adooparampu, Muvattupuzha
10	M/s.Puthuppally Service Co-operative Society, Ltd No.2730, Puthuppally P.O, Kayamkulam
11	M/s. Anikadu Agro Industries Corporation, Adooparampu, Muvattupuzha
12	M/s.Hindustan Agro Fertilizers, Mukkom Road, Kunnamangalam P.O, Anappara, Kozhikode
13.	M/s.Varsha Agro Industries, Chikkakalasangra Village, Subrahmanyapuram post, Bangalore
14.	M/s. Goutham Extracts & Oils, Moongilmada, Vannamada P.O, Palakkad -688555. Tel-98470556260
15	M/s. Leo Exports, Muthalamada P.O, Palakkad -678507. <u>Tel:0492-3205021, 9447225021</u>
16	M/s.Green valley Impex, Amrita kripa, House No.63, NPP Nagar, Peroorkada P.O. Thiruvananthapuram. Tel:9745037389
17	Shambu Coir works, Elluvila p.o, Kunnathukal, Neyyattinkara, Thiruvananthapuram-695504. Tel-9447752355

Coir products are 100% nature friendly and bio-degradable products. Traditionally, the use of coir was limited to the manufacture of floor coverings, cushions, mattresses etc., The coir products have great potential to save scarce non-renewable natural resources which is being realized by customers world over. Coir Geo-textiles, Coir ply, Coir pith, Organic Manure, Coir Garden Articles, etc., are the products which can contribute a great deal in respect of environment protection. Coir ornaments are latest addition to the list which are hand crafted and can be promoted as a souvenir.

The opinion regarding the coir pith manure is found to be very much encouraging. However, the industry members opinion is that most of the customers are not much aware of such a product and its advantages. So, consumer awareness in the form of large scale exhibitions with product demonstration sessions in different places should be spearheaded by the R&D institutions under the banner of Cor Board to apprise the consumer about their utility and usage.

**Coir Wood House:** One model innovative Coir Wood House has been erected by the Board at the Town Square, Alappuzha, Kerala on an area of 340 sq ft. for demonstration and publicity of Coir Ply. R&D institutes successfully demonstrated that these ply-boards can be effectively and economically used for manufacturing doors, windows, wall panels, false roofing, furniture and the other varied end uses replacing ply wood and wood. The Board has already succeeded in

developing knock down furniture, ready to shift wood houses using coir wood panels. In order to promote and propagate the use of eco-friendly coir wood in the market, a designing consultant viz M/s. Innovative Management Consultants (IMC), Kochi who have made some innovative models in this area approached the Board seeking assistance for undertaking the project “Prototyping of different types of Knock down furniture using coir wood panels for demonstration purposes”. The project is being implemented at CICT, Bengaluru from June-2017. The technology has already been transferred to M/s Natura, Bengaluru and is being marketed through them. Action has also been initiated for production of Coir “Compreg” boards for application in railways.



**Coco Lawn:** CCRI Kalavoor has successfully developed a process knowhow to develop a natural base for developing lawns using coir instead of soil. This invention is first of its kind to use 100% natural coir materials including the fertilizer (C-POM) for faster preparation of readymade, transportable lawns. This readymade lawn can be laid on any arid surface or even concrete floor. It has been nomenclature as “Coco-Lawn” and comprises of coir netting as a support material. A single or double layers of a non-woven coir fabric (Coir needled felt) is provided on the said netting. A layer of coir pith is provided on the non-woven layers. Grass slips are planted on the bed of coir pith and C-POM is sprinkled thereon to form a layer on the said bed. Water is sprinkled as per requirement. Over a period of three months a lush green readymade lawn is established. The ready to use lawn is made available in the form of a blanket, which can be shifted from one place to another and can be rolled up for transportation.

A readymade lawn of natural grass consists of a layer of netting material made of coir, a single or plurality of non-woven layers and a layer of fertilizer of treated coir pith and natural grass on the coir pith layer. The netting can be placed on a sheet made of plastic material such as polyvinyl chloride or polythene. Non-woven layers provide thickness to the lawn and allow grass roots to get entangled in the non-woven material. The layer of coir pith gives a support base to grass. Coir pith layer can be treated with other nutrients such as mushroom seeds and urea etc.

and allowed to mature till the weight is substantially reduced as lignin is consumed by fungi or mushroom seeds. Readymade lawn can be made in the form of rollable blankets, which can be laid on any surface.

The lawn is an eco-friendly alternative for various applications. It is very important considering the growing concern for the protection of environment and the growing demand for natural lawns for various applications. The principle involved in this invention is to adopt an eco-friendly method for faster development of readymade lawns using natural coir products, instead of using synthetic lawns, which are costly, non-environment friendly and have post usage disposal problems.



**Coir Geotextile:** The strengths of coir “Bhoovastra” as a geotextile material are considerable. Its greatest strength in the present global scenario is its characteristic of being eco-friendly and bio-degradable. In a world where the return to natural environment and preference for natural products have been growing tremendously, Coir bhoovastra which are entirely natural and bio degradable, enjoy this natural advantage. The other strengths of coir is as a geotextile material. Coir geotextiles are among the major product now being used for different environmental applications in the construction of mud wall, soil erosion control, green house, vegetation and greenery development in the mining dump yards and construction of rural roads and retention of slopes. Coir Board has made efforts in collaboration with NITs & other Institutes and constructed rural roads which are a major area of application which reveal that life of the rural unpaved roads can be doubled. Coir Board has implemented collaborative projects for evaluating the performance of the coir geotextiles reinforced rural roads with NIT, Trichy, College of Engineering, Trivandrum, MANIT, Bhopal, and NIT, Calicut in the states of Tamil Nadu & Kerala. The roads were constructed under PMGSY Scheme using coir geotextiles as a new material for reinforcement and the performance of the roads was evaluated. Marketing of coir geotextiles, coco-logs, Coir geo bags etc. for environmental applications is already being carried by Private manufacturers/exporters such as M/s. Charankattu Coir Manufacturing Co., Cherthala.

Action has already been made for the inclusion of coir geotextiles in the Manual of NRRDA, CPWD & National Highways. CCRI has been granted accreditation by the Indian Road Congress (IRC) and is making full efforts to publicize the salient findings of coir geotextiles road projects which have proved the use of coir geo-textiles for reinforcement of rural roads under the PMGSY Scheme of Govt. of India. Discussions on the potential use of coir geotextiles for applications in railways for embankment protection, cushioning in carriages and in tracks were held with the Executive Director(Carriage) & Director (Geotextiles & Carriage) by visiting the Railway Research Design & Standards Organization (RDSO), Lucknow in June-2017. Action is also being initiated to constitute a team for study of the other areas which coir geotextiles can be used.

### **Improvement in Products and Standardization Requirements:**

The products developed and diffused into the market at present are in their first phase of penetration and relevant data on the experience of usage with suggestions will come in due course.

Inputs from the industry members however revealed that there is need to further propagate and dissipate the technological innovations and products in the mass market as it is the core need for the coir sector as of date. This is because, the industry members sad their business performance in selling the new products convey that these products utility, usage and advantage are not effectively communicated to the consumers due to which the demand is not emanating from their side. To achieve the objective both at the national level and also to get relevant data on product usage and feedback from the market, the following strategies collated after receiving feedback from the industry members can be implemented in conjunction with the coir board and the research institutes.

**Effective Communication:** The existing information about the advantages of coir fibre geotextiles could be optimized. The development in the national and international market for geotextiles should be collected and disseminated on a regular basis, particularly information on technical aspects, environmental aspects etc. This will help in providing a systematic and regular feed back to the industry and trade and also to the strategy formulators. Establishment of a coir bhoovastra cell at the Headquarters of the Coir Board with modern communication infrastructure

can tackle this effectively. The Cell can also be entrusted with other responsibilities connected with the promotion of coir geotextiles in the domestic and international market.

**Promotional Activities:** The advantage of technical information as envisaged above should be translated into effective instruments for communication and market penetration. These instruments have to convince potential users of the advantages of coir geotextiles. The biodegradability of coir fibre should be presented as a major technical advantage over synthetic material. A manual well designed could serve the purpose. The test results on technical aspects and benefits of the coir fibre geotextile application in developing countries could also be mentioned in the manual. A technically supervised documentary on application of coir bhoovastra for different soil erosion control projects/ landscaping etc. may be produced in countries, where the products are employed widely with great success. This video/ CD may be screened to the potential uses in different countries for awareness creation, simultaneously improving the distribution network with the active co-operation of the existing suppliers. In this regard, the assistance being rendered by the Import Promotion Offices in overseas countries, may be taken. Coir Bhoovastra is a natural solution to the growing environment problem on account of soil erosion. Erosion control through bio-engineering applications of ecofriendly natural geotextiles is a development of the recent past and hence would be a subject of great public interest of this century with environment conscience people all around. It would therefore be possible to persuade national and international TV channels like Discovery Channel/National Geographic Channel/BBC etc. to produce a documentary on Coir Bhoovastra and its role in erosion control applications and telecast the same in their channels. This will help to provide Coir Bhoovastra the much-needed global exposure.

**Usage of International Platforms:** Geotextiles are design specific. The specifiers, civil engineers, contractors, importers etc; involved in application areas are specific targets. Therefore, it would be advantageous to use the international organizations like International Erosion Control Association (IECA) and International Geo-Synthetic Association (IGA) as promotional channels. Coir Board can facilitate membership of Coir Bhoovastra producing companies in India into IECA and initiate collaborative arrangements for marketing coir bhoovastra with the active support of International Geo-Synthetic Association. This will provide

a more harmonized market environment for natural fibre products to co-exist with its counterpart geosynthetic materials. The global market for geotextiles is very vast and in view of varying requirements and product type characterized with strength, longevity, price, availability, product flexibility etc. it would be mutually advantageous if efforts could be made to co-exist with synthetic in the market, both domestic and export.

**Participation in International Events:** Coir Board may jointly participate with major market players of coir bhoovastra in leading international trade events for awareness creation among the potential users. It should be promoted through selective promotional campaign abroad. The Board could also organize international seminars and workshops in leading markets of coir geotextiles giving participation to end-user's potential users, decision makers, specifiers, influencers etc

### **Findings:**

The new products like coir ply, C-Pom and geo-textiles have been tested and successfully transferred for industry utilization based on inputs gathered during field visits and interactions with stakeholders including the research institutes and industry members. Coir Board has initiated marketing of C-Pom through 17 manufactures registered under Coir Board for manufacturing and marketing the C-Pom. For geo-textiles, coir bhoovastra, the situation calls for interaction with the concerned decision making Govt Departments/Establishments like Irrigation, Roads and Highways, Port Trust authorities, Water Works, Construction and land scape, hotels and resort projects, Railways, Defense and other similar projects/organisations with a view to impress upon them the suitability of coir bhoovastra for permanent eco-friendly solution to soil erosion and other civil engineering problems. Interaction with the concerned authorities with a view to selling the concept and persistent efforts thereafter will definitely yield beneficial results. Besides, seminars, preparation of manuals and guidelines conducting lab trial and field trial, collaborative research projects etc. should be undertaken to popularize the use of coir geotextiles, through awareness creation. The need for supplementing the effort through publicity needs no emphasis. Besides, there is enormous potential in the domestic market as is evident from the fact that already many synthetic geotextile manufacturers have entered the Indian market and many more are interested to enter the market.

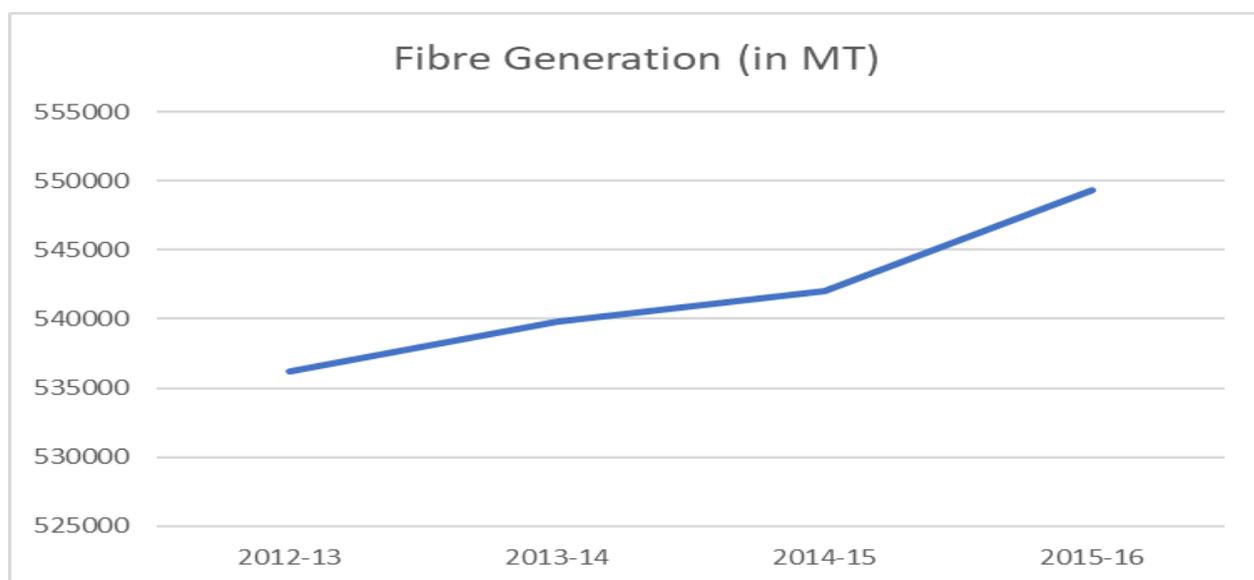
The products have been developed as per innovative standards and are benchmark unto themselves. However, the input from the industry members point to the fact that propagation of the product benefits and its usage as supplements for synthetic products needs to be taken up by way of exhibitions, product demonstrations, tie-ups with large scale government body requirements to make them appealing to the customers and help in generating demand for such products.

### Utilization of Coconut Coir Husk

The basic by-product of coir industry that comes out after de-husking the fibre i.e. 'Coconut husk' has only negligible commercial value, if not used by the coir industry. Coir Board has identified the growth potential of the industry. The output that comes out after de-husking that has commercial value is the coir fibre. Accordingly, the fibre generation figures during the plan period are mentioned in the table below:

Year	Fibre Generation (in MT)
2012-13	536185
2013-14	539815
2014-15	542000
2015-16	549300

*Source Coir Board*



The traditional production of fibres from the husks is a laborious and time-consuming process. This is highly polluting of surface waters and results in the accumulation of large dumps of pith. After manual separation of the nut from the husk, the husks are processed by various retting techniques, and generally in ponds of brackish waters (for three to six months) or in salt backwaters or lagoons. This requires 10-12 months of anaerobic (bacterial) fermentation. By retting the fibres they are softened and can be decorticated and extracted by beating, which is usually done by hand. After hackling, washing and drying (in the shade) the fibres are loosened manually and cleaned.

Alternatively, mechanical processing using either defibering or decortivating equipment can be used to process the husks after only five days of immersion in water tanks. Crushing the husk in a breaker opens the fibres.



By using revolving “drums” the coarse long fibres are separated from the short woody parts and the pith. The stronger fibres are washed, cleaned, dried, hackled and combed. The quality of the fibre is greatly affected by these procedures.

It is well known to all, that coir industries are labour intensive work and people are not very much interested to work in coir industries because of low earnings. Major work force in coir industries are rural women but in fibre extraction required more labour. With the manual process one person can consume only 120-150 husks/per day. Fibre from coconut husks is extracted with the aid of different kinds of machinery. Fibre extraction units in organized sector possess machinery required for the production of bristle, mattress and decorticated fibre. Crushing machine, defibering drums, disintegrator, burstor, decorticator, beater, sifter etc. are used in fibre production.

**Mobile Fiber Extraction Machine (MFEM):** Husk collection is the major issue for the coir industry, utilization of husk is not being done of coir husk as expected. To minimize the husk



collection process CCRI earlier developed Mobile Fibre Extraction Machine (MFEM). In year 2016 CCRI modified the MFEM and developed Nano Mobile Defibering Machine. It is low cost machine and can consume 600 husk/per day. It can be transported by two people and minimizing the problem of husk collection. As part of modernization of Coir Industry,

Central Coir Research Institute, Kalavoor under Coir Board designed and developed mobile fibre extraction machine. As per the details, it is estimated that, 400–500 green/dry coconut husks can be processed by the machine / hour and 250 Kgs of spinnable fibre can be produced per shift. This mobile machine can be provided for the fibre extraction process without other machinery such as burster, beater, turbo cleaner etc. at required islands with crusher and soaking facility and save energy by using only 10 HP motor or Diesel engine. The study did field visits of deployment of husk defibering machine and came up with instances of usage of the machine. A sample case of usage of machine is mentioned below:

**Case Study 5- Ms Thakamani (55 year)- Coir Worker- Fiber Extraction**

Ms Thakamani (55 year) is working in Arun Coir Works situated at Alleppey, Kerala. She is working from last 25 years in coir industry and doing fibre extraction work. Earlier she was doing this work manually but at present she is working with MFEM. As reported given below.



Particulars	Before infusion of New Technology	After Introduction of new Technology
Daily Production/Husk utilization	120 per day	4000 per day
Hard Labour	High	Low
Daily Earning	Rs- 120 / per day	Rs- 325/per day
Health	Risk	Very Low
Safety	Low	High
Product Quality	Low	Good

Production has increased due to development and adaption of MFEM machine and most of the workers in coir industries are being paid on production basis. Therefore, it has observed and reported by the users, R & D efforts are being done under S & T scheme are very helpful in development of coir industries as well as worker’s health, safety, earnings etc. It has also reported and observed this technology is helpful in increasing husk utilization, new entrepreneurs, employment generation etc.

Till yesterday there was very little technology and usage ideas available for utilization of husk. However, with the development of MFEM coupled with C-Pom as a product and its promotion as an eco-friendly and sustainable alternative to chemical based manure, there is ample promise that the economic value of husk will grow in future. Alternatively also, through all the above R & D efforts the Coir Board, husk utilization is increasing day by day. The major issue and reason

of non-utilization of husk is collection, and after popularization and adaptation of mobile and nano-defibering, it is hoped that husk utilization will be increased.

At the same time, apart from C-Pom, information collected during visits showed that utilization of husks of coconuts at the domestic level are never being utilized for value addition, and the main stumbling block is collection of husk. There should be some mechanism in place to collect the coconut husks used in the households for fibre extraction. The local self-governments should be involved in the job. The coconut husks are also used widely as an alternate fuel in brick kiln units where high prices are offered to coconut husks. Due to this, the fibre extraction units in many States are facing problem in mustering coconut husks required for the units. The utilization of husks for coir industry will lead to generate employment to thousands of workers from the rural sector of the coconut producing states in the extraction of coir fibre and its further processing.

A major collective initiative has to be taken up to promote the cause of coir by identifying the thrust areas leading to a quantum jump in coir sector development. There is a need for better synergy in the activities. It is needed to adopt a two-pronged strategy for the development of the coir industry in India. While in the State of Kerala, the strategy would be to sustain the existing workers and give them employment for more number of days, in other States it would be to create additional employment opportunities to the coir workers by setting up of more units in the field of extraction of coir fibre, yarn and products. Encompassing all these aspects a National Coir Policy for a holistic development of the industry has to be drawn up.

### **Findings:**

A total of around 3,66,000 Metric Tons of fibre were extracted during the plan period, and along with a substantive amount of husk was also generated. Earlier, coconut husk was treated as a waste product that used to rot and pose an environmental hazard. However, due to the breakthrough research of the R&D institutes in developing MFEM and C-Pom the scope of collection and utilization of husks has increased and the industry members as well as individual entrepreneurs have adopted the machine and the husk utilization technology. What is required now is to popularize the usage of MFEM and C-Pom by the R&D institutes with the end-users i.e. both small manufacturers, agriculturalists, conservationists, landscape designers, urban planners and agricultural research institutes through exhibitions, workshops, collaborative

projects and product demonstrations so that the usage and utility of husk increases in the coming years.

### **Role of R&D in Attracting Younger Generation to the Coir Sector**

Younger generation is attracted because of coir advantages of being environmental friendly natural fiber and value-added products manufactured by coir fiber. Various new technology machines have helped to increase the productivity and quality of the coir products so that they can compete with international player.

The research institutions i.e. CCRI and CICT have made considerable and commendable efforts to carry out original investigations to gain new scientific and technical knowledge directed towards modernization of coir fibre production processes, development of machines for effortless spinning & weaving of coir, product development and diversification, testing and standardization of coir /coir pith and extension of technologies to the benefit of the coir industry. For example, coir pith which was a waste generated in double quantities during the extraction of coir fibre from coconut husk was a huge problem to coir entrepreneurs two decades ago. It accumulated as hillocks & mountains along coir fibre extraction units as it was not degraded. Due to the R&D efforts of CCRI, coir pith today is a valuable product as it could be degraded to an organic soil nutrient & conditioner “Coir – Krishi-Mithra”. Furthermore, the properties of coconut husk chips & coir pith as a soil conditioner & nutrient source for floriculture could be highlighted, where the contribution of the research institutes have been immense. The potential of coir fibre & rubberized coir as garden articles & as suitable products for further value addition was also highlighted. Setting up of test facilities of international standards at CCRI facilitated export of large consignments of coir pith by entrepreneurs.

The export of coir & coir products from India registered an all-time high record of Rs.2281.65 crores in 2016-2017 of which the coir pith export contributed Rs.905.39 crores. This happened because the technology of weaving geotextiles on Anugraha loom developed by CCRI could be popularized in the coir industry which led to increased production & export of the same thereby benefitting the coir entrepreneurs in the industry. The technology of mechanical extraction of coir fibre using the Mobile Fibre Extraction Machine developed by CCRI led to increased

quantity of coir fibre & pith. The technology of weaving geotextiles on Anugraha loom developed by CCRI could be popularized in the coir industry which led to increased production & export of the same thereby benefitting the coir entrepreneurs. For example, there was a total of six technology transfers on coir machinery to machinery manufacturers in the financial year 2016-17 of which three were in MFEM, one for Vajra and the other two were for Anugraha loom.

As result of the technology developed by the institute the extraction of coir fibre from husk has been made easier (MFEM), drudgery in spinning of coir fibres has reduced by the technologies such as fibre magic, vegetable oil treatment and bio-chem treatment as well as design and development of various looms that has improved work atmosphere and productivity and new applications for coir products have been derived. Diversified products have been developed and can lead to the new markets other than the traditional coir products.

Standards have evolved by the effort of the research institute. By standardization the products can compete in the market. Institute also providing testing and technology support to the industry.

The point in elaborating all the above achievements is that these have been instrumental in providing the coir sector with the dynamism and modern outlook thereby upgrading it from a cottage based small scale sector to a modern, technologically competent and market oriented sector providing different types of job related and entrepreneurial opportunities. All these factors have been responsible for the attraction of youth to the coir sector. Interviews and survey results on interest of younger generation towards the coir sector showed an overwhelming 72.7 percent of responses thereby indicating that there is a direct and positive effect of modernization and technological advancement being spearheaded by the research institutes. Also, presently, almost 96 percent of the total workforce is under 50 years of which almost 20 percent of the workers are under 30 years. If a fraction of the percentage under the age group 31-50 years is accommodated in youth category and the category is stretched to 35 years, then it can safely be assumed that almost 24 percent of the current workforce is under 35 years. This data, read with the level of technological advancement, technical qualification of the manpower and the growth of

entrepreneurial activity and generation of employment would point to the involvement of youth and younger generation in the coir sector. All these have been possible due to the continued efforts of the research institutions in providing the technology bulwark for developing the scope, efficiency, spread and appeal of the coir sector.

However, field visits, interaction with the different stakeholders including industry members, workers, researchers and institute staff revealed that there remains a gap in institutionalizing the process of coir extraction and processing, which, in spite of many technological interventions, is still largely dependent on manual labour and physical process with the time period for the exercise stretching to months. This makes the process labour intensive and expensive and hence uneconomical for basing a large industry with mass production technology on it. This is unlike the modern technologies followed in other coconut producing countries where defibering and processing of coir as raw material of high quality is a mechanized process with less time and cost and a very large per capita output. In such a situation, the role of the research industry is to devise research strategies and programmes to fill the technology gap in the processing of coir into raw material so that the industry can get the traction to grow in scale and operations with latest technology to develop the white-collar management and technical cadre that will eventually attract the young generation to work in the coir sector.

#### **Findings:**

The extent of induction of the younger generation in the coir industry is limited to graduation of younger members of the family connected with the industry as part of familial progression. This is because the skills needed for working in this sector is still based on traditional knowledge and the R&D has only been able to provide some spectacular standalone innovations like MFEM C-Pom, Anugraha etc, which are efficient and useful but have not provided solutions to the long-drawn process of coir extraction as well as provide a complete seamless process from extraction of coir to its processing to form standardized yarns and raw material for developing different coir products. This will lead to rapid growth in scale of the industry to sustain a professional management and technical manpower system with well-defined job profiles and benefits to attract the youth and qualified young generation to this sector.

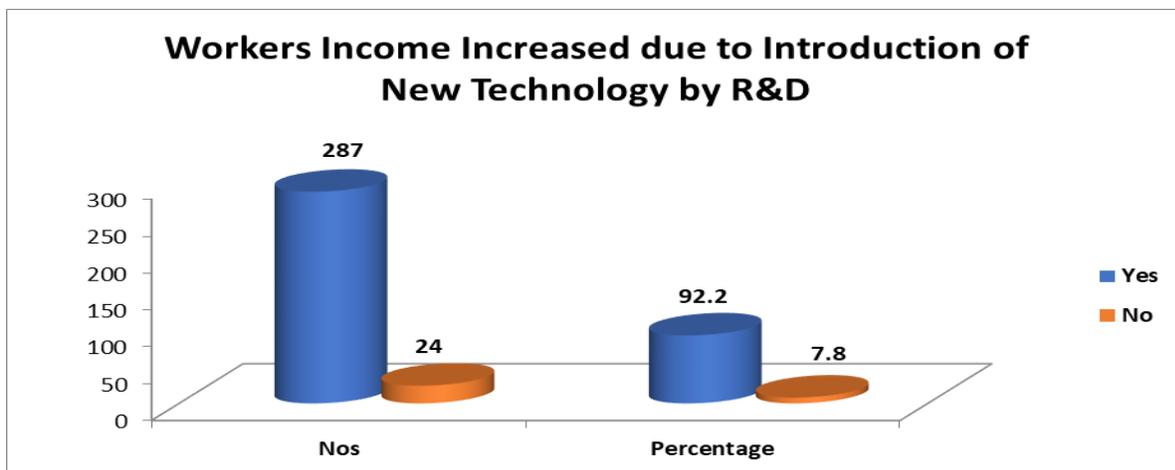
In essence, it can be concluded that the coir sector process is still managed through traditional processes with discrete technology interventions and the job requirements training is handed over to family members. Outside intervention an interest is not there because the process is traditional and the returns are low.

In such a situation, the focus of the R&D institutions should be to invest in studies to formalize and mechanize the coir extraction and processing on a large scale of industrial proportions so that the critical mass of raw material (coir yarn) is generated at optimum cost and time to create a market that will lead to creation of a technical and management cadre to attract the younger generation to the coir sector. In this endeavor, the research institutions can do collaborative studies with the IITs and IIMS to develop such systems. Also, to start with, they can source candidates from IITs, NITs and IIMS for research and managerial positions in their institutes.

### Increase in Workers Income due to New Technology Infusion by R & D efforts

The following graph shows the response of the workers contacted as part of the survey on coir workers, their scope, problems and prospects and to get a basic understanding of their status and its upliftment due to the efforts of R&D in infusing newer technologies and products to uplift the coir sector.

**Figure 5.1 Workers income increased due to introduction of new technology**



**Table 5.1 Workers income increased due to introduction of new technology**

Have Workers Income Increased due to Introduction of New Technology by R&D	Nos	Percentage
Yes	287	92.2
No	24	7.8
<b>Total</b>	<b>311</b>	<b>100</b>

The overwhelming responses (92.2%) of the workers from the sample group indicate that there has been a very certain and positive increase in income of the workers due to increase in technological inputs leading to growth in efficiency of production process and quality product output. In fact, it has also led to some workers graduating to small entrepreneurs apart from the existing entrepreneurs in the sector.

In order to highlight the positive impact of technology intervention of the science and technology programme in the six intervention areas in the plan period, the study analyzed the work of some sample groups as case studies as well as that of some entrepreneurs. It is mentioning two representation cases below:

**Case Study 6- Ms Beena (41 year)- Coir Worker**

Ms Beena (41 year) is working in Mangalathuvveli Coir Factory situated at Charthala Alleppey, Kerala. She is working from last 20 years in coir industry and doing spinning work. Earlier she was doing spinning work manually but at present she is working with automatic spinning



Particulars	Before infusion of New Technology	After Introduction of new Technology
Daily Production	12-14 Kg /per day	60 kg/per day
Hard Labour	High	Low
Working days	20 days in a month	24-26 day in a month
Daily Earning	Rs- 125 / per day	Rs- 300/per day
Health	Risk	Very Low
Safety	Low	High
Product Quality	Low	Good

machines. As reported given below. Production has increased due to

adaption of new technology and most of the workers in coir industries are being paid on production basis. Therefore, it has observed and reported by the users, R & D efforts are being done under S & T scheme are very helpful in development of coir industries as well as worker's health, safety, earnings etc.

**Case Study 7- Mr Babu (51 year)- Coir Worker- Weaving**

Mr Babu (51 year) is working in Amish Coir Works situated at Alleppey, Kerala. he is working from last 22 years in coir industry and doing weaving work. Earlier he was doing this with



Particulars	Before infusion of New Technology	After Introduction of new Technology
Daily Production	6 sq fit	10 sq fit
Hard Labour	High	Low
Daily Earning	Rs- 360 / per day	Rs- 550/per day
Health	Risk	Very Low
Safety	Low	High
Product Quality	Low	Good

wooden loom but at present (from 2015) he is working semiautomatic loom Uday. reported given below.

Production has increased due to development and adaption Semiautomatic loom Uday. Most of the workers in coir industries are being paid on production basis. Therefore, it has observed and reported by the users, R & D efforts are being done under S & T scheme are very helpful in development of coir industries as well as worker’s health, safety, earnings etc. etc.

The evidences and ratifications therefore are in favor of the R&D done by the institutes and the positive effect it has had on the income and lifestyle of workers as well as the ease with which they are able to do their work and earn better returns as compared to the stage when there was no technological intervention and the income was also low.

**Findings:**

An overwhelming 92 percent of the workers said that there has been an increase in the income and wages due to adoption of new technology. The increase in wages has been minimum of above fifty percent and has touched 100 percent in many cases. So overall, the impact of R&D interventions on workers’ wages and income has been very positive.

**Research Institutes- Fulfillment of Objective**

The Central Coir Research Institute (CCRI) and Central Institute of Coir Technology (CICT) were established to implement the S&T programmes for the development of coir industry. The total of research and infusion of technology includes researching on both the types of fibres i.e. brown and white fibre, efficient extraction of yarn, utilization of coir pith husk and producing innovative products with better and preferably eco-friendly technologies and ingredients in a process that has lees of drudgery and with better equipment. The outcome that is expected is that

the coir extraction, pith and husk utilization has attained efficient in terms of output and is less cumbersome. There has been development of newer type of products and processes that have contributed to the development of the coir sector and attracted the attention of consumers and new generation employees. There has been collaboration with different research institutes in India and abroad on technologies and processes to achieve further technological upgrading and overall modernization of the coir sector among others. The inputs received from field observations and interactions with stakeholders as analyzed and evaluated in the preceding sections provide fair enough assessment to consider the success of R&D efforts in achieving the desired objectives. This is more so plausible considering that though the progress on the stated objectives have not been spectacular, yet they have overall shown positive trends. However, it can well be argued that had there been timely filling up of the different vacant posts in the two research institutions, then the level of accomplishment in fulfilling the objectives might have been higher. A list of the vacancy positions during the period under review are mentioned below:

**Shortage of Technical and Scientific Staff**

**Vacant Position in CCRI Kalavoor**

Department	Vacant Position
Director RDTE	Joint Director (Research)
Engineering Department	Senior Scientific Officer (Mech) -1
	Scientific Assistant (Mech) -1
	Draughtsman -1
	Mechanic Grade II-1
	Fabrication Mistry -1
	Black Smith -1
	Carpenter -1
	Fitter Mechanic -1
Chemistry and Testing	Senior Scientific Officer (Poly)-1
	Scientific Assistant (Poly)-1
	Technical Assistant (Testing)-1
	Lab Assistant -2
Product Development and Diversification	Senior Scientific Officer (PD)-1
	Weaving Assistant-1
	Machine Operator- 2
Microbiology	Senior Scientific Officer (Micro)-1
Dye House	Dye Master-1
	Technical Assistant (Dyeing) -1
	Boiler Operator-1
	Boiler Attendant -1
	Helper (Dyeing) -3

<b>Additional Required Human Resource in CCRI Kalavoor</b>	
Microbiology	Joint Director (Microbiology.)
Product Development and Diversification	Joint Director (Geotextiles)
	Senior Scientific Officer (Geotextiles)

### **Vacant Position in CICT Bangalore**

<b>Department</b>	<b>Position</b>
Machine Design and Development	Senior Scientific Officer -1
	Scientific Assistant (Mech) -1

<b>Additional Required Human Resource in CICT Bangalore</b>	
Machine Design and Development	Scientist (Expert in Polymer Sc)
	Scientist (Expert Textile Technology)
	Engineer (M Tech- Mechanical)
Testing Department	Testing Head (PG-Chemistry Background)

### **Additional Infrastructure Required**

<b>CCRI Kalavoor</b>	<ol style="list-style-type: none"> <li>1. Twin screw extruder and pelletizer</li> <li>2. Brookfield viscometer</li> <li>3. Infrastructure for setting up of an ECO Lab (List Attached)</li> </ol>
<b>CICT Bangalore</b>	<ol style="list-style-type: none"> <li>1. With pilot machines, real time machineries are required for product development and diversification.</li> </ol>

It is not that the process was not functioning for filling up the vacant posts, but there are many dynamics attached in shortlisting and selecting the right candidates and putting them on board. Moreover, the process of selection in general, and government process in particular, is time consuming due to which these backlog in vacancies happened.

So, in order to avoid the occurrence of such situations in the current plan period, the research institutes should make anticipative planning in manpower requirements by bringing out a white paper on imminent vacancy positions one year prior to the actual occurrence and start the process of recruitment for the said positions. For impromptu vacancies, the institutes should keep a panel of consultants and experts so that they can be recruited on short-term and project basis in order to continue the flow of work. In order to facilitate the initiation of consultants or experts working on short term, the research institutes should finalize the work plan and process of implementation

of schemes at the outset so that the experts can take cue and carry forward the implementation of the schemes.

The same strategy should also be pursued in the realm of infrastructural preparedness in the form of bringing out a white paper on infrastructural requirements at the start of the preceding financial year and then fulfill the requirements accordingly. For example, interaction with the officers of the research institutes revealed that research institutes are promoting the establishment of Eco-Labs for the benefit of the coir industry.

**Establishment of Eco-Labs:** The research institutes are promoting the establishment of Eco-Labs for the benefit of the coir industry. The different benefits of establishing Eco-Labs are mentioned below:

- a. To meet the mandatory requirements of the Pollution Control Board for testing of coir products with regard to the emissions in air, water and soil.
- b. To test the coir products as per the 'ECOMARK' Criteria that has been finalized in consultation with the Central Pollution Control Board (CPCB) and has been recommended by the CPCB to the Ministry of Environment and Forests for acquiring of ECOMARK for coir products.
- c. European countries have banned the import of textiles which are dyed with chemical dye stuffs which contain 22 banned amines which have been found to be highly toxic to health. The facility is required to detect the presence of these 22 amines in the dye stuffs used in the coir industry and give clearance certificates so that the coir products will be eligible for export to European countries, which is a big market for coir products. ECOLAB will extend this facility to coir exporters/entrepreneurs/industrialists.

This is an important aspect of popularizing the usage of coir products with the masses and therefore needs to be pursued for implementation.

### **Findings:**

The research institutes had many vacant positions during the plan period. The position of Joint Director, Research at CCRI is still vacant, apart from eight vacant positions in the engineering department, four positions in chemistry and testing department, one position in micro-biology department, a joint director position in micro-biology department, five positions in dye-house

department and two positions in product development and diversification department of which one is a joint director position. In CICT, there are two vacant positions and three additional job requirements in machine design and development department and two additional requirements in the testing department. In terms of infrastructure, there are three requirements in CCRI and one infrastructure related requirements in CICT. All the department should immediately fill up the HOD posts in CCRI and CICT, and also recruit a joint director research in CCRI. The ideal strategy will be to recruit young professionals from IITs and IIMs so that they bring in fresh ideas to develop the coir sector systems, processes, technologies, infrastructure and products.

Additionally, a Centre of Excellence as a nodal vehicle to coordinate and collaborate on breakthrough research on coir industry based technologies, foster partnerships with leading research institutions nationally and globally, should be established to infuse new ideas, technologies and processes to the coir sector.

### **New Areas of Research and Development in Coir Industry**

Interaction with the officials and key stakeholders in the research institutions including the Director of CCRI revealed that there are many proposals that are being discussed and initiated, and are at various stages of consideration for implementation.

**Bio-Fuels from Coir Pith and Waste Fibre:** Talks are ongoing for collaboration with international institutions located in countries where bio mass is being harnessed for energy generation. Countries like Denmark, Finland & the UN provide funding support for development of bio-fuel using coir pith and waste fibre. Some of the prominent institutes with whom there are talks ongoing for active collaboration in this area are mentioned below:

- *Centre for Environmental Research & Technology(CE-CERT) \ Bourns College of Engineering University of California, Riverside California, USA.*
- *University of Bourns 59190 Bourdes Sweden Swedish countries for resource recovery.*
- *Boeing-Embraer, Joint Research Centre, Sao Jose Dos Campos Technology Park which has opened a joint centre for collaboration research to establish aviation biofuel industry in Brazil.*

**Bio-Plastics from Coir:** CCRI has initiated talks with the following national level and global institutions to develop bio-plastics from coir

- *State University of New York, College of Environmental Science and Forestry, Syracuse, New York 13210, USA*
- *Centre for Bio Polymer Science & Technology (CBPST), Kochi, Kerala, India*
- *CSIR-NEIST, Thiruvananthapuram, Kerala, India*

**Coir Composites:** CCRI has initiated talks with the following national level and global institutions to develop coir composites from coir waste.

- *Wageningen University & Research, Wageningen University & Research, The Netherlands.*
- *Indian Plywood Industries Research and Training Institute Bangalore, India*
- *Indian Institute of Technology(IIT), New Delhi, India*
- *Society for Development of Composites, Bangalore, India*

• **Coir Composite Products:** Composite products made of coir and another material are a focus area of research and development by the research institutes. These products being eco-friendly can be used in Green buildings in future and the demand for these products is anticipated to increase for use in the building industry as they are wood substitutes which prevent deforestation. This will promote the use of coir thereby utilizing the husk potential in all coconut growing states in India it is envisaged by the research institutes. A cost sheet of the different types of coir composite products is mentioned below for kind reference.

<b>Product</b>	<b>Unit of Measurement</b>	<b>Cost (Rs.)</b>
Coir Composite Boards.	Per Square feet	50
Coir Wall Panels.	Per Piece	110
Coir Composite Panel.	2.44m x 1.22 m	2240/-
Coir Pith & Wood Particle Panel	2.44m x 1.22m	1600/-
Coir Gift Articles.	Per Piece	75

**Coir Geo-Textiles and Coir Machinery:** CCRI has initiated talks with the following national level and global institutions to develop coir based composite geo-textiles and more technologically advanced coir machinery.

- *Linkage Project with the Australian Research Council, Australia*
- *Indian Jute Industries Research Association, Kolkata, West Bengal, India*
- *Indo German Tool Room, Ahmedabad, Gujarat, India*
- *National Institute of Technology (NIT), Trichy, Kerala, India*
- *National Institute of Technology, Kozhikode, Kerala, India*
- *Maulana Azad National Institute of Technology, (MANIT) Bhopal, India*

Action is also being initiated to constitute a team for study of the other areas which coir geotextiles can be used. Discussions on the potential use of coir geotextiles for applications in railways for embankment protection, cushioning in carriages and in tracks were held with the Executive Director(Carriage) & Director (Geotextiles & Carriage) by visiting the Railway Research Design & Standards Organization (RDSO), Lucknow in June-2017.

Other initiatives on research in further developing newer technologies and innovative products by the research institutes as part of their future R&D initiatives are mentioned below:

1.	Modification of the fully automatic one metre geotextiles weaving loom " Tejas" for weaving of wide width geotextiles for environmental applications for soil & water erosion control
2.	Development of machinery for manufacture of coir garden articles which is much in demand both in the Indian as well as export market
3.	Standardization of coir composites boards for interior & exterior applications for buildings so as to include the same under "Green Building" concept at CICT Bangalore
4.	Standardization of specifications for furniture including "Knockdown furniture" using coir composite/ coir wood at CICT Bangalore

Apart from the above inputs, the other suggestions that can be implemented to further the research and innovation climate in the coir sector can be by elevating both CCRI and CICT as Centers of Excellence for R& D in coir industry and thereby extend all technological help and grants under the S&T scheme to entrepreneurs/artisans through the National Coir Training & Design Centre under Coir Board by provision of adequate infrastructural facilities for the same. Along with the abovementioned initiatives, a comprehensive list of research proposals, initiatives and ideations under considerations are mentioned below:

## Possible Areas in R&D for the Coir Industry:

### (vi) Modernization of Production Process:

- **Improved MFEM:** Modification of MFEM to extract good quality fiber of uniform length and reduced impurities.
- **Improved Bio-Chem Treatment Process:** Development of technologies for quality improvement of coir fibre using Bio-chem treatment and enzyme treatment.
- **Fibre Quality Improvement Process:** Development of diversified products using a superior quality fibre such as Janata Mattress, superior quality coir floor covering that will result in increased production of new range of coir products which will be accepted both by internal and external markets

### (vii) Development of Machinery & Equipments:

- **Superior Weaving Machines:** Development of Plant Machinery and Control Systems to Spin Fine Quality Coir Yarn of Uniform Thickness and Reduced Hairiness for Weaving Superior Quality Coir Floor Furnishing Products and Shuttle Less Rapier Loom for easy weaving.
- **Improving Relevant Machines:** Improvement of machines like Pneumatic Anupam, machines for wrapping, Garden Article manufacturing, Coco-Log manufacturing, Multiple Head Curling machine and coir pith briquette machines will be undertaken to make these women user friendly, cost effective as well as more productive with better quality products.
- **Setting Up Tool Room:** A tool room will be set up/strengthened at CCRI for development-cum-repairing of different coir processing machines and for nurturing of coir processing workers to apprise them of maintenance and running the machine appropriately for maximum efficiency.

Apart from the above proposals, an anticipative planning on proposals for development of relevant machineries for the next twenty years have also been drawn up, the list of which is mentioned below:

- **Development of Rapier model shuttle less loom for weaving coir mattings in large quantity:** This project refers to the shuttle less power loom. At present power looms with the help of shuttle is being used in the industry for the production of coir mattings. The

compressed wood used for the fabrication of shuttle makes huge noise while in operation. A shuttle less loom for weaving coir matting's will be eco-friendlier and help for huge production of continues coir matting's

- **Development of fully automatic power loom for weaving thin variety of blended coir/natural fabrics:** At present, there is more demand for the thin variety of blended coir fabrics for producing diversified products but the production is limited due to the hand looms being used in the industry. By developing a fully automatic power loom for weaving more quantity of blended coir fabrics, it will be a boon to the industry.
- **Development of vertical Ring model coir spinning machine to spin different varieties of good quality of coir yarn for diversified use:** A good quality coir spinning machine to spin coir yarn with uniform thickness and reduced thickness is a long term need of coir industry. By this project, the issues related with the spinning sector of the coir industry will be solved
- **Development of drying machine for coir pith for logistics purpose for export:** A coir pith drier can be used for the drying of coir pith in bulk so as to compress the same for pith block for export purpose.
- **Development of fully automatic screen printing machine for PVC tufted mats:** The stenciling unit being used in the industry needs more man power for the operation, costly and time consuming. In this scenario, a fully automatic screen printing machine will be more benefit for the industry
- **Development of fully automatic fibre mat loom:** The production of fibre mat in the loom needs skilled labour, time consuming and production is very less. By this project, all of above problems can be solved
- **Development of fully automatic beaming device for warp coir yarn:** The winding of warp yarns in the beam for beaming operation is being done manual and the tension in warp yarn will be different which may affect the quality of the product. A fully automatic beaming device for winding the warp yarn will help to maintain the uniform tension in the each and every warp yarn as same
- **Development of modified version of bobbin winding machine for coir yarn:** At present, the bobbin winding machine being used in the industry is made out of heavy

weight materials and it is costly, the maintenance is more. This project will help to solve the problems associated with the existing machine

- **Development of fully automatic rope making machine:** At present, the rope is making manually only. This project proposal is focused into the fully automatic version

**(viii) Product Development & Diversification:**

- **Natural Dye Extraction Plant:** Operationalization of a natural dye extraction plant for production of naturally dyed coir product which will be 100% eco-friendly, is on plan.
- **Diversified Coir Products Plant:** Setting up of Pilot Plant for the production of diversified coir products which would increase the utilization of coconut husk for fibre extraction in all coir producing States thereby providing employment to rural youths which would prevent migration from rural areas to urban areas.
- **Extracting Sodium Lignosulphonate from Coir Pith:** Setting up of pilot plant for extraction of sodium lignosulphonate from coir pith as a demonstration for industrial application at CCRI as well as plans for diversified uses for cellulose and lignin from coir.

Other than the abovementioned areas of research, it is also known that Nano cellulose and cellulose nano-fibers are a value addition to the coir and the value and application of nanocellulose and cellulose nano-fibres are far high compared to the fiber and pith. Development of cellulose nano-fibres requires more R&D for which a proposal can also be drawn up. Besides, the thermos-setting resin characteristics of resin needs to be explored for development of value added products from coir.

**(ix) Development of Environment friendly technologies:**

- **Eco-Lab:** Setting up of Eco lab at CCRI, Kalavoor with the State-of-art equipments will be beneficial to exporters in testing the parameters extending for them in time and Coir Board proposes to help the exporters for a long period as part of improving the export of eco-friendly coir products. This will lead to development of nature friendly technology and will enhance acceptability of product before the discerning customers both in domestic and external market who are concerned about environment. Other benefits of eco-friendly products are it will lead to development of environment friendly technologies that will improve working and living conditions of workers. Also,

marketability of coir products against synthetic floor coverings can be increased by development of products with more aesthetic appeal.

- **International Collaborations in Research:** The research institutes in order to get new ideas, processes and technologies are considering international collaborations with countries where bio mass is being harnesses for energy generation. Countries like Denmark, Finland & the UN provide funding support for the above. There are proposals for collaboration under discussions with the following research centres:

- 5) Centre for Environmental Research & Technology(CE-CERT)
- 6) Bourns College of Engineering University of California, Riverside California, USA
- 7) Swedish countries for resource recovery University of Bourns 59190 Bourdes, Sweden.
- 8) Boeing-Embraer, Joint Research Centre, Sao Jose Dos Campos Technology Park which has opened a joint centre for collaboration research to establish aviation biofuel industry in Brazil.

**(x) Technology Transfer, Incubation, Testing & Service Facilities:**

- **ASPIRE:** ASPIRE is a scheme for providing incubation training on technology developed by the research institutes. It is being implemented in CCRI & CICT where incubation training on the technology will be imparted.
- **Product Testing Centres:** There is a proposal for setting up testing centres and sufficiently equipped laboratories for carrying out the testing requirements of customers of various coir products so that they satisfy the customer requirements and live up to their expectation standards besides getting certified for their authenticity, process and ingredients.

**Infrastructure Facilities:** The laboratory facilities developed at CCRI are excellent and state of the art, however, better utilization of these is required. The CCRI may consider signing MoU with local research and educational institutes for collaborative projects on coir for better utilization of these expensive machineries.

**Extension Services:** Extension services are to be prioritized and greater emphasis on the dissemination of the technologies to the field level functionaries and entrepreneurs, beneficiaries

need to be made. Capacity building Programs and Trade Related (Coir) Entrepreneurship Development Programs (TREAD) and Seminars need to be arranged periodically:

### **Inputs from Industry Members:**

The study also got some valuable inputs from different members of the industry on the research and development support required in many areas in order to further develop the scope of the coir industry in providing innovative products, developing newer technologies and ensuring overall growth of the coir sector based industries.

**Research in Efficient Extraction of Coir:** Mr Nagarajan, a leading exporter of coir products and President of Tamilnadu Coir Industry Association said that the key to volume growth in the coir industry lies in providing more attention to developing technologies to get more output in extraction of coir as raw material for producing different types of coir products. He considers the role of research and development as vital to get breakthrough in developing better machinery that can produce soft texture fibres without breakage, which is one of the major concerns of the coir sector entrepreneurs.

**Development of Bleaching Process:** Another requirement of the coir sector is the bleaching process that is costly and time consuming, and here the entrepreneurs see the role of research and development in developing better technologies for speedy and cost-effective bleaching process.

**Establishment of Coir Research Institute:** One of the prominent suggestions given by the entrepreneurs of Tamilnadu is that a Coir Research Institute may be established in Tamilnadu and other coir producing states so that more collaboration may be done because coir industries have never ending scope and opportunities in domestic and international market.

**Development of Coir Blended Fibres:** Blending of coir with other fibres is a suggestion that was also voiced by the entrepreneurs as they felt it will lead to new products development apart from the usual mats and matting. It will promote the use of coir in different ways as with other natural fibres. So, R & D should promote research and technological application on blending with other natural fibre for new product development they felt.

**Development of Coir Spinning Sector:** The coir industry requires development of the spinning sector as there is a need of more research to find technologies to for large scale yarn production. For spinning coir mill, the concept of centralized spinning should come including fabrication of versatile machine for spinning which can produce at least one ton daily as the present capacity is very low especially for developing yarn and other geo textiles. R & D is required for developing technology to produce uniform yarn. Once good quality yarn is available than it will be possible to develop many new products, the said. Some of the industry members said that subsidy may be provided for new product and machine development for the coir weaving sector.

**Development of Coir Composite Products:** One of the suggestions that came by way of interaction with the industry members is with regards to development of composite products using plastic waste and coir wood, which they felt has very good opportunity. Accordingly, they said that research should be done in cost minimization and other waste material like plastic or other can be mixed with coir and low-cost board can be developed.

**Dissemination of Research Output to Public and Consumers:** Industry members felt that the public at large is not aware of the possibilities that the coir sector can provide in terms of products for their different needs. They also felt that the public does not know that the industry is now more organized and has gone up in scale with government support and the contribution of research institutions in developing better technologies to improve the industry processes and products. So, they felt the Government should take step to create awareness and usefulness of coir sector and its spread and size, its products and research initiatives, its collaboration with other institutes and products to develop composite products like coir ply, blended yarn, and the contribution of the research institutes in continued development for the sector. In this way, the coir sector will be popularized and confidence will come in general people to use it, they said.

**Value Added Products from Coir Pith:** Industry members said that coir pith is being exported in other countries and they use it as raw material and make manure for various purpose. Some R & D has been done in CCRI but there is a need to do more research on this product so that end product can be exported from India. Many important materials like lignin can be extracted from the coir pith which is being imported from other countries. It can be developed here in lower cost

through the research effort of R&D institutions, they said. Also Curled coir is having good demand in East Europe, USA and other countries but here the quality specification is difficult to adhere and what is produced here is of slender quality and slandered quality. So, they felt that if specific research is undertaken to produce curled coir then it can cater to the demand for it in the western countries and earn valuable foreign exchange.

**Other Suggestions:** Along with all the above-mentioned suggestions, one of the suggestions that arose from the industry members is the lack of adequate professionals in the research institutions. It seems, the industry is aware of the shortage of qualified manpower in the research institutes and the long term vacant situation of important research posts. It is due to this that the members said the government should take urgent steps to provide young qualified professionals in research institutions as it is lacking now and from many years. A good research team is required in CCRI and CICT, which they felt is the need of the hour.

### **Findings:**

The possible new areas in R&D in the Coir Industry for which proposals are being discussed and initiated, and are at various stages of consideration for implementation include developing technologies for generating Bio-Fuels from Coir Pith and Waste Fibre in collaboration with global research institutes for international collaborations include:

- *Centre for Environmental Research & Technology(CE-CERT) \ Bourns College of Engineering University of California, Riverside California, USA.*
- *University of Bourns 59190 Bourdes Sweden Swedish countries for resource recovery.*
- *Boeing-Embraer, Joint Research Centre, Sao Jose Dos Campos Technology Park which has opened a joint centre for collaboration research to establish aviation biofuel industry in Brazil.*

Other areas of international collaboration include developing bio-plastics from coir in association with research institutes include:

- *State University of New York, College of Environmental Science and Forestry, Syracuse, New York 13210, USA*
- *Centre for Bio Polymer Science & Technology (CBPST), Kochi, Kerala, India*
- *CSIR-NEIST, Thiruvananthapuram, Kerala, India*

and Coir Composites in collaboration with the following research institutes:

- *Wageningen University & Research, Wageningen University & Research, The Netherlands.*
- *Indian Plywood Industries Research and Training Institute Bangalore, India*
- *Indian Institute of Technology(IIT), New Delhi, India*
- *Society for Development of Composites, Bangalore, India*

Other proposals for research include research on developing coir composite products, coir geotextiles and coir machinery with the following arrangements.

- *Linkage Project with the Australian Research Council, Australia*
- *Indian Jute Industries Research Association, Kolkata, West Bengal, India*
- *Indo German Tool Room, Ahmedabad, Gujarat, India*
- *National Institute of Technology (NIT), Trichy, Kerala, India*
- *National Institute of Technology, Kozhikode, Kerala, India*
- *Maulana Azad National Institute of Technology, (MANIT) Bhopal, India*

Other possible research interventions in five of the six technology research intervention areas and development of infrastructure:

**(xi) Modernization of Production Process:**

- **Improved MFEM:** Modification of MFEM to extract good quality fiber of uniform length and reduced impurities.
- **Improved Bio-Chem Treatment Process:** Development of technologies for quality improvement of coir fibre using Bio-chem treatment and enzyme treatment.
- **Fibre Quality Improvement Process:** Development of diversified products using a superior quality fibre such as Janata Mattress, superior quality coir floor covering that will result in increased production of new range of coir products which will be accepted both by internal and external markets

**(xii) Development of Machinery & Equipments:**

- **Superior Weaving Machines:** Development of Plant Machinery and Control Systems to Spin Fine Quality Coir Yarn of Uniform Thickness and Reduced Hairiness for Weaving Superior Quality Coir Floor Furnishing Products and Shuttle Less Rapier Loom for easy weaving.

- **Improving Relevant Machines:** Improvement of machines like Pneumatic Anupam, machines for wrapping, Garden Article manufacturing, Coco-Log manufacturing, Multiple Head Curling machine and coir pith briquette machines will be undertaken to make these women user friendly, cost effective as well as more productive with better quality products.
- **Setting Up Tool Room:** A tool room will be set up/strengthened at CCRI for development-cum-repairing of different coir processing machines and for nurturing of coir processing workers to apprise them of maintenance and running the machine appropriately for maximum efficiency.

Apart from the above proposals, an anticipative planning on proposals for development of relevant machineries for the next twenty years have also been drawn up, the list of which is mentioned below:

- **Development of Rapier model shuttle less loom for weaving coir mattings in large quantity:** This project refers to the shuttle less power loom. At present power looms with the help of shuttle is being used in the industry for the production of coir mattings. The compressed wood used for the fabrication of shuttle makes huge noise while in operation. A shuttle less loom for weaving coir matting's will be eco-friendlier and help for huge production of continues coir matting's
- **Development of fully automatic power loom for weaving thin variety of blended coir/natural fabrics:** At present, there is more demand for the thin variety of blended coir fabrics for producing diversified products but the production is limited due to the hand looms being used in the industry. By developing a fully automatic power loom for weaving more quantity of blended coir fabrics, it will be a boon to the industry.
- **Development of vertical Ring model coir spinning machine to spin different varieties of good quality of coir yarn for diversified use:** A good quality coir spinning machine to spin coir yarn with uniform thickness and reduced thickness is a long term need of coir industry. By this project, the issues related with the spinning sector of the coir industry will be solved
- **Development of drying machine for coir pith for logistics purpose for export:** A coir pith drier can be used for the drying of coir pith in bulk so as to compress the same for pith block for export purpose.

- **Development of fully automatic screen printing machine for PVC tufted mats:** The stenciling unit being used in the industry needs more man power for the operation, costly and time consuming. In this scenario, a fully automatic screen printing machine will be more benefit for the industry
- **Development of fully automatic fibre mat loom:** The production of fibre mat in the loom needs skilled labour, time consuming and production is very less. By this project, all of above problems can be solved.
- **Development of fully automatic beaming device for warp coir yarn:** The winding of warp yarns in the beam for beaming operation is being done manual and the tension in warp yarn will be different which may affect the quality of the product. A fully automatic beaming device for winding the warp yarn will help to maintain the uniform tension in the each and every warp yarn as same.
- **Development of modified version of bobbin winding machine for coir yarn:** At present, the bobbin winding machine being used in the industry is made out of heavy weight materials and it is costly, the maintenance is more. This project will help to solve the problems associated with the existing machine.
- **Development of fully automatic rope making machine:** At present, the rope is making manually only. This project proposal is focused into the fully automatic version

**(xiii) Product Development & Diversification:**

- **Natural Dye Extraction Plant:** Operationalization of a natural dye extraction plant for production of naturally dyed coir product which will be 100% eco-friendly, is on plan.
- **Diversified Coir Products Plant:** Setting up of Pilot Plant for the production of diversified coir products which would increase the utilization of coconut husk for fibre extraction in all coir producing States thereby providing employment to rural youths which would prevent migration from rural areas to urban areas.
- **Extracting Sodium Lignosulphonate from Coir Pith:** Setting up of pilot plant for extraction of sodium lignosulphonate from coir pith as a demonstration for industrial application at CCRI as well as plans for diversified uses for cellulose and lignin from coir.

**(xiv) Development of Environment friendly technologies:**

- **Eco-Lab:** Setting up of Eco lab at CCRI, Kalavoor with the State-of-art equipments will be beneficial to exporters in testing the parameters extending for them in time and Coir Board proposes to help the exporters for a long period as part of improving the export of eco-friendly coir products.
- **International Collaborations in Research:** International collaborations with countries where bio mass is being harnesses for energy generation. Countries like Denmark, Finland & the UN provide funding support accordingly:
  - 9) Centre for Environmental Research & Technology(CE-CERT)
  - 10) Bourns College of Engineering University of California, Riverside California, USA
  - 11) Swedish countries for resource recovery University of Bourns 59190 Bourdes, Sweden.
  - 12) Boeing-Embraer, Joint Research Centre, Sao Jose Dos Campos Technology Park which has opened a joint centre for collaboration research to establish aviation biofuel industry in Brazil.

**(xv) Technology Transfer, Incubation, Testing & Service Facilities:**

- **ASPIRE:** ASPIRE, a scheme for providing incubation training on technology developed by the research institutes, being considered for implementation in CCRI & CICT where incubation training on the technology will be imparted.
- **Product Testing Centres:** A proposal for setting up testing centres and sufficiently equipped laboratories for carrying out the testing requirements of customers of various coir products to satisfy customer requirements and live up to their expectation standards.

Other initiatives include reinforcing and utilizing the research infrastructure facilities and implementing schemes in dissemination of technologies to the end-users.

There were valuable inputs from industry members on possible areas of research to improve the prospects of the coir industry, which include conducting research in efficient Extraction of Coir, development of Bleaching Process, establishment of Coir Research Institute, development of Coir Blended Fibres, development of Coir Spinning Sector and Coir Composite Products, value

added products from coir pith besides dissemination of research output to public and consumers and recruiting qualified manpower for research institutes from top level educational institutions like IIT,NIT and IIMs.

### Need for Continuation of Scheme

The following table mentions the list of ongoing projects in the research institutes from the plan period under review.

#### Ongoing Projects with the Institutes (CCRI & CICT)

Project Title	Responsible Institution name	Start Date/Completion date	Cost of the Project (Rs in Lacs)	Released Fund (Rs in Lacs)	Status	Outcome of the project (project wise) Expected/Achieved
Graft Co-polymerization of Methyl Methacrylate on to coir fibre for quality improvement	CCRI	Feb'16/Feb/18	8.28	8.28	Project is ongoing. Technology of grafting onto coir is established. Property evaluation for fibre and yarn also completed. Property study on the value-added products are on the way	The physical properties of coir fibre and longevity can be enhanced by grafting and can lead to value added applications. Two international paper published in CORD.
Standardization of Binder-less Boards from coir pith	CCRI	03.10.16/31.10.17	9.69	9.69	The project is ongoing Binder-less boards from coir pith and used matting are taken as samples were sent to IPIRTI for property evaluation and standardization	Binder-less Boards with comparable or less cost than conventional particle boards without any synthetic binders.
Operationalization of ASTM/Hydraulic lab and library of CCRI	CCRI	Oct' 2015	9,90,000 for first year 1092000 for second year 1194000/ for third year	9,90,000 for first year 1092000 for second year	The project is ongoing by engaging project assistants for the operationalization of Library and ASTM lab.	
Modification of Coir fibre for value added applications	CCRI	Oct'16/Oct' 17	2.75	2.75	The project is ongoing by various surface treatment to coir fibre	

Project Title	Responsible Institution name	Start Date/Completion date	Cost of the Project (Rs in Lacs)	Released Fund (Rs in Lacs)	Status	Outcome of the project (project wise) Expected/Achieved
Lignin based glues for manufacture of process panel boards	CCRI	Oct'16/Oct'17	5.65	5.65	The project is ongoing. Laboratory scale resin development completed. Bulk scale trials are ongoing	The physical properties of coir fibre can be modified by various surface treatments for high end applications.
Development of flame retardant rubberised coir for cushioning applications in railways as per RDSO standards	CCRI	Feb'17/Feb'18	19.3	19.3	The project is ongoing for the development of flame retardant rubberised coir for cushioning applications in railways as per RDSO standards	A Bio-resin from Coir can be developed with properties equivalent to conventional PF resin. The so developed resin could be of E0 grade and without the formaldehyde emissions. The resin can be used in Coir wood and conventional plywood.  To impart flame retardancy to rubberized coir for find application in Railway coir cushioning
Design and Fabrication of Garden article making machine with different set of dyes	CICT	2014	4.80	3.98	On going	Development of coir industries and new entrepreneurs
Manufacturing of 5 sets of kitchen cabinets, wardrobe, sofa set...	CICT	2015	9.10	8.09	On going	For exhibition/marketing purpose
Project on greenhouse cultivation of plants using coir pit as a medium of cultivation	CICT	2014	5.55	NIL	Ongoing /human resource issue- 11 months project assistant and helper to be engaged	For demonstration and marketing purpose
Development of compreg board	CICT	2016	1.0	Nil	On going	For railways

Project Title	Responsible Institution name	Start Date/Completion date	Cost of the Project (Rs in Lacs)	Released Fund (Rs in Lacs)	Status	Outcome of the project (project wise) Expected/Achieved
Project on application of coir pith-plus (PSL Lab)	CICT	2016	1.62	.88	On going	Application and Testing
Project on Development of Process and Machinery for Spinning Fine Quality Coir Yarn of Uniformed Thickness and Reduced Hairiness	CCRI	2016	2.99	1.69	On going	Improved process and machinery for spinning fine quality coir yarn with uniform thickness and reduced hairiness

Information in the table shows that most of the projects are on track even if they are delayed as far as implementation period is concerned. All the same, they are crucial for the industry and the institutes' objectives of providing research support to the industry in general in order to provide the much-needed technology input for making the processes efficient and for developing new products. If the projects are left midway then it will serve no one's purpose. Alternately, these projects can be incorporated into a larger scheme of overall development of coir sector, as consolidation is one of the sore requirements of the coir sector, considering that it is now in a scattered state with the research institutes providing the fulcrum for the sector. Seen from that context also, the need and importance of the research programmes and the institutes grows manifold.

Along with the ongoing projects, the two research institutes are spearheading a number of incubation projects as part of their objective of promoting intervention of science and technology with the industry peers for overall development of the coir sector. A list of the incubation programmes currently underway are mentioned in the table below:

#### **Status Details of Incubation of R&D Technologies Developed by the Institutes (2012-17)**

Sl. No:	ADDRESS OF COIR ENTREPRENEUR	RESULTS
1.	Mr. P.M. CHAKOCHAN PUTHUPARAMBIL HOUSE, NEELAMKANDAM P.O., IDUKKI- 685 553 MOBITE No: <b>09961152463</b>	UNIT STARTED

2.	SMT. PONNAMMA. K., KURISUNKAL HOUSE NATTAKAM P.O. KOTTAYAM, MOBITE No: 09446069639	UNIT STARTED
3.	Mr.P.G. HSRIKUMAR PRAMADATH HOUSE, RANNI P.O., MUNDAPUZHA PATHANAMTHITTA- 689 672; MOBITE No: <b>09947386050</b>	PRELIMINARY WORK IS GOING ON AND SEEKING FOR CUY LOAN
4.	Mr.K.V. BALAN KAMALANIVAS, PALLICHANTHA, PALLIPPURAM P.O., CHERTHALA, ALAPPUZHA DIST., MOBITE No: <b>09287537681</b>	UNIT STARTED
5.	Mr. MANUKRISHNAN PANICKARETH PUTHANVEEDU, PATHANAM THITTA P.O., VALLIKKUNNAM-69 05001, MOBITE No: 08943148333	AT PRESENT NOT INTEREST
6.	Mr.RAJU C. ABRAHAM CHERIYIL KARUVEDAKAM P.O., CHENGALA KASARAGOD- 671 541, MOBITE No: <b>09744358775</b>	PRELIMINARY WORK IS GOING ON
7.	Mr.THOMAS PAYYAPPALLY PAYYAPPALLY HOUSE NEAR J.U.P.S., VARANCHARAPPALLY, P.O., THRISSUR; MOBITE No: <b>0946939123</b>	PRELIMINARY WORK IS GOING ON
8.	Mr.JOHNSON C.A., CHAMPAKKATTU HOUSE, KURUPPANKULANGARA P.O., CHERTHALA- 688 539 ; ALAPPUZHA DIST; MOBITE No: <b>094446512524</b>	UNIT STARTED
9.	Mr.JIBU. A.A., ARIBANAKULANGARA, MANNUR P.O., PALAKKAD- 678 642, MOBITE No: <b>09747455007</b>	PRELIMINARY WORK IS GOING ON
10.	Mr. P. MANIKANDAN No. 227, 5 <sup>TH</sup> J.J. STREET, SATHIYA NAGAR CHENNAI-96., MOBITE No: <b>09551310591</b>	PRELIMINARY WORK IS GOING ON
11.	Mrs. SREEDEVI ASARIPARAMBIL HOUSE, DOOR No.108, WARD-IV KOZHINJAMPARA, KRUTHEMPATHI P.O., MOBITE No: <b>09745030579</b>	PRELIMINARY WORK IS GOING ON
12.	Mr. HARIMOHAN UNNIKRISHNAN ARCADIA TC/10/16623 PULIMOODULINE VATTIYOORKAVU THIRUVANANDAPURAM MOBITE No: <b>08089677408</b>	PRELIMINARY WORK IS GOING ON
13.	Mr. M.P. SEBASTIAN MAVELI THAYIL HOUSE THURAVOOR P.O., CHERTHALA ALAPPUZHA DIST. MOBITE No: <b>08281414770</b>	PRELIMINARY WORK IS GOING ON
14.	Mr. V. SANKARAPILLAI GEETHA NIVAS NEENDAKARA KOLLAM	PRELIMINARY WORK IS GOING ON

	MOBITE No: <b>09567529912</b>	
15.	Mrs. AMBILY S. CHERUVALLIL KURAMPALA PANDALAM P.O., PATHANAMTHITTA MOBITE No: <b>09946659360</b>	PRELIMINARY WORK IS GOING ON
16.	Mr. P. MANIKANDAN No: 227,5 <sup>TH</sup> J J STREET SATHYA NAGAR CHENNAI MOBITE No: <b>09551310591</b>	ACTION INITIATED
17.	Mr. UNNIKRISSHANN K.E. EDAVARATH HOUSE PALLIPPURAM P.O., PATTAMBI PALAKKADU – 679 305 MOBITE No: <b>09446822378</b>	AVAITED CUY LOAN
18.	Mr. KURIYAKOSE KATTEKUDIYIL HOUSE MURAMPALLY P.O., KOZHIKODE- 673 580 MOBITE No: <b>09446566125</b>	PRELIMINARY WORK IS GOING ON
19.	Mr. RANGARAJAN T.R. THANNIKKAL HOUSE PERAMANGALAM P.O., THRISSUR- 680 545 MOBITE No: <b>09020209949</b>	PRELIMINARY WORK IS GOING ON FOR PITH BLOCK MAKING UNIT
20.	Mr. RANGARAJAN T.R. SINDHU NIVAS SANATHANAPURAM WARD ALAPPUZHA MOBITE No: <b>09048449916</b>	PRELIMINARY WORK IS GOING ON
21.	Mr. NIYAS P.I. ABBAD KEERTHI NAGAR IRON BRIDGE P.O., ALAPPUZHA MOBITE No: <b>09560997590</b>	CON'T TRAICE
22.	Mr. JAYA PRAKASH K.J. KOTHADATHE KIZHAKKETHIL HOUSE CHENGALLOOR P.O., PUTHUKKAD THRISSUR- 680 312 MOBITE No: <b>09497869752</b>	STARTED THE UNIT
23.	Mr. DEEPAK VATS 74-A, NEW POLICE LINE SECTOR-26, CHANDIGARH MOBITE No: <b>09728349550</b>	PRELIMINARY WORK INITIATED

24.	Mr. M.R. GOPAN UNNITHAN OTHARA SARAS MANJADITHARA PALLIKKAL P.O., KAYAMKUALAM, ALAPPUZHA MOBITE No: <b>09946216050</b>	PRELIMINARY WORK IS GOING ON
25.	Mrs. MANJUSHA RAJU SARASWATHI MANDIRAM S. ADUVASSERY P.O. ALUVA, ERNAKULAM DIST. MOBITE No: <b>09400773253</b>	PRELIMINARY WORK INITIATED
26.	Mr. B. SHAJISHA MUTTAL PUTHUVAL KEERIKKADU SOUTH KAYAMKULAM P.O. MOBITE No: <b>09447148199</b>	IN THE INDUSTRY
27.	Mr. RATHEESH V.G. PUTHANPURAKKAL NEDUMBASSERY MOBITE No: <b>09947330338</b>	PRELIMINARY WORK IS GOING ON
28.	Mrs. NINI SHAJI MUTTAL PUTHUVAL KEERIKKADU SOUTH KAYAMKULAM P.O. MOBITE No: <b>09744353674</b>	IN THE INDUSTRY
29.	Mr. ALDRIN VAZ VAS VILLA EXCHANGE ROAD ALAPPUZHA- 688 001 MOBITE No: <b>09846677230</b>	PRELIMINARY WORK INITIATED
30.	Mr. SABITH SABITH MANZIL CIVILSTATION ROAD ALAPPUZHA MOBITE No: <b>09995311884</b>	BIG UNIT STARTED TAMIL NADU <b>HE IS THE ONLY ONE COIR PITH SUPPLIER TO ENTIRE EGYPT.</b>
31.	Mr. SABAH MOHAMMED SABAH MANZIL VELLAKINAR ALAPPUZHA MOBITE No: <b>9995769721</b>	UNIT STARTED IN AN ELABARATED MANNER
32.	Mrs. VIJAYAMMA RAMAPURATH PUTHUVEL KANDALLOOR SOUTH P.O. KAYAMKULAM, ALAPPUZHA MOBITE No: <b>08606395690</b>	UNIT IS NOT STARTED NOW
33.	Mr. PATEL PRATIK KUMAR JAYANTHI BHAI AT & POST- ADIYA TA-HARIJ DIST. PATAN-384 265 GUJARATH MOBITE No: <b>09825439463</b>	PLANNED TO START COIR POLIMER BASED INDUSTRY (CANDIDATE IS A B. Tech ENGINEER)
34.	Mr. JOSE C.I. CHAKIYATH HOUSE-299 ELAVOOR P.O. ANGAMALI (VIA)	PRELIMINARY WORK IS GOING ON

	MOBITE No: <b>09495287880</b>	
35.	Mr. ASHARAF, MA PERL VALLEY ODAKKAM P.O. KANNUR- 670 741 MOBITE No: <b>0946827957, 09746423238</b>	UNIT STARTED IN AN ELABARATED MANNER
36.	Mr. K. RAMESH PANNIYANKARA KALAM PANNIYANKARA P.O. VADAKKANCHERRY- 678 683 MOBITE No: <b>09995544068</b>	UNIT STARTED
37.	Mr. M. GOWTHAMAN 131/TOWN SALAM TAMIL NADU CHENNAI MOBITE No: <b>09677798333</b>	STARTED THE PRELIMINARY WORKS
38.	Mr. BINESH KUMAR KONGOTTUPARAMBIL AYALUR PALAKKADU DIST. MOBITE No: <b>09447840710</b>	STARTED THE PRELIMINARY WORKS
39.	Mr. SANTHOSH. K. KANNOOTHIL HOUSE LAND LINE VILLAGECHERUKAPARAMBA P.O. MALAPPURAM MOBITE No: <b>09495344388</b>	PRELIMINARY WORK IS GOING ON
40.	Mr. SHAJAHAN PATHOOR PATHOOR HOUSE THIRURANGADI MALAPPURAM MOBITE No: <b>09747480674</b>	UNIT STARTED
41.	Mr. JECOB C.O., CHERICKAL HOUSE NATTAKAM P.O., KOTTAYAM MOBITE No: <b>09447662316</b>	NOW GOT GOVT. JOB UNDER POLUTION CONTROL BOARD
42.	Mr. T.K. SURESH SHEEBANIVAS PRAYAR SOUTH ALUMPEEDIKA OCHIRA, KOLLAM DIST. MOBITE No: <b>09946717710</b>	UNIT STARTED
43.	Mr. RAJU. K.O. KAKA PARAMBIL KANICHUKULANGARA, P.O. CHERTHALA MOBITE No: <b>09446192116</b>	STARTED THE PRELIMINARY WORKS
44.	Mr. JOHN. P.J. PUTHIYAMADATHIL VELLAMANDA MANANTHAVADI	STARTED THE PRELIMINARY WORKS

	WYNAD, P.O. WYNAD-670 731 MOBITE No: <b>09746314738</b>	
45.	Mr. PATEL VISHAL KUMAR KANTI BHAI GOTHI VAS, AT/P.O., ADIYA TA-HARIJ, DIST- PATAN-384 265 GUJARAT MOBITE No: <b>08530406230</b>	PLANNED TO START COIR POLIMER BASED INDUSTRY (CANDIDATE IS A BTech ENGINEER)
46.	Mr.G. SUDHEENDRAN THAKIDIVELIYIL KANNATHERY ERUMAPATTY THRISSUR- 680 584 MOBITE No: <b>09605050558</b>	PRELIMINARY WORK IS GOING ON
47.	Mr. ABDUL JALEEL. M. CHERIYAMANDAM MUTHAIKAT, P.O. MALAPPURAM- 676 106 MOBITE No: <b>09605400366</b>	PRELIMINARY WORK IS GOING ON
48.	Mr. DESMOND ANTONY REBEIRO THE HERITAGE FACTORY WARD ALAPPUZHA- 688 106 MOBITE No: <b>09562643454</b>	PRELIMINARY WORK IS GOING ON
49.	Mr. V.S. RAJU SARASWATHI MANDIRAM S. ADUVASSERY, P.O., ALUVA, ERNAKULAM DIST. MOBITE No: <b>09809038910</b>	STARTED THE PRELIMINARY WORKS
50.	Mr. ASSAHARUDEEN CHERUVILA VEEDU 28 <sup>TH</sup> MAIL NAVAIKULAM, P.O. THIRUVANANDAPURAM MOBITE No: <b>09387018600</b>	STARTED THE PRELIMINARY WORKS
51.	Mrs. SHAHIDA. P.M. PALATHINKAL HOUSE MUDAKAL, P.O. PERUMBAVOOR, P.O. ERNAKULAM MOBITE No: <b>09847338573</b>	PLANNED TO ATTEND FURTHER TRAINING IN COIR POLYMER TOYS
52.	Mr. PATEL VISHAL CHHAGAN BHAI RAJIBHAI BHAI GOTHI VAS, AT/P.O., ADIYA TA-HARIJ, DIST- PATAN (N.G) GUJARAT-384 265 MOBITE No: <b>08530406230</b>	PLANNED TO START COIR POLIMER BASED INDUSTRY (CANDIDATE IS A BTech ENGINEER)
53.	Mr. SIJO. P.L. PONNOYOR HOUSE P.O., PARAPPUR THRISSUR MOBITE No: <b>09747171104</b>	ELABORATED UNIT IS FUNCTIONING

54.	Mr. T.V. JOHN, M/s JMJ OIR INDUSTRIES, THIMIRI. P.O, KANNUR -670581 Ph:9447641782	COIR PITH UNIT IS RUNNING
55.	Mrs. VIDYA VASANT PATIL MAYOOR BAKERY, TILAK ROAD, ALIBAG-402 201 DISSTRIC: RAIGAD, MAHARASHTRA. MOBITE: 09422094046	PRELIMINARY WORK IS GOING ON
56	Mr. NEISON-JOCKY PEN GASS(NAVIWADI), SOPARA-(TALUK), PALGHAR DIST. PIN: 401 203 MAHARASHTRA STATE. MOBITE: 07798855017	PRELIMINARY WORK IS GOING ON
57	Mr. SHEIKH ZAHID FAZAL, SON OF S K FAZLUDDIN NEAR BENEFT TAILOR VSSSTADIUM, MOTIJHARAM SAMBALPUR, ODDISHA MOBITE: 07735825267, 08895400194	PRELIMINARY WORK IS GOING ON
58	Mr. PRASANT KAWSIKH PLOT No. 2624/3481 NEAR CHATURBHUI COTTAGE, P.O., BJB NAGAR, BHUBANESWAR PIN: 754 014 MOBITE: 9776824986	STARTED THE INDSTRY AT BHUBANESWAR
59	Mr. P. GOKULAKRISHNAN 72, SURABHI NAGAR VAZHUDHA REDDY VILLUPURAM, TAMIL NADU PIN: 605 401 MOBITE: O9500009380	WAITING FOR CUY LOAN
60	Mr. S. DEVAIAH (DANIEL) IIT-JODHPUR, RATHANAEL JODHPUR DIST. ROOM No. 1005 JODHPUR PIN: 342 011 MOBITE: O7728079848	FABRICATION OF COIR MACHINERIE AT IIT- JODHPUR
61	Mr. S. HAMEEDULLAH SHERIFF S/O V. SHAHJAHAN 120/23, MELLAPALLI STREET KAYALPATNAM, TUTICORIN DIST TAMIL NADU PIN: 628 204 MOBITE: O9894677286	PRELIMINARY WORK FOR SETTING UP OF PITHPLUS PRODUCTION UNIT
62	Mr. S. SANKAR RAM S/O Mr. S.S. SUBRAMANYAM No. 14/67, AGASTTIYAR SANNATHU STREET, KALLIDAIKURICHI, THIRUNELVELI DIST. TAMIL NADU PIN: 627 416 MOBITE: O9597187533	PRELIMINARY WORK FOR SETTING UP OF PITHPLUS PRODUCTION UNIT
63	Smt. ANITHA M. NAIR MUZHACHIKKAL HOUSE MUNDAPPUZHA RANNI, PATHANAMTHITTA DIST KERALA PIN: 689 672 MOBITE: O9496954947	PRELIMINARY WORK FOR SETTING UP OF COIR POLIMER BASED INDUSTRY

64	Smt. USHAKUMARI M.T. PARVATHI MANDIRAM MUNDAPPUZHA RANNI P.O., PATHANAMTHITTA DIST KERALA PIN: 689 672 MOBITE: 09400384722	PRELIMINARY WORK FOR SETTING UP OF COIR POLIMER BASED INDUSTRY
65	Smt. JAYA RAJAGOPAL MUZHACHIKKAL <b>MUNDAPPUZHA</b> RANNI P.O., PATHANAMTHITTA DIST KERALA PIN: 689 672 MOBITE: 09605296836	PRELIMINARY WORK FOR SETTING UP OF COIR POLIMER BASED INDUSTRY
66	Smt. SIMI.T.S. PRAMADATH <b>MUNDAPPUZHA</b> RANNI P.O., PATHANAMTHITTA DIST KERALA PIN: 689 672 MOBITE: 09605296836	PRELIMINARY WORK FOR SETTING UP OF COIR POLIMER BASED INDUSTRY
67	Mr. K. DENAYAL 7/410, POLLACHI MAIN ROAD SULTHANPET, SULUR (T.K) COIMBATORE. TAMIL NADU PIN: 641 669 MOBITE: 09605296836	PRELIMINARY WORK IS GOING ON
68	Mr. SANTHOSH. O.S. OROMARI HOUSE VARAVOOR P.O., THRISSUR KERALA PIN: 680 583 MOBITE: 09605296836	PRELIMINARY WORK IS GOING ON FOR STARTING A BIG UNIT
69	Mr. A.V. ACHUTHAN AVESSERY HOUSE VARAVOOR P.O., THRISSUR KERALA PIN: 680 583 MOBITE: 09995050345	PRELIMINARY WORK IS GOING ON FOR STARTING A BIG UNIT
70	Mr. REJEEV OLIYIL OLIYIL PADINJAKKARA MOOKKUTHAL HOUSE MALAPPUARAM DIST.KERALA PIN: 679 574 MOBITE: 08089797899	PRELIMINARY WORK IS GOING ON FOR STARTING A BIG UNIT
71	Smt. SHEELA K.A. SURENDRAN KAYYIPURAM, PANAVALLY P.O, CHERTHALA, ALAPPUZHA DIST. KERALA MOBITE: 09287948739	STARTED THE INDUSTRY WITH NURSERY.
72	MR. BHASKAR D. S/O DHARMA PRABHU C (LATE) 04,KAMALA NILAYA, MUNESWARA LAYOUT, ATTUR, YELAHANKA BANGALURU- PIN: 560 064 MOBITE: 0731282244	PRELIMINARY WORK IS GOING ON

73	Smt. NAGASHREE BELUR. J. D/O JAYAPRAKASH B.R., # 238, 707 2 <sup>ND</sup> FLOOR LIG 4 <sup>TH</sup> PHASE, YELAHANKA NEW TOWN BANGALURU- PIN: 560 064 MOBITE: 08105104170	PRELIMINARY WORK IS GOING ON
74	MR. UNNIKRISHNAN K. ASST. MANAGER, QA/Qc PERIYAR POLY PVT. LTD (SKY FOAM) POLLACHI, TAMIL NADU unni7731@gmail.com MOBITE: 08943630545	Attended training on Testing of Rubberized Coir through Chemistry department of CCRI.

As the table above depicts, the different incubation projects are at various stages of progress. Leaving them midway will not serve the purpose of the institute or the industry fraternity and moreover it is one of the core objectives of these institutes and their mission of providing S&T support to the coir industry.

## CHAPTER -6: SWOT ANALYSIS & CONCLUSION

In order to evaluate the justification of the R&D projects importance in the overall scheme of things, the SWOT of the presence of S&T and otherwise s mentioned below:

<b>Strengths:</b>	<b>Weaknesses:</b>
<ul style="list-style-type: none"> <li>• S&amp;T Scheme is the only mode of imparting new technologies to the coir industry considering that the industry members are not big enough to conduct large scale and continuous research, which the research institutes by way of being state funded, can continue with their work of providing technological leadership</li> <li>• S&amp;T Schemes are a focused programme aimed at innovating and developing new products and processes as a rallying point for the industry, which no industry member can supplement.</li> <li>• The industry may lose identity and scatter away, and degenerate into a low-level sector without fresh inputs in technology, processes and products, which the S&amp;T schemes are providing at present.</li> </ul>	<ul style="list-style-type: none"> <li>• The schemes are part of the routine government process and thereby experience the same procedural delays and elaborate decision-making processes that mar other government schemes, which stretches their implementation schedule.</li> <li>• The schemes are a top down approach at least in terms of implementation aspect, which creates gaps in implementation expectations and schedules.</li> <li>• The schemes are providing research solutions to some part of the coir extraction, coir and pith processing and other processes. They are not taking a comprehensive assessment of research and technology requirements, in which case the overall S&amp;T requirements for the sector may not come up, and gaps may still persist in research requirements</li> </ul>

<p><b>Opportunity:</b></p> <ul style="list-style-type: none"> <li>• S&amp;T Schemes under the aegis of research institutes can form a rallying point for consolidation of the industry in terms of spearheading standardization of processes and products, which is a need for a sector to gain traction in mass market products</li> <li>• Presently R&amp;D's focus is on developing discrete tools and technologies to provide part solutions, though what is needed is development of comprehensive technologies encapsulating the total raw material production and processing for products technology. The gap in solutions provides huge opportunity for R&amp;D to conduct research to develop and implement viable technology process thereby create a paradigm shift in the scale, size and structure of the coir industry</li> </ul>	<p><b>Threat:</b></p> <ul style="list-style-type: none"> <li>• No Threats</li> </ul>
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So, taking into account the points discussed and the different incubation projects, industry interface, market penetration and new product development happening at present, it would be advisable to continue with the S&T schemes in the next plan period.

**Findings:**

There are many important research projects that are currently underway for the betterment of the coir sector that include projects and assignments on:

- ✓ Graft Co-polymerization of Methyl Methacrylate on to coir fibre for quality improvement

- ✓ Standardization of Binder-less Boards from coir pith that is an eco-friendly and cost-effective technology
- ✓ Operationalization of ASTM/Hydraulic lab and library of CCRI
- ✓ Modification of Coir fibre for value added applications
- ✓ Development of Lignin based glues for manufacture of process panel boards
- ✓ Development of flame retardant rubberised coir for cushioning applications in railways as per RDSO standards
- ✓ Design and Fabrication of Garden article making machine with different set of dyes
- ✓ Manufacturing of five sets of home furniture requirements like kitchen cabinets, wardrobe, sofa set etc
- ✓ Project on greenhouse cultivation of plants using coir pit as a medium of cultivation
- ✓ Development of compreg board for Indian Railways
- ✓ Project on application and testing of coir pith-plus
- ✓ Project on Development of Process and Machinery for Spinning Fine Quality Coir Yarn of Uniformed Thickness and Reduced Hairiness

Along with the ongoing projects, the two research institutes are spearheading incubation projects with 76 industry units as part of their objective of promoting intervention of science and technology with the industry peers for overall development of the coir sector that are at various stages of progress. Leaving them midway will not serve the purpose of the institute or the industry fraternity. The necessity of continuing with the R&D schemes is highlighted in the SWOT analysis of the Scheme where the gaps in institutional research requirements necessitate the continuance of the scheme, especially in developing the technology and system for large scale, efficient, standardized and qualitative output of coir as raw material and coir finished goods that will upliftment the industry to mass industry status and develop the managerial and technical cadre to attract the educated younger generation for a fruitful career in the coir sector, which is presently confined to cottage industry based time consuming low output physical process where the skill is confined to traditional families engaged in coir sector. Development of technologies for creating the scale of operations will infuse new talent and develop the sector, in which the role of R&D schemes in spearheading it is of utmost importance.

<p><b>Strengths:</b></p> <ul style="list-style-type: none"> <li>• S&amp;T Scheme is the only mode of imparting new technologies to the coir industry considering that the industry members are not big enough to conduct large scale and continuous research, which the research institutes by way of being state funded, can continue with their work of providing technological leadership</li> <li>• S&amp;T Schemes are a focused programme aimed at innovating and developing new products and processes as a rallying point for the industry, which no industry member can supplement.</li> <li>• The industry may lose identity and scatter away, and degenerate into a low-level sector without fresh inputs in technology, processes and products, which the S&amp;T schemes are providing at present.</li> </ul>	<p><b>Weaknesses:</b></p> <ul style="list-style-type: none"> <li>• The schemes are part of the routine government process and thereby experience the same procedural delays and elaborate decision-making processes that mar other government schemes, which stretches their implementation schedule.</li> <li>• The schemes are a top down approach at least in terms of implementation aspect, which creates gaps in implementation expectations and schedules.</li> <li>• The schemes are providing research solutions to some part of the coir extraction, coir and pith processing and other processes. They are not taking a comprehensive assessment of research and technology requirements, in which case the overall S&amp;T requirements for the sector may not come up, and gaps may still persist in research requirements</li> </ul>
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<p><b>Opportunity:</b></p> <ul style="list-style-type: none"> <li>• S&amp;T Schemes under the aegis of research institutes can form a rallying point for consolidation of the industry in terms of spearheading standardization of processes and products, which is a need for a sector to gain traction in mass market products</li> <li>• Presently R&amp;D's focus is on developing discrete tools and technologies to provide part solutions, though what is needed is development of comprehensive technologies encapsulating the total raw material production and processing for products technology. The gap in solutions provides huge opportunity for R&amp;D to conduct research to develop and implement viable technology process thereby create a paradigm shift in the scale, size and structure of the coir industry</li> </ul>	<p><b>Threat:</b></p> <ul style="list-style-type: none"> <li>• No Threats</li> </ul>
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The ongoing projects, importance of research in technology of coir sector and the huge opportunities that are inherent in providing the process, technology and framework for scaling up of the coir sector necessitates that the schemes should continue in achieving, sustaining and further improving the coir industry.

**3. Conclusion:**

India is a young country. Every year India adds more than five million people eligible for securing jobs. India's young demographic profile has placed the country favorably in terms of

manpower availability. People can be turned to economic assets if they can be usefully employed. This demographic dividend requires engaging our youth in creative purpose through developing appropriate skills, including entrepreneurial skills in coir industry also.

With above facts India is also facing the problem of unemployment and poverty that continue to pose serious challenges to polity and economy of the nation. The need of the hour, therefore, is to create 'job providers' in large numbers rather than 'job seekers'. Coir sector provides scope for creating 'job providers' in the modern coir projects.

Development of the rural economy has been one of the prime concerns for Government of India. Accordingly, efforts have been made on a continuous basis for improving the economic and social well-being of people in rural areas on a sustainable basis. Despite the sincere efforts, the problems of poverty, unemployment, drudgery and migration still exist in rural economy. There is a need to address these problems by creating employment opportunities in the rural areas and this could be done by setting up of small enterprises in the Coir- based industry sector more so as nearly eighty percent of the workforce is women. There is ample scope for innovation, value addition and entrepreneurship development in this sector.

In this context, the role of research institutions in spearheading the development of the coir sector is much more essential than can be envisaged. The performance of the schemes in S&T has been beneficial for the coir industry in diffusing technology and processes for the betterment of the industry, provided newer technologies for de-husking, defibering, provided ideas for new products and developed the same, partnered with industry and research institutions in implementing the research outcomes under S&T scheme, provided mentoring and handholding support in incubation programmes under its supervision and provided all the necessary support to bring growth and spread of the coir sector by way of providing solutions in technological upgradation and product growth.

However, the projects and schemes that were earmarked for the plan period did not get completed during the period, the reasons for which have been discussed and analyzed. At the same time, the coir industry has also not been able to get the mass market position, even though it produces products that are counterpart of other mass market products like home furnishings, interiors, consumer goods, infrastructure equipment among others.

It is not that the schemes are not working on that front. But the fact is that the schemes and outcome have not got completed due to factors beyond the scope of the schemes or the institutions. However, it cannot be denied that the schemes had met their objectives to a great extent and are continuing to do so in the present scheme of things and arrangement. So, the implementation of schemes has been somewhat successful even though there is lot of scope and opportunity to further strengthen the scheme to bring about greater development in the coir sector. Important aspects of the development process that need constant implementation are being handled by the research institutions through their schemes in the form of providing handholding support, skill upgradation for overall development of products, processes and attracting the youth to the sector, mentoring industry members in technology incorporation and process improvement and providing overall support to the coir industry members.

The detailed conclusion on each aspects of the terms of reference for the study are mentioned below:

#### **Major Achievements – Project Head Cost and Benefit**

Fund released by the ministry under the scheme has been fully utilized in different five heads. The funds for using natural dyes and for IPR in coir sector were not utilized at all. Regarding the major achievements under each project head, the research institutes carried on their work on improving upon the technologies and products already developed in earlier years and in the process, improvised the products to make it more attuned to the end-users' requirements.

#### **Impact of Technologies Developed, on Coir Industry Workers, Operations and Output**

The responses from the sample group of workers show that the new technologies developed by the research institutes have helped increase the productivity of the workers by reducing drudgery and increasing the ease of operations, output of products and increase the safety levels at workplace. However, the technologies developed have managed to only provide solutions to the existing problems of the workers at the workplace. They have not helped the worker to gain expertise in product development or skill upgradation, or provided a comprehensive and technologically advanced process and system that will improve the profile of the workforce and help them graduate from their present level. The worker still today is that of people having familial connections with the coir sector and with low educational levels, both men and

womenfolk. It is still an industry having two levels of stakeholders i.e. entrepreneurs, who many a times double up as managers, and the workers. There is no institutionalized managerial team, both technical and marketing cadre, which the R&D through its S&T intervention could have helped in creating, by institutionalizing the process by introducing new technologies and systems.

### **Diffusion of Technology Developed by Research Institutes and Export Performance**

The technologies developed by the R&D institutes in defibering, de-husking and processing of coir pith into yarn have been majorly accepted by the industry and a total of around 150 industries of various size as well as scores of individual entrepreneurs have availed of the technologies and products developed by CRI and CICT. There has been an overall YoY growth in exports of coir and coir products in the financial year 2015-16 at the rate of 27.3 percent in volume exports and 20 percent in value exports. Here it is to be noted that the volume percentage in exports is higher than the value percentage growth. The inputs of the industry members on providing technology, process and products for manufacturing and selling value added products is important to note as by that way only the financial performance, market share and product profile of the coir products made in India will improve. So, the R&D institutes should focus on developed uniform yarn making technology and processes, value added finished products and blended yarns to improve the profile of the coir industry, inculcate interest in younger generation to work for the industry and improve the global and domestic market share.

### **Market Penetration of Products Developed by CCRI and CICT**

The new products like coir ply, C-Pom and geo-textiles have been tested and successfully transferred for industry utilization based on inputs gathered during field visits and interactions with stakeholders including the research institutes and industry members. Coir Board has initiated marketing of C-Pom through 17 manufactures registered under Coir Board for manufacturing and marketing the C-Pom. For geo-textiles, coir bhoovastra, the situation calls for interaction with the concerned decision making Govt Departments/Establishments like Irrigation, Roads and Highways, Port Trust authorities, Water Works, Construction and land scape, hotels and resort projects, Railways, Defense and other similar projects/organisations with a view to impress upon them the suitability of coir bhoovastra for permanent eco-friendly solution to soil

erosion and other civil engineering problems. Interaction with the concerned authorities with a view to selling the concept and persistent efforts thereafter will definitely yield beneficial results. Besides, seminars, preparation of manuals and guidelines conducting lab trial and field trial, collaborative research projects etc. should be undertaken to popularize the use of coir geotextiles, through awareness creation. The need for supplementing the effort through publicity needs no emphasis. Besides, there is enormous potential in the domestic market as is evident from the fact that already many synthetic geotextile manufacturers have entered the Indian market and many more are interested to enter the market.

The products have been developed as per innovative standards and are benchmark unto themselves. However, the input from the industry members point to the fact that propagation of the product benefits and its usage as supplements for synthetic products needs to be taken up by way of exhibitions, product demonstrations, tie-ups with large scale government body requirements to make them appealing to the customers and help in generating demand for such products.

### **Utilization of Coconut Coir Husk**

A total of around twenty-six lakh Metric Tons of fibre were extracted during the plan period, and along with a substantive amount of husk was also generated. Earlier, coconut husk was treated as a waste product that used to rot and pose an environmental hazard. However, due to the breakthrough research of the R&D institutes in developing MFEM and C-Pom the scope of collection and utilization of husks has increased and the industry members as well as individual entrepreneurs have adopted the machine and the husk utilization technology. What is required now is to popularize the usage of MFEM and C-Pom by the R&D institutes with the end-users i.e. both small manufacturers, agriculturalists, conservationists, landscape designers, urban planners and agricultural research institutes through exhibitions, workshops, collaborative projects and product demonstrations so that the usage and utility of husk increases in the coming years

### **Role of R&D in Attracting Younger Generation to the Coir Sector**

The extent of induction of the younger generation in the coir industry is limited to graduation of younger members of the family connected with the industry as part of familial progression. This is because the skills needed for working in this sector is still based on traditional knowledge and the R&D has only been able to provide some spectacular standalone innovations like MFEM C-Pom, Anugraha etc, which are efficient and useful but have not provided solutions to the long-drawn process of coir extraction as well as provide a complete seamless process from extraction of coir to its processing to form standardized yarns and raw material for developing different coir products. This will lead to rapid growth in scale of the industry to sustain a professional management and technical manpower system with well-defined job profiles and benefits to attract the youth and qualified young generation to this sector.

In essence, it can be concluded that the coir sector process is still managed through traditional processes with discrete technology interventions and the job requirements training is handed over to family members. Outside intervention an interest is not there because the process is traditional and the returns are low.

In such a situation, the focus of the R&D institutions should be to invest in studies to formalize and mechanize the coir extraction and processing on a large scale of industrial proportions so that the critical mass of raw material (coir yarn) is generated at optimum cost and time to create a market that will lead to creation of a technical and management cadre to attract the younger generation to the coir sector. In this endeavor, the research institutions can do collaborative studies with the IITs and IIMS to develop such systems. Also, to start with, they can source candidates from IITs, NITs and IIMS for research and managerial positions in their institutes.

### **Increase in Workers Income due to New Technology Infusion by R&D Efforts**

An overwhelming 92 percent of the workers said that there has been an increase in the income and wages due to adoption of new technology. The increase in wages has been minimum of above fifty percent and has touched 100 percent in many cases. So overall, the impact of R&D interventions on workers' wages and income has been very positive.

### **Research Institutes-Fulfilling of Objective**

The research institutes had many vacant positions during the plan period. The position of Joint Director, Research at CCRI is still vacant, apart from eight vacant positions in the engineering department, four positions in chemistry and testing department, one position in micro-biology department, a joint director position in micro-biology department, five positions in dye-house department and two positions in product development and diversification department of which one is a joint director position. In CICT, there are two vacant positions and three additional job requirements in machine design and development department and two additional requirements in the testing department. In terms of infrastructure, there are three requirements in CCRI and one infrastructure related requirements in CICT. All the department should immediately fill up the HOD posts in CCRI and CICT, and also recruit a joint director research in CCRI. The ideal strategy will be to recruit young professionals from IITs and IIMs so that they bring in fresh ideas to develop the coir sector systems, processes, technologies, infrastructure and products.

Additionally, a Centre of Excellence as a nodal vehicle to coordinate and collaborate on breakthrough research on coir industry based technologies, foster partnerships with leading research institutions nationally and globally, should be established to infuse new ideas, technologies and processes to the coir sector.

### **New Areas of Research and Development in coir Industry**

The possible new areas in R&D in the Coir Industry for which proposals are being discussed and initiated, and are at various stages of consideration for implementation include developing technologies for generating Bio-Fuels from Coir Pith and Waste Fibre in collaboration with global research institutes for international collaborations include:

- *Centre for Environmental Research & Technology(CE-CERT) \ Bourns College of Engineering University of California, Riverside California, USA.*
- *University of Bourns 59190 Bourdes Sweden Swedish countries for resource recovery.*
- *Boeing-Embraer, Joint Research Centre, Sao Jose Dos Campos Technology Park which has opened a joint centre for collaboration research to establish aviation biofuel industry in Brazil.*

Other areas of international collaboration include developing bio-plastics from coir in association with research institutes include:

- *State University of New York, College of Environmental Science and Forestry, Syracuse, New York 13210, USA*

- *Centre for Bio Polymer Science & Technology (CBPST), Kochi, Kerala, India*

- *CSIR-NEIST, Thiruvananthapuram, Kerala, India*

and Coir Composites in collaboration with the following research institutes:

- *Wageningen University & Research, Wageningen University & Research, The Netherlands.*

- *Indian Plywood Industries Research and Training Institute Bangalore, India*

- *Indian Institute of Technology(IIT), New Delhi, India*

- *Society for Development of Composites, Bangalore, India*

Other proposals for research include research on developing coir composite products, coir geo-textiles and coir machinery with the following arrangements.

- *Linkage Project with the Australian Research Council, Australia*

- *Indian Jute Industries Research Association, Kolkata, West Bengal, India*

- *Indo German Tool Room, Ahmedabad, Gujarat, India*

- *National Institute of Technology (NIT), Trichy, Kerala, India*

- *National Institute of Technology, Kozhikode, Kerala, India*

- *Maulana Azad National Institute of Technology, (MANIT) Bhopal, India*

Other possible research interventions in five of the six technology research intervention areas and development of infrastructure:

**(xvi) Modernization of Production Process:**

- **Improved MFEM:** Modification of MFEM to extract good quality fiber of uniform length and reduced impurities.

- **Improved Bio-Chem Treatment Process:** Development of technologies for quality improvement of coir fibre using Bio-chem treatment and enzyme treatment.

- **Fibre Quality Improvement Process:** Development of diversified products using a superior quality fibre such as Janata Mattress, superior quality coir floor covering that will result in increased production of new range of coir products which will be accepted both by internal and external markets

**(xvii) Development of Machinery & Equipments:**

- **Superior Weaving Machines:** Development of Plant Machinery and Control Systems to Spin Fine Quality Coir Yarn of Uniform Thickness and Reduced Hairiness for Weaving Superior Quality Coir Floor Furnishing Products and Shuttle Less Rapier Loom for easy weaving.
- **Improving Relevant Machines:** Improvement of machines like Pneumatic Anupam, machines for wrapping, Garden Article manufacturing, Coco-Log manufacturing, Multiple Head Curling machine and coir pith briquette machines will be undertaken to make these women user friendly, cost effective as well as more productive with better quality products.
- **Setting Up Tool Room:** A tool room will be set up/strengthened at CCRI for development-cum-repairing of different coir processing machines and for nurturing of coir processing workers to apprise them of maintenance and running the machine appropriately for maximum efficiency.

Apart from the above proposals, an anticipative planning on proposals for development of relevant machineries for the next twenty years have also been drawn up, the list of which is mentioned below:

- **Development of Rapier model shuttle less loom for weaving coir mattings in large quantity:** This project refers to the shuttle less power loom. At present power looms with the help of shuttle is being used in the industry for the production of coir mattings. The compressed wood used for the fabrication of shuttle makes huge noise while in operation. A shuttle less loom for weaving coir matting's will be eco-friendlier and help for huge production of continues coir matting's
- **Development of fully automatic power loom for weaving thin variety of blended coir/natural fabrics:** At present, there is more demand for the thin variety of blended coir fabrics for producing diversified products but the production is limited due to the hand looms being used in the industry. By developing a fully automatic power loom for weaving more quantity of blended coir fabrics, it will be a boon to the industry.
- **Development of vertical Ring model coir spinning machine to spin different varieties of good quality of coir yarn for diversified use:** A good quality coir spinning machine to spin coir yarn with uniform thickness and reduced thickness is a long term need of coir

industry. By this project, the issues related with the spinning sector of the coir industry will be solved

- **Development of drying machine for coir pith for logistics purpose for export:** A coir pith drier can be used for the drying of coir pith in bulk so as to compress the same for pith block for export purpose.
- **Development of fully automatic screen printing machine for PVC tufted mats:** The stenciling unit being used in the industry needs more man power for the operation, costly and time consuming. In this scenario, a fully automatic screen printing machine will be more benefit for the industry
- **Development of fully automatic fibre mat loom:** The production of fibre mat in the loom needs skilled labour, time consuming and production is very less. By this project, all of above problems can be solved
- **Development of fully automatic beaming device for warp coir yarn:** The winding of warp yarns in the beam for beaming operation is being done manual and the tension in warp yarn will be different which may affect the quality of the product. A fully automatic beaming device for winding the warp yarn will help to maintain the uniform tension in the each and every warp yarn as same
- **Development of modified version of bobbin winding machine for coir yarn:** At present, the bobbin winding machine being used in the industry is made out of heavy weight materials and it is costly, the maintenance is more. This project will help to solve the problems associated with the existing machine
- **Development of fully automatic rope making machine:** At present, the rope is making manually only. This project proposal is focused into the fully automatic version

**(xviii) Product Development & Diversification:**

- **Natural Dye Extraction Plant:** Operationalization of a natural dye extraction plant for production of naturally dyed coir product which will be 100% eco-friendly, is on plan.
- **Diversified Coir Products Plant:** Setting up of Pilot Plant for the production of diversified coir products which would increase the utilization of coconut husk for fibre extraction in all coir producing States thereby providing employment to rural youths which would prevent migration from rural areas to urban areas.

- **Extracting Sodium Lignosulphonate from Coir Pith:** Setting up of pilot plant for extraction of sodium lignosulphonate from coir pith as a demonstration for industrial application at CCRI as well as plans for diversified uses for cellulose and lignin from coir.

**(xix) Development of Environment friendly technologies:**

- **Eco-Lab:** Setting up of Eco lab at CCRI, Kalavoor with the State-of-art equipments will be beneficial to exporters in testing the parameters extending for them in time and Coir Board proposes to help the exporters for a long period as part of improving the export of eco-friendly coir products.

- **International Collaborations in Research:** International collaborations with countries where bio mass is being harnesses for energy generation. Countries like Denmark, Finland & the UN provide funding support accordingly:

13) Centre for Environmental Research & Technology(CE-CERT)

14) Bourns College of Engineering University of California, Riverside California, USA

15) Swedish countries for resource recovery University of Bourns 59190 Bourdes, Sweden.

16) Boeing-Embraer, Joint Research Centre, Sao Jose Dos Campos Technology Park which has opened a joint centre for collaboration research to establish aviation biofuel industry in Brazil.

**(xx) Technology Transfer, Incubation, Testing & Service Facilities:**

- **ASPIRE:** ASPIRE, a scheme for providing incubation training on technology developed by the research institutes, being considered for implementation in CCRI & CICT where incubation training on the technology will be imparted.
- **Product Testing Centres:** A proposal for setting up testing centres and sufficiently equipped laboratories for carrying out the testing requirements of customers of various coir products to satisfy customer requirements and live up to their expectation standards.

Other initiatives include reinforcing and utilizing the research infrastructure facilities and implementing schemes in dissemination of technologies to the end-users.

There were valuable inputs from industry members on possible areas of research to improve the prospects of the coir industry, which include conducting research in efficient Extraction of Coir,

development of Bleaching Process, establishment of Coir Research Institute, development of Coir Blended Fibres, development of Coir Spinning Sector and Coir Composite Products, value added products from coir pith besides dissemination of research output to public and consumers and recruiting qualified manpower for research institutes from top level educational institutions like IIT,NIT and IIMs.

### **Need for Continuation of Scheme**

There are many important research projects that are currently underway for the betterment of the coir sector that include projects and assignments on:

- ✓ Graft Co-polymerization of Methyl Methacrylate on to coir fibre for quality improvement
- ✓ Standardization of Binder-less Boards from coir pith that is an eco-friendly and cost-effective technology
- ✓ Operationalization of ASTM/Hydraulic lab and library of CCRI
- ✓ Modification of Coir fibre for value added applications
- ✓ Development of Lignin based glues for manufacture of process panel boards
- ✓ Development of flame retardant rubberised coir for cushioning applications in railways as per RDSO standards
- ✓ Design and Fabrication of Garden article making machine with different set of dyes
- ✓ Manufacturing of five sets of home furniture requirements like kitchen cabinets, wardrobe, sofa set etc
- ✓ Project on greenhouse cultivation of plants using coir pit as a medium of cultivation
- ✓ Development of compreg board for Indian Railways
- ✓ Project on application and testing of coir pith-plus (PSL Lab)

Along with the ongoing projects, the two research institutes are spearheading incubation projects with 76 industry units as part of their objective of promoting intervention of science and technology with the industry peers for overall development of the coir sector that are at various stages of progress. Leaving them midway will not serve the purpose of the institute or the industry fraternity. The necessity of continuing with the R&D schemes is highlighted in the SWOT analysis of the Scheme where the gaps in institutional research requirements necessitate the continuance of the scheme, especially in developing the technology and system for large scale, efficient, standardized and qualitative output of coir as raw material and coir finished goods that will upliftment the industry to mass industry status and develop the managerial and Centre for Market Research & Social Development

technical cadre to attract the educated younger generation for a fruitful career in the coir sector, which is presently confined to cottage industry based time consuming low output physical process where the skill is confined to traditional families engaged in coir sector. Development of technologies for creating the scale of operations will infuse new talent and develop the sector, in which the role of R&D schemes in spearheading it is of utmost importance.

<p><b>Strengths:</b></p> <ul style="list-style-type: none"> <li>• S&amp;T Scheme is the only mode of imparting new technologies to the coir industry considering that the industry members are not big enough to conduct large scale and continuous research, which the research institutes by way of being state funded, can continue with their work of providing technological leadership</li> <li>• S&amp;T Schemes are a focused programme aimed at innovating and developing new products and processes as a rallying point for the industry, which no industry member can supplement.</li> <li>• The industry may lose identity and scatter away, and degenerate into a low-level sector without fresh inputs in technology, processes and products, which the S&amp;T schemes are providing at present.</li> </ul>	<p><b>Weaknesses:</b></p> <ul style="list-style-type: none"> <li>• The schemes are part of the routine government process and thereby experience the same procedural delays and elaborate decision-making processes that mar other government schemes, which stretches their implementation schedule.</li> <li>• The schemes are a top down approach at least in terms of implementation aspect, which creates gaps in implementation expectations and schedules.</li> <li>• The schemes are providing research solutions to some part of the coir extraction, coir and pith processing and other processes. They are not taking a comprehensive assessment of research and technology requirements, in which case the overall S&amp;T requirements for the sector may not come up, and gaps may still persist in research requirements</li> </ul>
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<p><b>Opportunity:</b></p> <ul style="list-style-type: none"> <li>• S&amp;T Schemes under the aegis of research institutes can form a rallying point for consolidation of the industry in terms of spearheading standardization of processes and products, which is a need for a sector to gain traction in mass market products</li> <li>• Presently R&amp;D's focus is on developing discrete tools and technologies to provide part solutions, though what is needed is development of comprehensive technologies encapsulating the total raw material production and processing for products technology. The gap in solutions provides huge opportunity for R&amp;D to conduct research to develop and implement viable technology process thereby create a paradigm shift in the scale, size and structure of the coir industry</li> </ul>	<p><b>Threat:</b></p> <ul style="list-style-type: none"> <li>• No Threats</li> </ul>
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So, it is advisable to continue with the S&T schemes in the next plan period.

## **CHAPTER -7: RECOMMENDATION**

The conclusions along with the information and evaluation done point to some prominent focus areas where R&D can play a very important role in changing the dynamics of the coir sector and providing it with the necessary impetus to make a paradigm shift towards a greater role in the economy and market of the country and the world. These provide the indicators to provide for some macro level strategic research recommendations followed by some operational level recommendations.

### **7.1 Macro-Level Strategic Research Recommendations.**

**Improvement of Coir Extraction Process and Technology:** The first area is in improving the efficiency, cost infusion and quality of coir extraction on a large industrial output scale so as to provide a voluminous source of raw material round the year for coir based industries. The raw material for coir based industry primarily is coir fibre followed by husk. Presently, coir fibre has varied uses, but still more experimentation on uses can happen if good quality standardized coir is available readily in large amount at affordable prices. Presently, coir extraction is a laborious, time-consuming, manual and annual process not being able to provide the scale and band-width for growth and modernization of the industry. So, the priority is to focus on research in this area so that the scale and complexity of operations in coir sector increases so that either the sector would look outwards from the family trade Coir to look for talent to join operations or the younger generation themselves will get attracted to it for its scale of returns and the technological processes involved.

**Develop a Coir Industry Large Scale Process:** The second area of focus should be in streamlining the entire process from coir extraction to development of affordable quality coir as raw material and then provide the applicable technologies for developing products of different kinds i.e. pure coir products, coir as substitute product, composite coir products, blended coir products and infrastructural materials based on coir as raw material. In this way, a whole new administrative, technological and management workforce would be required to manage the scale and diversity of operations due to which the younger generation will get attracted to work for the sector

**Improve the Scope of Technology Intervention to IT and Automation Research:** The third focus area is to improve the level of technology involved in the R&D process. Presently, the focus of research is on developing varied products and processes in piecemeal basis to provide some spectacular solutions to a problem faced by the coir sector. The focus along with this, should also be towards developing systems preferably based on software systems to efficiently monitor quality, production processes, speed up and automate certain processes that are time consuming and costly among others. This will work towards improving the standardization, quality and output of products as well as both educate the present workforce and upgrade their skills and attract the educated and talented brains from top notch educational institutions to work in the coir sector.

In order to implement the strategic research recommendations, the Coir Board can hire young professionals from IITs, IIMs, IISc and other institutions on contractual period of 5-7 years if possible, and work with them in making plans and processes that will further attract the younger generation to the industry. It can also initiate knowledge sharing and tapping through national and international collaboration with coir research institutes and other institutes to tap on their knowledge and skills, technology transfers as well as best practices.

Overall, it should make these research recommendations, the catalyst for growth of the coir sector and incorporate them in the fundamental goals and objectives of Coir Vikash Yojana.

Apart from the broad strategic goals that will take some time to get sanctioned and put to practice, there are other immediate operational goals that needs to be implemented to keep the momentum going and prepare the bedrock for implementing the mission oriented long term strategic goals for overall development of coir sector and market domination. they are mentioned below:

### **7.2 Operational Recommendations:**

**Disseminating Research Achievements to End-Users:** The study found that paucity of skilled workers is the most significant production problem faced by both small and medium size coir units of the study area, particularly with regards to adapting the new technologies developed by the research institutes, and which requires skilled manpower, who are not attracted to the industry due to its low returns. Many a times the units in order to manage / continue productions hire manpower with higher price. Hence, it is suggested that the state government as well as the Coir Board may encourage the entrepreneurs to start manufacturing value-added coir products like mats, rugs, maurzouks, carpets etc., which will help them to earn more and enable them to pay attractive wages to their workers. If attractive wages are paid, more workers will be attracted towards the coir units even during the peak-agricultural seasons. Thereby, the major problem of shortage of workers may be solved.

The Coir Board as a solution therefore, and to disseminate the technologies developed; to the end-users to develop and profile of workers to upskill them, may, with the support of the State government depute skilled manpower for training sessions, from NCDTC or CCRI, Kalavoor in Kerala to get training in all diversified products. These persons after getting training may act as

Master Trainers at the state level. The Coir Board through the State Government should conduct Demonstration and Production programmes continuously with the help of Mobile Coir Fibre Extraction Machines with the help of SHGs, NGOS, Artisans and Co-operatives. Coir Technology Incubation Centres may be established to provide training and create new enterprises. The schemes of National Skill Development Corporation and National Small Industries Corporations may be linked with Coir trade.

**New Product Design and Development:** Coir has to be made competitive through design development, quality upgradation and technological upgradation. Coir has multi various applications like door mats, mattings, carpets, Geotextiles, Rubberised fibre, Curled coir, Coir wood, Garden articles, handicrafts, etc. The new products may be popularized extensively in India and abroad. Aggressive awareness drives may be taken up to inform people about the multiple usages of coir products. It is also recommended design institutes such as NID and NIFT may be engaged to develop new and better coir products. The activities should be linked with National Manufacturing Competitiveness Programme (NMCP) for the MSMEs which aimed at improving the processes, designs, and technology and market access.

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## Annexure-1

### Field Photographs













**List of Research Papers by CCRI and CICT**

- S.Karthika,M.J.Reshma, P.A.Wilson, R.Anita Das, U.S.Sarma, K.Harikrishnan & Sabu Thomas (2016) Characterisation and evaluation of phenol degrading Bacillus spp. For enhancing the softness of coir fibre. Journal of Natural Fibers Vol.13, No.3 253-260.
- Jincy P.J., Anita Das Ravindranath and U.S.Sarma (2015) Ecofriendly organosolv process for pulping of tender coconut fibre CORD 31 (1) pp 13-23.
- Karthika , Sabu , Anita Das Ravindranath (2014) Molecular characterization of phenol degrading bacteria isolated from the environment and its application in quality improvement of the coir fibre. Accepted for publication in J. of Natural Fibres
- Jayaraj A.P., Anita Das Ravindranath and Sarma, U.S. (2014) Nanocellulose from diseased wood biomass. CORD 30 (1) pp1-10.
- Reghuvaran, A. & Ravindranath,A.D. (2014). Use of coir pith compost as an effective cultivating media for ornamental, medicinal and vegetable plants. International journal of Biology, Pharmacy and Allied Sciences (IJBPAS). 3(1); 88-97.
- Reghuvaran A. & Ravindranath, A D. (2013). Bioconversion of coir pith as effective soil less media for roof gardening. Adv. Appl. Res. 5(2); 141-146.
- **Anita Das Ravindranath and U.S.Sarma (2012) Application of coir geotextiles in the construction of roads on agrarian soils. Paper presented at the Annual Conference and Trade Exposition of the International Erosion Control Association (EC12) at Las Vegas Nevada, USA from 25.02.2012 to 29.02.2012.**
- Subha P.V & Anita Das Ravindranath (2012) Synthesis of Nanocellulose from coir pith. CORD- Vol 28 No.1 2012 pp.14-23.
- Radhakrishnan S., Anita Das Ravindranath, Hanosh, M.S. Sarma, U.S., & Jayakumaran Nair A. (2012) Quantitative evaluation of the production of lignolytic enzymes-lignin peroxidase and manganese peroxidase by P.sajor caju during coir pith composting. CORD Vol 28 No.1 2012 pp. 24-33

- Abesh Reghuvaran & Anita Das Ravindranath. (2012). Bioconversion of coir pith to effective soil less media for roof gardening. International Journal of Agricultural Science & Research. (Accepted). (Impact Factor 2.857).
- Abesh Reghuvaran & Anita Das Ravindranath. (2012). Coir pith biodegradation by the combined action of fungi *Pleurotus sajor caju* and Nitrogen fixing bacteria *Azotobacter vinelandii* and *Azospirillum brasilense*. International Journal of Environmental Science & Technology. (Under Review). (Impact Factor 3.157).
- Radhakrishnan.S. “Utilization of Coir pith for the production of compost and Cocolawn” for agri / horti applications. Paper presented in National Seminar organized by Codissia in connection with Agri Intex-2014 held during the period from 18-21 July, 2014 at Coimbatore.
- Radhakrishnan.S. “New R&D Technologies inn Coir sector” Paper presented in National Seminar on modern technologies on coir organized by Coir Board and Singai Clusters (p) Ltd at Sinagmpunari and Thiruppuvanam in Sivagangai District, Tamil Nadu on 26<sup>th</sup> & 28<sup>th</sup> , February,2014
- Radhakrishnan.S. “Ecofriendly technologies on the application of Coir pith for the production of compost and Cocolawn”. Paper presented in National Seminar organized by Coir Board at Coimbatore on 8<sup>th</sup> February, 2014
- Radhakrishnan.S. “Modern technologies on coir for sustainable development” Paper presented in an Awareness camp on Coconut technologies Workshop organized by CPCRI & Project Associates from Business Planning and Development unit, National Agricultural Innovation Project (NAIP) and Indian Council of Agricultural Research (ICAR) at Fourth Estate Hall, Thiruvananthapuram on 7<sup>th</sup>, February,2014.
- Radhakrishnan.S. “Coir pith and its application as Agri/ Horticulture media” . Paper presented in “International Fair for Horticulture” at Novi Sad, Belgrade from 25<sup>th</sup> to 30<sup>th</sup> September 2012
- Radhakrishnan.S. “New R& D Technologies in Coir Sector for self employment”. Paper presented in National Seminar on Popularization of Coir Technologies in North East States organized jointly by CSIR- North East Institute of Science & Technology and CCRI at Tripura during the period from 5-6<sup>th</sup>, May, 2013.

- Lakshmi NS, Sarika Babu, Sumy Sebastian & PK Ravi (2015) Improvement in Physical Properties of MMA Grafted Coir Fibres. *CORD* 31(2) pp
- Lakshmi NS, Sarika Babu, Sumy Sebastian & PK Ravi (2015) Low Temperature grafting of MMA onto Coir Fibre. *CORD* 31 (1) pp 24-31
- Sumy Sebastian, Ketan Panchal, Mahendra Parmar & Das Anita Ravindranath (2016), Coir – Polypropylene Injection Moulded Composites. *COIR NEWS*, Jan, 2016, pp 15-18
- Sumy Sebastian, Ketan Panchal, Mahendra Parmar & Das Anita Ravindranath (2016) Coir polymer moulded composites. Proceedings of the International and National Seminar 1st to 5th February, 2016 at Coir Kerala 2016, Alappuzha. pp 68
- Sumy Sebastian, Sarika Babu, Lakshmi NS & PK Ravi (2015) Binderless Coir Wood. Proceedings of 27<sup>th</sup> Kerala Science Congress Jan -2015 pp 835-840
- Sumy Sebastian, Das Anita Ravindranath (2017), Coir Geotextiles Protection to soil and saves mother earth. *Compendium of Research Articles, Uses and Established Environmental Friendly Applications of Coir Geotextiles Feb'2017*. Pp 67-76.
- Anupriya SG, Sheela Evangeline, Sayida MK, Sumy Sebastian, Das Anita Ravindranath, Study on the Performance of Coir Geotextile Reinforced Flexible Pavements. *Compendium of Research Articles, Uses and Established Environmental Friendly Applications of Coir Geotextiles Feb'2017*. Pp 105-110

**List of Patents Filed during 2012-17**

- A versatile automatic rotor based coir fibre spinning machine to spin coir fibres obtained from green/dry coconut husk, U. S. Sarma, T. A. Rajendrababu, C. R. N. Komalakumar, A. Radhakrishnan, 23r April, 2012
- Compact PVC tufting machine to produce small mats, T.A. Rajendra Babu, U.S. Sarma, Gopalan Balachandran & Payaningal Aboobackar Koya, Wheels Free, Calicut(433/Kol/2014 dtd. 03.04.2014)
- An ecofriendly process of softening/bleaching of coir fibres, coir yarn, mats and matting, Gopalan Balachandran, U.S. Sarma, Anita Das Ravindrananth(462/Kol/2014 dtd. 16.04.2014)
- An ecofriendly process of manufacturing handmade paper of coir fbit fibres, Gopalan Balachandran, US Sarma, T.A. Rajendra Babu(485/Kol/2014 dtd. 23.04.2014)

**List of Coir Industries Surveyed**

SN	Name of Industry	Address	Contact Person	Phone
1	Kanti Floor Furnishing	Alleppey	Mr Kalyan Sundaram	9447782228
2	TMMC	Cherthala	Mr VR Prasad	9447782529
3	Mangatheveli Coir	Cherthala	Mr Anil kumar	9746848128
4	Indicoco export	Kochi	Mr Shivi	7736770179
5	Safine	Cherthala	Mr Indu Krup	9447014234
6	Nethai small scale coir mat product	Alleppey	Mr V Sugathan	8547997161
7	Ashok Industries	Cherthala	Mr D Dhanwantharan	9249249061
8	Kerala State Coir Manufacturing	Alappuzha	Mr Vinay Kuma/Mr PV Shashidharan ( MD)	8547840293
9	Plants India	Kochi	Mr Johny Manuwalan	9495955310
10	Cocoland	Alappuzha	Mr Sudarshan	9446086000
11	Amish Coir Works	Pathirapally Alappuzha	Mr Sugadhan	8547997161
12	Arun Coir Works	Alleppey	Mr Vishvnathan KV	9497177813
13	Sri Rasathi Coir Products	10, Kanakkupilai Street, Kottur(sf No 16),Kottur Village,Tamil Nadu - 642114, India	Mr. K. Palanisamy (CEO)	4259286253
14	Sri Lakshmi Coir Products	No : 21, laskhmi illam, happy gardens, soolisvaranpatti, Suleeswaran Patti, Pollachi - 642006, petrol bunk backside	Mr. TA Rengaraj	8608075500
15	Santhi Coir Products	210, Erulapuram Junction, Kalainager Road, Kottar Post, Pollachi,- 629001	Mr.Neelan	9486522576
16	Sri Venkatesa Fibres	2/205, Seelakampatti, Pollachi - 642001, Pollachi Taluk, Pollachi	Mr.Venkat	4259266325

SN	Name of Industry	Address	Contact Person	Phone
17	PSG Coir Products	1/22, Mahalakshmi Nagar,Pollachi - 642002, Coimbatore	Mr.Devaraj Padmanaban	4259238498
18	Periyar Coir Products	Meenkarai Road, Divansapudur, Pollachi - 642001	Mr.Ganeshan	9605000304
19	Sree Amman Coirs	No 6/2, Kattabomman Street, Pollachi - 642001, Near New Bus Stand	Mr.Danapal	4259223446
20	Athi Coirs	Kollupalayam, Thippampatti, Amabarampalaya m, Pollachi - 642103, Near Zion Garden	Mr.Manikandan	4259284133
21	Sree Amman Coirs	No 6/2, Kattabomman Street, Pollachi - 642001, Behind Bus Stand	Mr.Danapal	9994446846
22	Swastik Coirs	200/61 Kottur Road, Suleeswaranpatti, Pollachi Bazaar, Pollachi - 642001	Mr.Kannan	4259222516
23	Vishak Coir Products	Raj Nagar, Chinnampalayam, Pollachi - 642001, Near New RTO Office	Mr.Venkat	9486437658
24	Benlion Coir Industries	6/134 A, Puravipalayam Vadakipalayam, Pollachi - 642110	Mr.Murugan	4259229459
25	Prakash Coir	no 192, meen karai street, tamilnadu rice mill compound, tirushur road, Amabarampalaya m, Pollachi -	Mr.Prakash	9976072843

SN	Name of Industry	Address	Contact Person	Phone
		642103, opposite to avla hospital		
26	Sri Murugan Fibre Industries	Nallampalli Privu, Udumalpet Road, Thippamatty, P. O. Pollachi, Thippampatti, Coimbatore-642107, Tamil Nadu, India	Mr. Shanmugam P. (Managing Director)	8071814887
27	Whales Industry	Pollachi	S K Gautam	9443136451
28	Suresh Engineering	Kochi	Mr Suresh Kumar	9895775501
29	Thuron Coir Mills	Pollachi	Mr Nagrajan	9443054064
30	Shakti Murugan	Pollachi	Mr Ishwarmurti	9942240406
31	Harieshri Coir	Pollachi	Mr Savita	9894085740
32	Universal Electro Hydrolics	Coimbtore	Mr Jaibalan	9843052025
33	PSG-Tech-COE	Coimbtore	Mr R Jayaprakash	9994499800
34	2 M Enginners	Peenya Industrial Area	Mr Manjunath	8028361581
35	Sri Chamundeshwari Coir Products	Chennapatana	Mr Muni Venktappa	9448832112
36	Sri Venkateshwara Fibre Udyog Pvt. Ltd	# 365 (Ground Floor), 8th A Main, 3rd Stage, 4th Block Bangalore - 560079	Mr Vinay Kothari	9448284984
37	Accurate	Peenya Industrila area	Mr Shashithar	9845517680
38	Palled Industries	Garudangiri Road, Arsikere, Karnataka, 573103	Mr Pruthviraj	7795880000
39	Kohinoor Coir Industry	Huliyar Road, Arsikere, Karnataka-573103	Mr Mohammed Isatha Shyam	9449852294
40	Nafpro Coir	Garudangiri Road, Arsikere, Karnataka, 573103	Mr Prem Kumar	7760946615
41	Sri Karibasaveshwara Industries	Garudangiri Road, Arsikere, Karnataka, 573103	Mr Vijay	9448654628

SN	Name of Industry	Address	Contact Person	Phone
42	Haritham Coir	30-D zone near, pejarvai Mutt Karnataka	Mr Sarath Hari	9448219676
43	Kalpacha Coir Products Pvt Ltd	Lavelle road, bangalore, karnataka	Mr Abdul Basher	8197702478
44	Anjaneya Coir Industries	Garudangiri Road, Arsikere, Karnataka, 573103	Mr Kariyappa	9845197266
45	Naresh Coir	Garudangiri Road, Arsikere, Karnataka, 573103	Mr Naresh	9962263960
46	Karnataka State Coir Corporation	VTCC Building Kasturba RoadBangalore	Mr Tirthraj	9845510666

**EVALUATION STUDY ON PLAN SCHEME SCIENCE & TECHNOLOGY**  
**Coir Board Ministry of MSME Government of India**  
**RDTE/COIR BOARD OFFICIAL Schedule**

Kindly furnish all the information in the following format and attach sheets for any additional information.

<b>General Information</b>			
1	Name of the Official		
2	Designation		
3	Phone No. with STD code		Mob. No.
4	E- mail ID (in all small letters)		

<b>Physical Status of the Scheme</b>					
	<b>2012-13</b>	<b>2013-14</b>	<b>2014-15</b>	<b>2015-16</b>	<b>2016-17</b>
<b>Target</b>					
<b>Achieved</b>					

<b>Financial Status of the Scheme ( in Lacs)</b>

	<b>2012-13</b>	<b>2013-14</b>	<b>2014-15</b>	<b>2015-16</b>	<b>2016-17</b>
<b>Target</b>					
<b>Achieved</b>					

<b>Details of the Scheme/Projects ( Please attach separate sheet )</b>								
Modernization of Production Processes, Development of Machinery and Equipments, Product Development and Diversification, Development of Environment Friendly Technologies and Technology Transfer, Incubation, Testing and Service Facilities ( <b>Please provide information of each head in below format</b> )								
No of Project Approved During 2012-17	Project title	Responsible Institution name	Start Date/Completion date	Cost of the Project (Rs in Lacs)	Released Fund (Rs in Lacs)	Status	Outcome of the project ( project wise) Expected/Achieved	Remarks

<p><b>About the Performance of SCHEME SCIENCE &amp; TECHNOLOGY</b></p> <p>In your opinion, What are the major achievements under each project heads with particular reference to the cost benefit aspects?</p> <p>Modernization of Production Processes:</p>
--

Development of Machinery and Equipments:
Product Development and Diversification:
Development of Environment Friendly Technologies:
Technology Transfer, Incubation, Testing and Service Facilities:

In Your Opinion what are the possible new areas of R & D in the Coir Industry and suggest the names of collaborators competent to be associated with for the purpose?
Please Suggest ways and means to collaborate with academia an industry for developing new products
In your opinion, Research Institutes have been able to achieve the objectives for which these institutes have been established or some addition/modification is required?
What extent the utilization of coconut husks in the country has increased due to the introduction of new

machineries and production techniques

How far the R&D efforts of the Board have succeeded in terms of New industry set up and Younger generation participation?

**Please suggest for improvements in the following areas:**

Scheme guidelines

Present method of scrutiny of project proposals in various heads:

Implementation of Scheme and Monitoring:

Funding Pattern and Financial Monitoring:

Overall recommendation on scheme guidelines & Implementation:

<b>Major Bottlenecks and Suggestions in terms of implementation Scheme</b>		
<b>S. No.</b>	<b>Bottleneck</b>	<b>Suggestion</b>
1.		
2.		
3.		
4.		
5.		

Signature of Respondent

Signature & Date of Interviewer / Investigator

Thanks for Your Cooperation

## EVALUATION STUDY ON PLAN SCHEME SCIENCE & TECHNOLOGY

**Coir Board Ministry of MSME Government of India**

**Research Institutes (CCRI and CICT) Schedule**

Kindly furnish all the information in the following format and attach sheets for any additional information.

<b>General Information</b>			
1	Name of the Official contacted		
2	Designation		
3	Phone No. with STD code	Mob. No.	
4	E- mail ID (in all small letters)		

<b>Physical Status of the R &amp; D activities</b>					
	2012-13	2013-14	2014-15	2015-16	2016-17
<b>Target</b>					
<b>Achieved</b>					

<b>Financial Status of R &amp; D activities in the institute ( in Lacs)</b>					
	2012-13	2013-14	2014-15	2015-16	2016-17

<b>Target</b>					
<b>Achieved</b>					

<b>Details of the Scheme/Projects ( Please attach in separate sheet )</b>								
Modernization of Production Processes, Development of Machinery and Equipments, Product Development and Diversification, Development of Environment Friendly Technologies and Technology Transfer, Incubation, Testing and Service Facilities ( <b>Please provide information of each head in below format</b> )								
No of Project Approved During 2012-17	Project title	Responsible Institution name	Start Date/Completion date	Cost of the Project (Rs in Lacs)	Released Fund (Rs in Lacs)	Status	Outcome of the project ( project wise) Expected/Achieved	Remarks
2012-13								
2013-14								

<b>Details of Available Human resource in the institution ( Please attach in separate sheet )</b>			
<b>Please provide information in below format</b>			
Name of Sectioned Position	No of Sectioned Position	Vacant Position	Reason of vacant Position

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Is Institution suffering for non availability of sufficient technical/scientific human resource? If yes please provide information in below format

**Details of Required Human resource in the institution**

**Please provide information in below format ( Please attach in separate sheet )**

Name of Sectioned Position	No of Sectioned Position	Additional Requirement	Rational of Required Position

Is Institution suffering for non availability of sufficient infrastructure? If yes please provide information in below format

**Details of Required Infrastructure in the institution**

**Please provide information in below format ( Please attach in separate sheet )**

Name of the required facility	What value will be added

**About the Performance of SCHEME SCIENCE & TECHNOLOGY**

In your opinion, What are the major achievements by the institute under each project heads and how the outcome of the projects benefitted the coir sector?

Modernization of Production Processes:

--

Development of Machinery and Equipments:
--

Product Development and Diversification:
--

Development of Environment Friendly Technologies:
---

Technology Transfer, Incubation, Testing and Service Facilities:
--

In your opinion R & D activities in the institute have helped to increase productivity of the workers, improve, reduce drudgery of work, workplace safety, and improve the health impact of the workers? Also provide success story of any project.

In your opinion R & D activities in the institute have helped to improve quality of the products, reduce hostages, improve productivity and achieve cost effectiveness? Also provide success story of any project.
How far the technologies developed by the institutes are useful to the trade and industry?
How far the R & D in the processing and production techniques has helped to improve the organization domestic and export markets for coir products?
R & D in the Coir Industry and suggest the names of collaborators competent to be associated with for the purpose.
Suggest ways and means to collaborate with academia an industry for developing new products
At what extent R & D institutes succeeded in transferring the technology to the Manufactures/Entrepreneurs?

In your opinion, Research Institutes have been able to achieve the objectives of the scheme for which these institutes have been established or some addition/modification is required?
What extent the utilization of coconut husks in the country has increased due to the introduction of new machineries and production techniques? Pls provide data if available

<b>Please suggest for improvements in the following areas:</b>
Scheme guidelines
Present method of scrutiny of project proposals in various heads:
Implementation of Scheme and Monitoring:
Funding Pattern and Financial Monitoring:

Overall recommendation on scheme guidelines and implementation:

<b>Major Bottlenecks and Suggestions in terms of implementation Scheme</b>		
S. No.	Bottleneck	Suggestion
1.		
2.		
3.		
4.		
5.		

Signature of Respondent

Signature & Date of Interviewer / Investigator

Thanks for Your Cooperation

## EVALUATION STUDY ON PLAN SCHEME SCIENCE & TECHNOLOGY

### Coir Board Ministry of MSME Government of India

#### Manufacturer/Entrepreneur Schedule

Kindly furnish all the information in the following format and attach sheets for any additional information.

General Information			
1	Name of the Manufacturer/ Entrepreneur		
2	Address		
3	Contact person Name & Designation		
4	Phone No. with STD code		Mob
5	E- mail ID (in all small letters)		
6	Year of Establishment		
7	Mode of Operation	Proprietorship (1) (3) Pvt. Ltd(4)	Partnership (2) Society/SHG Govt. Undertaking(5)
8	Category of Company	Micro (1) Large(4)	Small(2) Medium(3)
9	Turn Over of the Company (average of last 3 years)		
10	Total Employee (Permanent + Contract)		
11	Company Registered with Coir Board	Yes (1)	No(2)

<b>Technology Transferred</b> ( Please provide information of each Technology/machine/process separately)		
Year	Technology Transferred from CCRI and CICT	Benefits of Technology in terms of Productivity, Quality, Cost, Workers Safety etc,
2012-13		
2013-14		
2014-15		
2015-16		
2016-17		

In your opinion, how and what extent the outcome of the R & D projects/activities in various heads benefitted the coir sector?
Modernization of Production Processes:
Development of Machinery and Equipments:

Product Development and Diversification:
Development of Environment Friendly Technologies:
Technology Transfer, Incubation, Testing and Service Facilities:

At what extent R & D efforts help manufactures/Entrepreneurs/traders to develop Coir Sector?
Are you satisfy with the process and efforts of R & D activities or some improvements / changes are required?
At what extent R & D activities Coir Sector have helped to improve quality of the products, reduce hostages, improve productivity and achieve cost effectiveness? Also provide success story of any project.

How far the R & D activities in Coir Sector succeeded in transferring the technology to the manufacturers and Entrepreneurs.
At what extent R & D in the processing and production techniques has helped to improve the organization domestic and export markets for coir products?
In your opinion R & D activities in Coir Sector have helped to increase productivity of the workers, improve, reduce drudgery of work, workplace safety, and improve the health impact of the workers? Also provide success story of any project
Suggest ways and means to collaborate with academia an industry for developing new products
In your opinion, Research Institutes have been able to achieve the objectives of the scheme for which these institutes have been established or some addition/modification is required?
What extent the utilization of coconut husks in the country has increased due to the introduction of new machineries

and production techniques ( Please provide authentic data if available)
At what extent the income of workers in the industry have increased due to the R & D efforts of the Board
In your opinion, R & D efforts are able to attract younger generation to participate in the coir sector? if yes Pls share
What extent the utilization of coconut husks in the country has increased due to the introduction of new machineries and production techniques? Pls provide data if available

At what extent the new products like Coir ply, Coco lawn, C-pom, coir-geotextiles etc. developed by the Institutes have made in-roads in to the market? Do these products require more improvements/standardizations to meet with the consumer tastes/demand
Coir ply
Coco lawn

C-pom
Coir-geotextiles
Any other products if any

<b>Major Bottlenecks and Suggestions on R &amp; D Activities of Coir Board</b>		
S. No.	Bottleneck	Suggestion
1.		
2.		
3.		
4.		

Signature of Respondent

Signature & Date of Interviewer / Investigator

Thanks for Your Cooperation

## EVALUATION STUDY ON PLAN SCHEME SCIENCE & TECHNOLOGY

Coir Board Ministry of MSME Government of India

### Scientists/ Technical Person Schedule

Kindly furnish all the information in the following format and attach sheets for any additional information.

<b>General Information</b>			
1	Name of the Scientists/ Technical Persons		
2	Designation		
3	Phone No. with STD code	Mob. No.	
4	E- mail ID (in all small letters)		
5	Education ( Highest + Technical)		
6	Month & Year of Joining		
7	Role in the Institute ( in Brief)		

<b>About the Performance of SCHEME SCIENCE &amp; TECHNOLOGY ( R &amp; D activities)</b>
In your opinion, What are the major achievements by you as well as institute under each project head and how the outcome of the projects benefitted the coir sector?
Modernization of Production Processes:
Development of Machinery and Equipments:
Product Development and Diversification:

Development of Environment Friendly Technologies:

Technology Transfer, Incubation, Testing and Service Facilities:

In your opinion R & D activities in the institute have helped to increase productivity of the workers, improve, reduce drudgery of work, workplace safety, and improve the health impact of the workers? Please also share success story of any project.

In your opinion R & D activities in the institute have helped to improve quality of the products, reduce hostages, improve productivity and achieve cost effectiveness? Please share success story of any project

How far the technologies developed by the institutes are useful to the trade and industry?

How far the R & D in the processing and production techniques has helped to improve the organization domestic and export markets for coir products?

R & D in the Coir Industry and suggest the names of collaborators competent to be associated with for the purpose.
Suggest ways and means to collaborate with academia an industry for developing new products
At what extent R & D institutes succeeded in transferring the technology to the Manufactures/Entrepreneurs?
In your opinion to what extent the utilization of coconut husks in the country has increased due to the introduction of new machineries and production techniques. ( Pls share if any report or data available)
In your opinion, Research Institutes have been able to achieve the objectives of the scheme for which these institutes have been established or some addition/modification is required?

In your opinion, What kind of support required to increase the effectiveness of coir and coir sector

<b>Major Bottlenecks and Suggestions in terms of R &amp; D activities</b>		
S. No.	Bottleneck	Suggestion
1.		
2.		
3.		
4.		
5.		

Signature of Respondent

Signature & Date of Interviewer / Investigator

Thanks for Your Cooperation

## EVALUATION STUDY ON PLAN SCHEME SCIENCE & TECHNOLOGY

### Coir Board Ministry of MSME Government of India

#### Worker Schedule

Kindly furnish all the information in the following format and attach sheets for any additional information.

<b>General Information</b>			
1	Name of the Worker		
2	Address		
3	Contact no		
4	Age		
5	Gender	Male	Female
6	Name of the Factory / Place where you are presently working		
7	Working days in a month	In 2012	At present
	Income monthly	In 2012	At present
8	What role you perform in the industry		
9	Year since working		
10	Total years of experience in Coir Industry		
11	Payment Basis	Monthly	Weekly      Daily

1	Any other member from your family engages in coir sector?	Yes	No
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2	New machine and system have been introduced in your company?	Yes	No
3	Due to R & D efforts /New technology/process younger generation is being attracted to work in coir industry?	Yes	No
4	Due to the R & D efforts /New technology/process in the industry production have been increased	Yes	No
5	Due to the R & D efforts /New technology/process in the industry product quality have been increased	Yes	No
6	Due to the R & D efforts/New technology/process in the industry efficiency of workers have been increased	Yes	No
7	Due to the R & D efforts/New technology/process workplace safety has increased	Yes	No
8	Due to the R & D efforts/ New technology/process worker's income have increased	Yes	No

10	What benefits that you intend to get to continue working in the Coir Industr
11	Your suggestion to improve the Coir Industry

Signature of Respondent

Signature & Date of Interviewer / Investigator

Thanks for Your Cooperation