



Report of the Quinquennial Review Team

2017 - 2022

भा.कृ.अनु.प. – केंद्रीय कपास प्रौद्योगिकी अनुसंधान संस्थान
ICAR-Central Institute for Research on Cotton Technology (ICAR-CIRCOT)

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July 2024



Report of the
Quinquennial Review Team
on

***ICAR-Central Institute for Research on Cotton
Technology
&
CRP on Natural Fibre***

For the Period 2017-2022

***Submitted to the
Indian Council of Agricultural Research***

July 2024

Foreword

The Indian Council of Agricultural Research (ICAR) constituted the Quinquennial Review Team (QRT) vide F.No.A.Engg.3/25/2022-IA-II (AE) e-file No. 230159 dated 20-12-2022 to review the functioning and research and development programmes of ICAR-CIRCOT, Mumbai and its Regional Units, namely, the Ginning Training Centre, Nagpur, Quality Evaluation Units located in Sirsa, Coimbatore, Guntur, Surat and Dharwad & CRP on Natural Fibres. The team comprised of Dr. K. K. Singh, Vice Chancellor, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut as Chairman and Dr. G. S. Nadiger, Dr. A. J. Shaikh, Dr. Kanchan K. Singh, Dr. S. Patel, Mr. Prashant Kumar Mohota as Members and Dr A S M Raja as Member Secretary. The schedule of meetings and visits is presented in **Annexure-II**. The QRT report of ICAR-CIRCOT and its Regional Units & CRP on Natural Fibres for the period 2017-22 is submitted in this document along with suggestions and recommendations for consideration of Indian Council of Agricultural Research.

The QRT acknowledges with gratitude the excellent support given by Dr S. K. Shukla, Director, ICAR-CIRCOT and his team for making the visits and deliberations of the QRT useful and valuable, thereby facilitating timely submission of this report

Chairman



(Dr. K. K. Singh)

Vice Chancellor

Sardar Vallabhbhai Patel University of Agriculture & Technology

Members



Dr. G. S. Nadiger
Former Director
Textile Committee



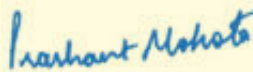
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Mr. Prashant Kumar Mohota
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Dr. A S M Raja
Member Secretary
Principal Scientist & Head
QEID, ICAR-CIRCOT

EXECUTIVE SUMMARY

Indian Council for Agricultural Research (ICAR) has constituted QRT vide Letter No.A.Engg.3/25/2022-IA-II (AE) e-file No. 230159 dated 20-12-2022 & 14.02.2023 to review the progress of research of ICAR-CIRCOT, Mumbai during 2017-2022.

The team consisted of Dr. K. K. Singh, Vice Chancellor, Sardar Vallabhbhai Patel University of Agriculture & Technology, Modipuram, Meerut as Chairman & Dr. G. S. Nadiger, Former Director of Laboratories (Textile Committee); Dr. A. J. Shaikh, Former Director, ICAR-CIRCOT; Dr. Kanchan K. Singh, Dean, SOA Sanskriti University; Dr. S. Patel, Professor & Former Head, Agricultural Processing & Food Engg, IGKV; Mr. Prashant Kumar Mohota, Managing Director, Gimatex Industries Pvt Ltd as Members and Dr. A. S. M. Raja, Principal Scientist & Head, QEID, ICAR-CIRCOT as Member Secretary.

The QRT visited ICAR-CIRCOT, Mumbai and its regional stations viz. Ginning Training Centre, Nagpur, Quality Evaluation Units located at Coimbatore, Dharwad and Surat. The QRT interacted with various stakeholders such as farmers, representatives of ginneries, textile industries, machine manufacturers, Director ICAR-CICR, Vice Chancellors of UAS Dharwad & PDKV Akola and IMC members. The QRT also interacted with DDG (Agril. Engg.), ADG (PE) of Agricultural Engineering SMD of ICAR and received valuable suggestions.

Cotton is one of the most important commercial crops cultivated in India, accounting for around 23% of the total global cotton production. It plays a major role in sustaining the livelihoods of about 6.0 million cotton farmers and 40-50 million other people engaged in related activities such as cotton processing and trade. The Indian textile industry consumes a diverse range of fibres and yarns, with the ratio of cotton to non-cotton fibres being around 60:40 whereas it is 30:70 in the rest of the world. Cotton is backbone Indian textile industry. It is second largest employment provider, after agriculture. Due to its economic importance, cotton is also termed as "White Gold."

ICAR-CIRCOT has a crucial role to play in ensuring the availability of quality cotton to the Indian textile industry. The institute is promoting quality-based trading of cotton to enable farmers to fetch better prices for their produce. CIRCOT functions according to ICAR-approved mandates and caters the needs of cotton farmers, ginning & textile industry and provides consultancy and technical support to other stakeholders. The institute collaborates with various institutions to produce better cotton with desirable fibre qualities required by the textile industry, and to develop technologies for the efficient use of cotton and its by-products, while also promoting entrepreneurship in the country. During the period under report, the institute developed 55 technologies in the field of post-harvest processing of cotton and commercialized 18 technologies. The revenue generation of the institute was to the tune of Rs.11.00 crores through various technological services. Institute got Sardar Vallabhai Patel Best Institute Award during 2019 from ICAR.

Considering the achievements of the institute and interaction with stakeholder, QRT recommends that institute should undertake research work in the following areas

1. Innovative Pre-Ginning and Ginning Technologies Using Industry 4.0 Practices for Enhancing Efficiency and Cotton Quality Parameters
2. Advanced Viable Technologies for Processing of Mechanically Harvested Cotton
3. Computer Vision and Machine Learning Models for Fibre to Fabric Quality Assessment
4. Technical Textiles for Protective, Medical, Agro and Sports Applications
5. Studies on Vortex and Rotor Spinning Technologies
6. Traceability in Cotton Value Chain
7. Circularity in Cotton Post-harvest Processing
8. Nanotechnology and Biotechnology Applications in Textiles and Agriculture

Similarly for CRP on Natural Fibre, the major emphasis should be development of

1. Technologies for Blending of Cotton with other Natural Fibres like Hemp, Ramie and Himalayan Fibres etc
2. Technologies to Extract High-End Products from the Natural Fibre Biomass Available Abundantly.

In the case of extension activities, the main focus should be technology assessment and promotion of Agri-Entrepreneurship & Incubation especially in the field of post-harvest processing of cotton and value addition to biomass and by-products. Institute should transform as the National Referral Laboratory (NRL) for cotton fibre. Institute should get standard reference material (SRM) accreditation from NABL for its calibration cotton as per ISO 17034. Institute should establish demonstration plant for ginning of mechanically harvested cotton at GTC, Nagpur.

ICAR-CIRCOT is a 100 years old institute and has played a significant role in development and commercialisation of post-harvest processing technologies related to cotton. The infrastructure facilities of the institute should be strengthened by construction of new office buildings in Mumbai as well as GTC Nagpur. GTC Nagpur should be given regional station status by the Council. The regional quality evaluation units located at Sirsa, Surat, Guntur, Dharwad and Coimbatore should be strengthened in terms of infrastructure and additional manpower. QRT recommends that ICAR should provide a one-time catch-up grant to the tune of Rs.60 crores to the institute to improve the infrastructure facilities. Based on the overall review, QRT rates the progress and achievements of the institute as Very Good.

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Chapter 1

Introduction

ICAR has constituted QRT for ICAR-CIRCOT, Mumbai vide Letter No.A.Engg.3/25/2022-IA-II (AE) e-file No. 230159 dated 20-12-2022 & 14.02.2023 to review the progress of research during 2017-2022 The QRT started its deliberations in June 2023 and reviewed of the progress of research, constraints, potentials, strategies plans for scientific research and management and Action Taken on Recommendations (ATR) of the last QRT (Annexure I).

1.1 Constitution and Composition of the Review Panel

The composition of the QRT is given below:

S. No.	Name & Contact Details	Designation
1.	Dr. K. K. Singh Vice Chancellor Sardar Vallabhbhai Patel University of Agriculture & Technology Modipuram, Meerut-250110	Chairman
2.	Dr. G. S. Nadiger Former Director of Laboratories (Textile Committee) A-102, Augustus, Lodha Paradise, Near Majiwada Fly Over, Thane (W), Mumbai-400601	Member
3.	Dr. A. J. Shaikh Former Director, ICAR-CIRCOT, Mumbai 21, Sarini, Sector 16 A, Vashi, Navi, Mumbai-400703	Member
4.	Dr. Kanchan K. Singh Dean, SOA Sanskriti University, 28 km stone, Mathura-Delhi Highway, Chhata, Mathura-281401	Member
5.	Dr. S. Patel Professor & Former Head, Agricultural Processing & Food Engg, IGKV, Raipur-492012	Member
6.	Mr. Prashant Kumar Mohota Managing Director (MD), Gimatex Industries Pvt Ltd., Ram Mandir ward, Hinganghat-442301, Wardha	Member
7.	Dr. A. S. M. Raja Principal Scientist & Head, QEID, ICAR-CIRCOT, Adenwala Road, Matunga, Mumbai-400019	Member Secretary

1.2 Terms of Reference of the Quinquennial Review Team

The QRT has addressed all the Terms of Reference (ToR) assigned to it in a comprehensive manner in its report. The QRT examined whether the research and development programmes of ICAR-CIRCOT and its Regional Units, namely, the Ginning Training Centre, Nagpur, Quality Evaluation Units located in Sirsa, Coimbatore, Guntur, Surat and Dharwad, and the CRP on Natural Fibres, are in conformity with the mandates of ICAR and the nation. The ToRs are described as follows:

(i) Research achievements and impact

- To critically examine and identify the research achievements of the Institutes and their Regional Units since the previous quinquennial review, and to critically evaluate them. This evaluation should consider the objectives, mandates, and resources of the organization, as well as the socio-economic impact of the research on farmers/beneficiaries. Additionally, the transferability of results to farmers through extension should be critically reviewed.
- The research and its impact should be brought out in quantifiable benchmarks wherever possible.
- To assess the value for money, the Quality Review Team (QRT) should evaluate and present the physical outputs and outcomes in comparison to the budget expended during the reporting period. If the anticipated outcomes will require a significant amount of time, projected outcomes should also be provided
- The socio-economic impact of research on farmers/beneficiaries and transferability of results to farmers being an important aspect of research outcome, the transferability should be mandatory for major research projects.

(ii) Research relevance and budget allocation

To examine objectives, scope and relevance of the research programmes and budget of the institute for the next 5 years in relation to overall state/regional/national plans, policies and long and short-term priorities and also the Perspective Plan for Vision 2030/Vision 2047 documents.

(iii) Relationship/collaboration with SAUs and other stakeholders

To pinpoint whether the research programmes of the past and proposals for future are in harmony with the vision of the ICAR (HQ) and the programme of the related centres of research and agricultural universities, state government, private sector, etc.

(iv) Linkages with clients/end-users

To examine the kind of linkages established with the clients and end-users of the research results, i.e. farmers and the extent of interest displayed in conducting "on-farm research" in farmers' fields and in organizing demonstrations/training courses for the transfer of technology to extension agencies and KVKs of the ICAR.

(v) Proposed changes in organization, programmes and budget

To examine whether any changes in the organizational set-up are called for in respect of manpower and funds allocation. The decentralization in day-to-day working and transparency should be highlighted. Further, the Committee may also examine the resource generation efforts and implementation and project-based budgeting.

(vi) Constraints

To examine the constraints hindering the institute in achieving its objectives and implementation of its programme and goals, and to recommend ways and means to minimise or eliminate them.

(vii) Looking forward

To explore any other points deemed relevant by the Committee or referred to it by the ICAR, the Institute Director, or the Management Committee, concerning future program development,

1.3 The Process

Dr. K.K. Singh, Vice Chancellor, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut was appointed as Chairman of QRT for ICAR-CIRCOT vide ICAR Letter No.A.Engg.3/25/2022-IA-II(AE) e-file No. 230159 dated 20-12-2022.

The QRT conducted the review meeting by visiting ICAR-CIRCOT, Mumbai, Ginning Training centre, Nagpur and the Quality Evaluation units located in Coimbatore, Surat and Dharwad. Moreover, the review meeting of Quality Evaluation Units situated at Dharwad, Guntur, Surat and Sirsa was also conducted in Mumbai. The details are given in Annexure II. The QRT visited all the laboratories and facilities of the institute at the Headquarters and Regional Units, and interacted with the Director, Heads of Departments, Incharge Scientists, Scientists, Officer Incharges, Technical Officers, Administrative and Support Staff. The QRT also interacted with various stakeholders of ICAR-CIRCOT including industries, traders, researchers of National Agricultural Research System and ascertained their requirements and expectations. The report of the QRT was also presented before the Institute Managing Committee (IMC). The brief account of the process followed by the QRT during the review is provided below in chronological order:

1.3.1 First Meeting- Introductory Meeting

The introductory meeting of the Chairman, QRT with Sr. Officers of ICAR Headquarters and the Director, ICAR-CIRCOT, Mumbai was held in the office of the Deputy Director General (Agril. Engg.), ICAR, KAB-II, New Delhi on 31.01.2023. The meeting was attended by Dr. K. K. Singh, Chairman, QRT, Dr. S.N. Jha, Deputy Director General (Agri. Engg.), Dr. K. Narasaiah, Assistant Director General (Process Engg.) and Dr. S.K. Shukla, Director, ICAR-CIRCOT, Mumbai. In this meeting, the composition of the committee was decided. The composition of the committee was communicated to ICAR-CIRCOT, Mumbai on Feb 14, 2023 vide F.No. A. Engg.3/25/2022-IA-II(AE), e file 230159.

1.3.2 Second Meeting- Planning Meeting

The Planning Meeting of the QRT was held at ICAR-CIRCOT, Mumbai on June 6, 2023, chaired by Dr. K. K. Singh. Dr. S. N. Jha, Deputy Director General (Agril. Engg.) and Dr. K. Narasaiah, Assistant Director General (Process Engg.), attended the meeting representing the Council. Dr. S. K. Shukla, Director of ICAR-CIRCOT, Mumbai, extended a warm welcome to the Chairman and the QRT members, providing a concise overview of the institute's research progress and achievements. Dr. K. Narasaiah, ADG, presented the draft analysis of the institute's achievements from 2017 to 2022. Dr. A.S.M. Raja, the Member Secretary of QRT, presented the Action Taken Report (ATR) based on the recommendations of the previous QRT (2012-2017). The meeting was attended by Heads of Departments, In-charge Scientists, and Heads of

Administration & Finance. Following the meeting, the QRT participated in a stakeholder meeting held on the same day.

1.3.3 The Third Meeting:

The third review meeting of the QRT was held at ICAR-CIRCOT, Mumbai on July 24-25, 2023. During this meeting, the Committee engaged in discussions with the Director, ICAR-CIRCOT, Mumbai regarding the various institute-related matters. The QRT chairman clarified that the purpose of this meeting was to evaluate the institute's progress and provide guidance for its activities over the next five years. He emphasized that generally only 10% of the technologies reach the end users, prompting an analysis into why 90% of technologies are not adopted. There may be potentially valuable technologies that require further refinement or modification so as to be adopted by the end users. Collaboration with industry and other institutes was strongly recommended for the project implementation. Additionally, the institute should explore the application of advanced technologies such as AI, IoT and robotics in research to reduce the costs and enhance technology viability. Conducting impact analyses for all developed technologies was deemed essential. The suggestion to embark on a mega project involving a team of scientists to collect data from industries was also put forth. The Heads of the Divisions viz., Mechanical Processing Division (MPD), Quality Evaluation & Improvement Division (QEID), Chemical & Bio-chemical Processing Division (CBPD), Engineering Technology Transfer Division (ETTD) and Lead Centre Project Coordinator of CRP on natural fibres (CRP on NF) made presentations before the QRT. The QRT also visited all the Research Divisions and Service Sections and the Library. Separate meetings were also held with the Scientists, Technical Staff, Administrative Staff, Supporting staff, members of Institute Joint Council, PME, ITMU and Women's Cell internal committee on July 25th 2023. The QRT specifically asked about the constraint, problems faced by the staff if any and called for suggestions for improvement of functioning of the Institute.

1.3.4 The Fourth Meeting

The fourth review meeting was conducted at Ginning Training Centre, ICAR-CIRCOT, Nagpur during Oct 10-11, 2023. Dr. K. Pandiyan, Sr. Scientist and Officer In-charge, GTC, Nagpur welcomed the Chairman and QRT members and showcased the various infrastructure and pilot plant facilities present at the Centre. Subsequently, a meeting was organized where Dr. Pandiyan provided a brief presentation on the research progress and achievements of the centre. Following the discussion, a stakeholders meeting was arranged, which was attended by representatives from ginning industries, cotton trading, cotton testing, seed industries and biomass utilization industries. Thereafter, the Committee visited ICAR-CICR, Nagpur, where Dr. Y.G. Prasad, Director of the institute welcomed the QRT and briefly presented the various projects undertaken by ICAR-CICR in collaboration with ICAR-CIRCOT such as AICRP on Cotton, Best Post-Harvest Management Practices, Cotton Mechanization through Development of Robotic Harvesters, Naturally Coloured Cotton, Processing of Mechanically Harvested Cotton, Development of ELS Cotton, etc. Subsequently, the QRT visited M/s. Precision Tooling Engineers, Nagpur and physically observed the working of various Lab Model Ginning Machines developed by the industry in collaboration with ICAR-CIRCOT. Dr. K. K. Singh, QRT, Chairman, inaugurated the Modified Lab Gin SR700 developed by M/s. Precision Tooling Engineers, Nagpur in collaboration with ICAR-CIRCOT. Thereafter, the QRT team visited M/s. Bajaj Steel Industries Ltd., Nagpur and took note of various ginning technologies developed by the industry in collaboration with ICAR-CIRCOT.

On Oct 11, 2023, the QRT visited M/s. Gima Tex Industries, Hinganghat, Wardha, as well as Textile Parks, Special Purpose Vehicles (SPV) developed with the assistance of the Ministry of Textiles, Government of India. The team visited the Modern Spinning Plant, Garmenting Unit and Oil Packing Unit, detailed discussions held with Mr. Vineet Mohota, the CEO, and Mr. Ravi Fating, Manager, regarding various issues in the area. Additionally, the team visited the weaving and open-end spinning unit of the industry located in Wani, holding detailed discussions about various operations there.

1.3.5 The Fifth Meeting

The fifth meeting was conducted at ICAR-CIRCOT, Mumbai on Dec 05, 2023 to review the progress of GTC, Nagpur and QEUs. Dr. K. Pandiyan, Officer Incharge, GTC, Nagpur presented a report on the next five-year programmes of the centre along with requirements of manpower, budget, infrastructure, etc. Dr. A. S. M. Raja made a brief presentation about the location and activities of Quality Evaluation Units. He informed that some of the Quality Evaluation Units are as old as the Institute, established during the 1930s and all the units are manned by Technical Officer and Technicians. He also presented the activities and future programmes of Q.E. Units located at Coimbatore, Guntur, Surat and Dharwad. Subsequently, Dr. Hamid Hasan, Officer Incharge, Q.E. Unit of Sirsa made a presentation about the progress of that unit. It was decided that QRT should visit QEU located at Coimbatore physically to review the progress and future programmes, as this centre, is situated amid hub of textile industries. The QRT Chairman and Members viz. Dr. Kanchan K. Singh, Dr. G.S. Nadiger, Dr. S. Patel and Dr. A. J. Shaikh attended the 9th ACRDN meeting & International Conference during Dec 6-8, 2023 at ICAR-CIRCOT Mumbai organised by the institute as part of the centenary year celebration and actively participated in the deliberations of the conference.

1.3.6 The Sixth Meeting

The sixth QRT meeting was held at the Quality Evaluation Unit, Coimbatore during Jan 18-19, 2024. Mr. K. Thiagarajan, Chief Technical Officer & Officer In-charge of the Centre, welcomed the Chairman, QRT members and Director, ICAR-CIRCOT, Mumbai and showcased the various testing facilities of the Centre on Jan 18, 2024. Subsequently, Dr. A.S.M. Raja, Head, QEID presented a brief report on the research and testing activities, achievements and future plans of the Centre. The QRT suggested various measures for the improvement of the Centre. After the discussion, a stakeholders meeting was arranged by the centre, in which stakeholders from the ginning industries, high volume instrument (HVI) manufacturers, cotton trade and faculties of Tamil Nadu Agricultural University (TNAU), Seed industry, etc. participated. The stakeholders provided valuable inputs about the role that the Centre could play in improving the cotton value chain.

Subsequently, the committee visited the Regional Station, ICAR-CICR, Coimbatore. Dr. A. H. Prakash, Head, Research Station, welcomed the Chairman and Members of the QRT and briefly presented the collaboration and assistance provided by the Q.E. Unit, especially AICRP on Cotton Project. The Scientists of the Station gave a brief presentation on the various R&D programmes like ELS varietal/ hybrid development, high density planting system programmes (HDPS), Pink Bollworm eradication, etc. undertaken by this station. Later, Dr. U. Shivakumar, Prof., Department of Microbiology, TNAU presented the progress of the CRP on the Natural Fibre Project undertaken by his department. The QRT appreciated the progress of the project and suggested to undertake Toxicity analysis and microbial load in the development of bacterial cellulose products. On the same day, QRT team visited M/s. Premier Evolvics Ltd., HVI manufacturer and discussed with their management about the issues related to cotton testing

and the areas of collaboration and suggestions for improvement of cotton quality. The QRT team also visited the facilities present in the industry.

On Jan 19, 2024, the QRT convened a meeting during which Dr. A.S.M. Raja, Member Secretary, presented a draft report of the QRT and Dr. S.K. Shukla, Director, clarified several points raised by the QRT Chairman and members. The meeting extensively discussed the functioning of the Quality Evaluation Units. Finally, the Chairman requested Dr. A.J. Shaikh, Member of the QRT, to visit the Q.E. Unit in Surat to review its functioning and the constraints faced. It was emphasized that all Q.E. units should make suitable efforts to justify their existence. Additionally, the QRT recommended that more research work to be undertaken in the mandated area and scientists should be encouraged to publish research papers and file IPs.

Later, on Jan 19, 2024, the QRT team visited M/s. Shantalaxmi Ginning Mills in Pollachi and held discussions with Mr. A. Laxmanan, MD, and his team regarding various issues related to cotton, particularly ELS cotton. Following this, the QRT team visited M/s. Mag Solvics Ltd. in Kinatkadavul and discussed cotton quality testing and improvement issues with their management regarding improvement in their machines. Additionally, the QRT team visited M/s. Statex Engineering Ltd. in Kuruchi and discussed various issues regarding the servicing of the HVI instrument supplied by the company. The industry assured prompt service for the instruments supplied by them.

1.3.7 The Seventh Meeting

QRT meeting was held at Quality Evaluation Unit, ICAR-CIRCOT, Surat on Apr 24, 2024. Dr. A. J. Shaikh, Member, QRT, Dr. S. K. Shukla, Director, ICAR-CIRCOT and Dr. A. S. M. Raja, Member Secretary, QRT visited the Quality Evaluation Unit at Surat. Dr. M.C. Patel, Cotton Research Scientist, Main Cotton Research Station, Navsari Agriculture University, Surat arranged a meeting with his team for formal discussions. Dr. Pankaj Gandhi, Director, MANTRA, Surat participated in the meeting as a special invitee.

In his address, Dr. S.K. Shukla emphasized that the Quality Evaluation Unit is operating in a highly deteriorated building, posing significant risks to the employees and workers. Given the outward tilt of the outer wall of the building where the unit is located, there is a looming risk of collapse at any time. Dr. S.K. Shukla expressed that unless an alternative space is provided, the unit may face the risk of closure. He further emphasized that the centre may employ two additional technicians when there is extra load of testing samples, during the cotton season period from November to March. Moreover, the majority of samples received for testing are from the breeding project and these samples are evaluated without any payment, thereby posing a financial burden on the main institute as it has to maintain costly equipment and staff. Dr. Shukla suggested that given the huge volume of samples, the university could consider sending these samples to Mumbai or any other Regional Unit of ICAR-CIRCOT for testing.

Dr. M.C. Patel responded by stating that the university is currently in the process of constructing a new building for the Research Station and suitable space will be allocated for the Quality Evaluation Unit of ICAR-CIRCOT. In the meantime, he suggested that the unit could be temporarily relocated to the Gramin Training Centre Building located in front of the Main Cotton Research Station. Dr. M. C. Patel highlighted the historical significance of the Quality Evaluation Unit, established in 1928 at Nanpura and subsequently relocated to MCRS, NAU, Surat. He emphasized that, this unit has a long history of providing valuable services, particularly in hybrid cotton development and therefore, should be strengthened rather than closed.

Dr. A.J. Shaikh, in his address, highlighted that the Q.E. Unit previously had scientists who actively participated in the breeding program. He suggested to the University that the scientists from the Q.E. & I. Division, under which the Surat Unit operates, could be incorporated into the research programmes of the Main Cotton Research Station. Additionally, he proposed that the technical manpower of the Q.E. Unit could be effectively utilized by providing internships and training programs on topics such as clean cotton picking, post-harvest management of seed cotton, and quality testing. This would ensure better efficiency and effective utilization of the manpower. He also mentioned that whenever required, scientists from the ICAR-CIRCOT Headquarters could be called upon to support these activities.

Based on the discussion, the action points emerged from the meeting is given below:

- The Q.E. Unit, Surat should be immediately shifted to the nearby Gramin Training Centre building as a temporary arrangement.
- The Unit should attempt to attract more commercial testing of samples along with the research samples.
- Wherever possible the University should provide the financial support for testing of their research samples.
- The Scientist from the ICAR-CIRCOT, Mumbai should be associated with the Breeding Programme of MCRS for supporting quality improvement of cotton fibres.
- The Q.E. Unit should also conduct training programmes to the farmers in the area of clean picking of cotton and post-harvest management of seed cotton.

1.3.8 The Eighth Meeting

QRT Meeting was conducted at Quality Evaluation Unit, ICAR-CIRCOT, Dharwad on June 14th & 15th, 2024. Dr. G.S. Nadiger, Member, QRT, Dr. A. J. Shaikh, Member, QRT, Dr. S. K. Shukla, Director, ICAR-CIRCOT and Dr. A. S. M. Raja, Member Secretary, QRT were present during the meeting. On 14th June 2024, QRT visited Agricultural Research station (ARS), Hebbali farm and University of Agricultural Sciences, Dharwad campus and had discussion with University officials about the functioning of the unit. On 15th June 2024, a stakeholder's meet has been arranged in which Dr. Venkatesh R Kulkarni and his team of scientists, representatives from cotton corporation of India, Hubli, Cotton Association of India (CAI), Hubli and Dr.B.N. Khadi participated. Dr. S.K. Shukla in his address informed about the concern raised by QRT during the meeting in Mumbai on 5-6th December 2024 about the performance of the Dharwad unit and steps taken by the HQ for improving the performance. He outlined that new HVI, trash separator, compressor etc have been provided to the centre. Dr. A S M Raja, Head, QEID presented the progress of the unit and highlighted that QEU, Dharwad has tested significant numbers of commercial samples compared to previous years.

Dr. A.J. Shaikh, in his address, proposed the visibility of the centre has to be improved through organising workshops, stakeholders meet internships and training programs on topics such as clean cotton picking, post-harvest management of seed cotton, and quality testing to farmers and other stakeholders. This would ensure the effective utilization of the manpower. He also mentioned that whenever required, scientists from the ICAR-CIRCOT Headquarters could be called upon to support these activities. Dr.G.S.Nadiger, member QRT opined that that the unit is located at right place and also proposed to CIRCOT and UAS to initiate joint project for developing calibration cotton. Dr.B.N Khadi in his address highlighted the unit was established during 1928 and helped the UAS Dharwad in developing commercially successful cotton

varieties/hybrids. He also requested the QRT to consider strengthening of the centre and offered to arrange a meeting with private seed cotton industries for testing their cotton samples

After that, the QRT visited UAS, Dharwad campus and met Dr. P.L. Patel, Hon'ble Vice Chancellor and discussed with him about the functioning of the unit. He was of the opinion that the root cause of the problem for the dismal functioning of the unit during the last five years had to be identified and corrective measures need to be taken. He also opined that the centre should not be closed and to be strengthened.

1.3.9 The Ninth Meeting

The ninth meeting was conducted at ICAR-CIRCOT, Mumbai on 5th & 6th July 2024. On 5th July 2024, QRT-IMC meeting was arranged under the chairmanship of Dr. K. K. Singh. Dr. A S M Raja, Member Secretary, QRT presented the draft QRT recommendations. Based on the discussion, the action points emerged from the meeting is given below:

1. The performance of the QEU's situated at Guntur, Dharwad and Surat can be improved though strengthening of infrastructure and manpower. Their presence in cotton growing area is added advantage to the institute for serving the stakeholders.
2. The recommendation of the QRT need to be in broad areas. The number of recommendations can be reduced by clubbing the draft recommendations research area wise.

After that, QRT had an interaction with the scientist and asked their suggestion for the report. During that day, QRT inspected the space available for construction of office building and Type V quarters in the institute premises. QRT also visited the ICAR-CIRCOT, Mahim quarters and had a first-hand look on the space available for construction of new type IV quarters. On 6th July, 2024, QRT visited Ghatkopar and inspected the two institute staff quarters viz. Karpasa & Param. During the day, QRT finalised the report with mutual discussion among the members. In the concluding meetings, Chairman and members interacted with the scientists and also thanked the Director for his support in conducting the proceedings.

1.3.10 The Tenth meeting

The tenth meeting was conducted at Agril. Engineering, SMD, ICAR, New Delhi on 26.07.2024. Dr. K.K.Singh, Chairman, Dr. S.K. Shukla, Director and Dr. A S M Raja, Member Secretary, attended the meeting. Chairman briefed the QRT recommendations to DDG (Agril.Engg.). Dr. Dr. K. Narasaiah, ADG(PE) present during the meeting suggested to modify the format of recommendation into tabular form giving 'Observation' and 'Recommendation' in different columns

Chapter 2

ICAR-CIRCOT: Brief History and Contributions

2.1 Brief History

Central Institute for Research on Cotton Technology (CIRCOT) is one of the premier constituent institutes of the Indian Council of Agricultural Research (ICAR), under the Department of Agricultural Research and Education (DARE), Ministry of Agriculture, Government of India. Within the ICAR organizational setup, CIRCOT falls under the Agricultural Engineering Division.

ICAR-CIRCOT, Mumbai was inaugurated on Dec 03, 1924, a day before the inauguration of Gateway of India, by Mr. Rufus Daniel Isaacs, then Viceroy and Governor General of India. The institute was established by the Indian Central Cotton Committee (ICCC) under the name Technological Laboratory (TL) with the dual objectives of assisting cotton breeders in developing new strains by evaluating various fibre quality parameters and conducting research on their spinning potential. For nearly a century, CIRCOT has been providing valuable services to all stakeholders of the cotton industry.

In 1966, after abolition of the commodity committees, the administrative control of the institute was transferred to the Indian Council of Agricultural Research (ICAR) and the name of the Institute was changed to Cotton Technological Research Laboratory (CTRL). The mandate for research and development widened to all aspects of post-harvest technology of cotton and value addition to cotton by-products and processing of wastes. CIRCOT (then CTRL) becomes one of the centers of work of All India Coordinated Research Project on Cotton (AICCIP). Director, CTRL was nominated as the principal investigator, to coordinate the technological aspects under the AICCIP, initiated by ICAR. This development led to a greater coordination between CTRL and breeders and considerably increased the tempo of research work at CTRL since technological research work was very much needed to promote the cotton in the textile mills where quality and productivity are the only yardsticks needed by the cotton merchants. The AICCIP project is continuing till date. Later, the Institute was renamed as Central Institute for Research on Cotton Technology (CIRCOT) from 1st April 1991. The Institute has been providing yeoman service to the trade and industry during its long sojourn of about a century by imparting training on cotton quality evaluation and ginning and also by offering the quality assessment support for fibre, yarn and fabrics on commercial terms.

The Institute headquarter is located at Matunga (East) in Mumbai. The Institute has four major research divisions namely Mechanical Processing Division (MPD), Quality Evaluation and Improvement Division (QEID), Chemical and Biochemical Processing Division (CBPD) and Engineering Transfer of Technology Division (ETTD). The Ginning Training Centre (GTC) of CIRCOT located in Nagpur serves the ginning industry by carrying out research in ginning and imparting skill development programmes for gin fitters and technicians employed in ginning-

pressing units dispersed all over India. Moreover, this centre offers technical consultancy services to gin machinery manufacturers. There are five more regional units of institute located at Coimbatore, Guntur, Dharwad, Surat and Sirsa, mainly to assist breeders in testing the technological performance of the varieties being developed by them. Since 2014, ICAR-CIRCOT has also been coordinating the Consortium Research Platform (CRP) Project on Natural Fibres as lead centre for promotion of research and development in natural fibres.

ICAR-CIRCOT, is a Referral Laboratory for cotton fibres and has been accredited with ISO/ IEC 17025:2017 by National Accreditation Board for Testing and Calibration Laboratories (NABL). ICAR-CIRCOT has been accredited with ISO 9001:2015 for its Quality Management System by Bureau of Indian Standards (BIS). ICAR-CIRCOT has served the cotton community for about a century, since its inception, by reorienting itself to suit the changing needs of its stakeholders. CIRCOT has spearheaded and sustained the research and development of technologies and machinery for the postharvest processing of cotton. The Institute is widely recognized for its contribution in testing, standardization and development of test methods for different types of textile materials. ICAR-CIRCOT has forayed into fields of Green Technology, Nanotechnology and Bio technology and is researching to develop environment-friendly textile processes using these cutting-edge technologies. In 2015, ICAR-CIRCOT established Country's first Nano cellulose Pilot Plant at its headquarters in Mumbai.

A vibrant and active Business Promotion and Development (BPD) Unit set up under NAIP was involved in transferring of technology and for providing incubation facilities to potential entrepreneurs. These activities are now continuing through the Agribusiness Incubator (ABI) set up at the institute in 2016. In acknowledgement to its admirable initiatives in Agri Business Incubation, RKVY Division of Ministry of Agriculture and Farmers Welfare, has bestowed ICAR-CIRCOT as an R-Agri Business Incubator which is one amongst 29 R-ABIs at Pan-India level under RKVY-RAFTAAR (Rashtriya Krishi Vikas Yojana-Remunerative Approaches for Agri and Allied Sectors Rejuvenation) scheme from 31st January 2019.

In the recent past, the Institute has carried out pioneering work on ginning and mechanical processing of cotton, development of industrial yarns and fabrics by using natural and synthetic blends and production of calibration cotton for the textile industry. It has also forayed into areas of environment-friendly processing of cotton, nanocellulose production and application of nanotechnology in textiles and agriculture, utilization of cotton by-products, crop residues & value addition to cotton processing waste. Over the last 99 years, ICAR-CIRCOT has proved itself as the main R&D solution provider on cotton technology to its valued stakeholders.

2.2 CIRCOT's Contributions

Following are glimpses of important milestones achieved by ICAR-CIRCOT:

- ICAR-Central Institute for Research on Cotton Technology (ICAR-CIRCOT) is the only institute in the country and among the few 2-3 institutes in the world that carry out basic and strategic research in processing of cotton & it's by-produce. The institute is accredited with **ISO 17025:2017** by NABL. The Institutes is also accredited with **ISO 9001:2015** by BIS.

- ICAR-CIRCOT has developed and commercialized cotton pe-cleaner for ginneries. The adoption of the CIRCOT-Bajaj cotton pre-cleaner by the ginning industry has resulted in reduction of trash content and improvement in the bale value of cotton. The overall economic benefit computed as a result of the utilization and adoption of the CIRCOT-Bajaj pre-cleaner has been estimated at Rs. 438 crores per annum. Hence, an estimated amount of about Rs. 2200 crore benefit realised to the cotton processing industry in the reported period by the adoption of CIRCOT-Bajaj cotton pre-cleaner.
- The significant contributions in the area of ginning machinery research have helped the country to be self-reliant and also become net exporter of ginning machinery. The ginning machinery is now being exported from India to over 15 countries including US, Uzbekistan, Australia, etc. The ginning machinery worth Rs. 300 crore per annum is exported particularly by M/s. Bajaj Steel Industries Ltd., Nagpur, one of the CIRCOT collaborators for the last about 25 years. An amount of over Rs. 1000 crore realized to Indian ginning industry by way of export of ginning and allied machinery during the reported period.
- The institute has developed different variants of lab model gins for ginning of samples for evaluation of cotton quality parameters useful for cotton breeders, traders and seed industries, etc. About 200 units of the CIRCOT lab model gins were marketed during the reported period by the CIRCOT licensee.
- CIRCOT has done yeoman service to cotton farmers by assisting the Govt. of Maharashtra in procurement of cotton at MSP during the corona period. The cotton prices fell down by Rs. 3000 per quintal after emergence of corona pandemic leading to distress sale of cotton by farmers. In order to address this issue, CIRCOT organized special training programmes on cotton grading and marketing to 200 agricultural officers of Govt. of Maharashtra and assisted them in procurement of cotton from farmers at MSP. **The farmers were benefited by additional income of Rs 3000 crore by selling their cotton at MSP in 2020-21.**
- Calibration cotton, a standard reference material, is one of the hallmarks of ICAR-CIRCOT's R&D. It is an import substitute to USDA calibration cotton and has a countrywide acceptance with about **340** corporate users. The economic impact by means of saving of precious Foreign Exchange (Forex), amounts to around Rs. 58 lakhs per annum. An amount of over Rs. 250 lakhs foreign exchange were saved during the reported period by sale of CIRCOT Calibration cotton to different stakeholders including spinning mills and testing labs.
- The Institute extends technological support to the country's cotton breeding programme, for varietal development with improved productivity and quality that suits industry needs, under All-India Coordinated Research Project on Cotton (AICRP). Two hundred fifty-two (252) new cotton varieties have been released during the review period 2017-22.
- ICAR-CIRCOT provided the protocols of cotton quality parameters for branding of the Indian cotton as Kasturi. The same protocols have been adopted by the TEXPROCIL for

launch of Kasturi cotton branding of the Indian cotton.

- CIRCOT is also the nodal centre for the implementation of the Consortia Research Platform (**CRP**) **project on Natural Fibres**, since its inception during 2014. The institute is part of major initiatives such as '**National Biomass Mission**' of Ministry of Power, aiming to promote use of biomass as energy source in thermal power plants. The institute is also working in coordination with the **Cotton Corporation of India Ltd.** and **Maharashtra Cotton Marketing Federation** towards improvement in the bale value of cotton. CIRCOT is actively associated with the **World bank** funded '**Smart Cotton Initiative**' of Government of Maharashtra aimed at capacity building among the farmers and community-based organizations for promoting world class cotton production from the year 2020.
- The institute has developed solution for eco-friendly, efficient and rapid burning crematorium, an alternative to the traditional wood-based creation using briquettes made from cotton stalks and other agro-biomasses. This technology saves about **55% expenses** of cremation from **Rs. 5500** to **Rs. 2500**. The technology has been transferred to two manufacturers and over 50 units are sold to different parts of our country during the reported period.
- The institute has developed effective technologies to address the issue of spread of pink bollworm from ginneries to nearby cotton farms, the technologies deals with quarantine of pink bollworm present in cottonseeds and gin trashes by controlled heating and compacting, respectively.
- CIRCOT has developed various niche products out of the **naturally coloured cotton spun yarn** such as Jackets, Handkerchiefs, Infant wears. These products are 100% chemical free, has very high wash durability (due to inherent colour), soft feel and skin friendly.
- The institute has pioneered work in **nanotechnology**. During the reported period, the **Nano-Zn production** technology has been licensed to M/s. Rashtriya Chemicals and Fertilizers Limited (**RCF**), Mumbai and M/s. Biofac, Hyderabad for commercial production.
- Under Agri Business Incubation Centre, Institute has graduated 24 incubatees, commercialized 13 technologies, signed 53 MoUs, completed 92 consultancy projects, conducted 143 training programmes, filed 3 patent and granted with 2 patents.
- Under CIRCOT R-ABI scheme, 73 startups were supported with sanctioned grant-in-aid of Rs. 497.77 lakhs for flourishing their agri-startups. Also, startups have developed 17 prototype and launched 33 MVPs in the national market. Startups has generated Rs. 2019 lakhs of turnover.
- The Institute has been conducting year-round innovative customized skill development programmes, at national and international levels, to different stakeholders including farmers, ginneries, cotton graders, traders, faculties of universities, scientists of ICAR institutes, etc. **More than 3000** Indian stakeholders and **15 foreign delegates** were trained and a revenue of about **Rs. 102 Lakhs** generated during the reported period.

- The institute was one of the knowledge partners for implementing the ambitious Cotton Technical Assistance Programme (**Cotton TAP**) of the Govt. of India for Africa for development of cotton sector in the seven African countries viz., Benin, Burkina Faso, Chad, Mali, Malawi, Nigeria and Uganda. The institute has conducted in-country training programme in these countries and commissioned a **Regional Knowledge cum Training Centre** for Post-harvest Management & Ginning Technology in Benin during the reported period.
- ICAR-CIRCOT has assisted the United Nations Conference on Trade and Development (**UNCTAD**) in implementing a UN Development account Project 1617K on “Promoting Cotton by products in Eastern and Southern Africa” in Zambia, Zimbabwe, Tanzania and Uganda by organising a capacity building programme for 12 delegates.
- Institute has generated **Rs.11.91 crore revenue** through technology transfer activities, skill development programmes, research consultancy and commercial testing services during the reported period.
- The institute has published 168 research papers during the reported period in NAAS rated journals of 6 and above.
- ICAR-CIRCOT has been an active member of the Textile Division of Bureau of Indian Standards (BIS).
- ICAR-CIRCOT is recognized by University of Mumbai for providing education in basic sciences.

ICAR-CIRCOT has been conferred with **prestigious Sardar Patel Outstanding ICAR Institution Award in the year 2019** for its significant contribution in R & D of various cotton post-harvest technologies and value addition of by-products, skill development of human resources in agriculture and textile sector, commercial testing services, commercialization of technologies, entrepreneurship development programs and start-up generation.

2.3 Cotton Scenario

Cotton is one of the most important commercial crop cultivated in India, accounting for around 23% of the total global cotton production. It plays a major role in sustaining the livelihoods of about 6.0 million cotton farmers and 40-50 million other people engaged in related activities such as cotton processing and trade. The Indian Textile Industry consumes a diverse range of fibres and yarns, with the ratio of cotton to non-cotton fibres being around 60:40 in India, whereas it is 30:70 in the rest of the world. Cotton is the backbone of the Indian textile industry. It is second largest employment provider, after agriculture. Due to its economic importance in India, cotton is also termed "White Gold."

India ranks first in the world in cotton acreage, with 130.6 lakh hectares under cotton cultivation, approximately 40% of the world's total area of 324.2 lakh hectares. Approximately, 67% of India's cotton is produced in rain-fed areas, while the remaining 33% is grown on irrigated lands. During 2017-2022, cotton production in India has experienced fluctuations, sometimes going significantly higher side and sometimes lower side. In the past five years, cotton production reached its peak at 370 lakh bales (170 kg) in 2017-18, declining to 332 lakh

bales in 2022-23. Cotton prices were below the Minimum Support Price (MSP) during 2019-20 and 2020-21. However, in 2021-22, seed cotton prices increased significantly to Rs. 10,000-13,000 per quintal, approximately 30% above the MSP. In 2023-24, the prices of seed cotton are hovering around the MSP price.

All cotton produced in India is hand-picked, whereas sophisticated mechanical harvesters are used for cotton picking in several developed countries. Currently, Indian farmers face difficulties in securing timely labour for cotton picking. Additionally, the cost of manual picking has significantly increased over the past 2-3 years, making cotton farming unsustainable. Although India has made good progress in developing picking machinery, there has been limited success in eliminating leaves and cleaning the highly trashy cotton in ginneries.

India produces cotton in all staple length groups. However, the production of Extra Long Staple (ELS) cotton, with a length above 32.5 mm, is only about 5 lakh bales. It is estimated that the Indian textile industry's consumption of the ELS cotton is 15 lakh bales, creating a deficit of 10 lakh bales. This shortfall is typically met through imports, primarily from the US and Egypt. The ELS cotton is utilized to manufacture niche fabrics and textile products that are in high demand worldwide.

The brand name for Indian cotton, "Kasturi Cotton India," was launched on World Cotton Day in 2022 to promote the objectives of "Make in India," "Atmanirbhar" and "Vocal for Local" in the cotton sector. ICAR-CIRCOT provided quality norms to brand Indian cotton as Kasturi. In addition, during 2022-23, the Govt. of India notified a Quality Control Order (QCO) to ensure that the quality of cotton meets industry standards. However, the implementation of QCO was deferred by the Govt. of India due to opposition from the ginning industry.

ICAR-CIRCOT has a crucial role to play in ensuring the availability of quality cotton to the Indian textile industry. The institute should also promote cotton quality-based trading to enable farmers to fetch better prices for their high-quality cotton.

Chapter 3

Organisation and Management

3.1 Introduction

Established in 1924 as the Technological Laboratory of the Indian Central Cotton Committee (ICCC), the institute is now 99 years old. After being taken over by the ICAR in 1966, the laboratory was renamed as Cotton Technological Research Laboratory. In 1991, the name was changed again to the Central Institute for Research on Cotton Technology (CIRCOT).

CIRCOT has four research divisions: the Quality Evaluation and Improvement Division (QEID), the Mechanical Processing Division (MPD), the Chemical and Biochemical Processing Division (CBPD), and the Engineering Technology Transfer Division (ETTD). Additionally, there are service sections such as the Test House, ABI, Library, AKMU, PME Cell, ITMU, Administration and Finance & Accounts. The institute also operates a Ginning Training Centre in Nagpur under the MPD and five Regional Quality Evaluation Units located in Sirsa, Surat, Guntur, Dharwad, and Coimbatore, all under the QEID. The organizational chart is provided in Fig 3.1.

3.2 Vision, Mission and Mandate

(a) Vision

Global Excellence in Cotton Technology

(b) Mission

To Provide Scientific and Managerial interventions to Post-Harvest Processing and Value Addition to Cotton and Utilization of its By-Products to Maximize Economic, Environmental and Societal benefits.

(c) Mandate

- Basic and Strategic Research on Processing Cotton and its Agro-Residues, Development of Value-Added Products and Quality Assessment
- Skill Development and Business Incubation Services and Function as Referral Laboratory for Cotton Fibres.

Quality Policy

ICAR-CIRCOT has established a quality policy in accordance with the requirement of ISO 9001:2015. The policy is appropriate to the nature of the institute's activities.

ICAR-CIRCOT is committed to undertake basic and strategic research on quality assessment, processing and development of value-added products from cotton and its agro-residues. The institute is committed to skill development and business incubation services in its mandated areas and functions as referral laboratory for cotton fibres. The institute strives for the satisfaction of its stakeholders through

- Undertaking innovative research projects and provide business incubation facilities
- Technology commercialisation, training and testing services
- Continual improvement of systems and processes

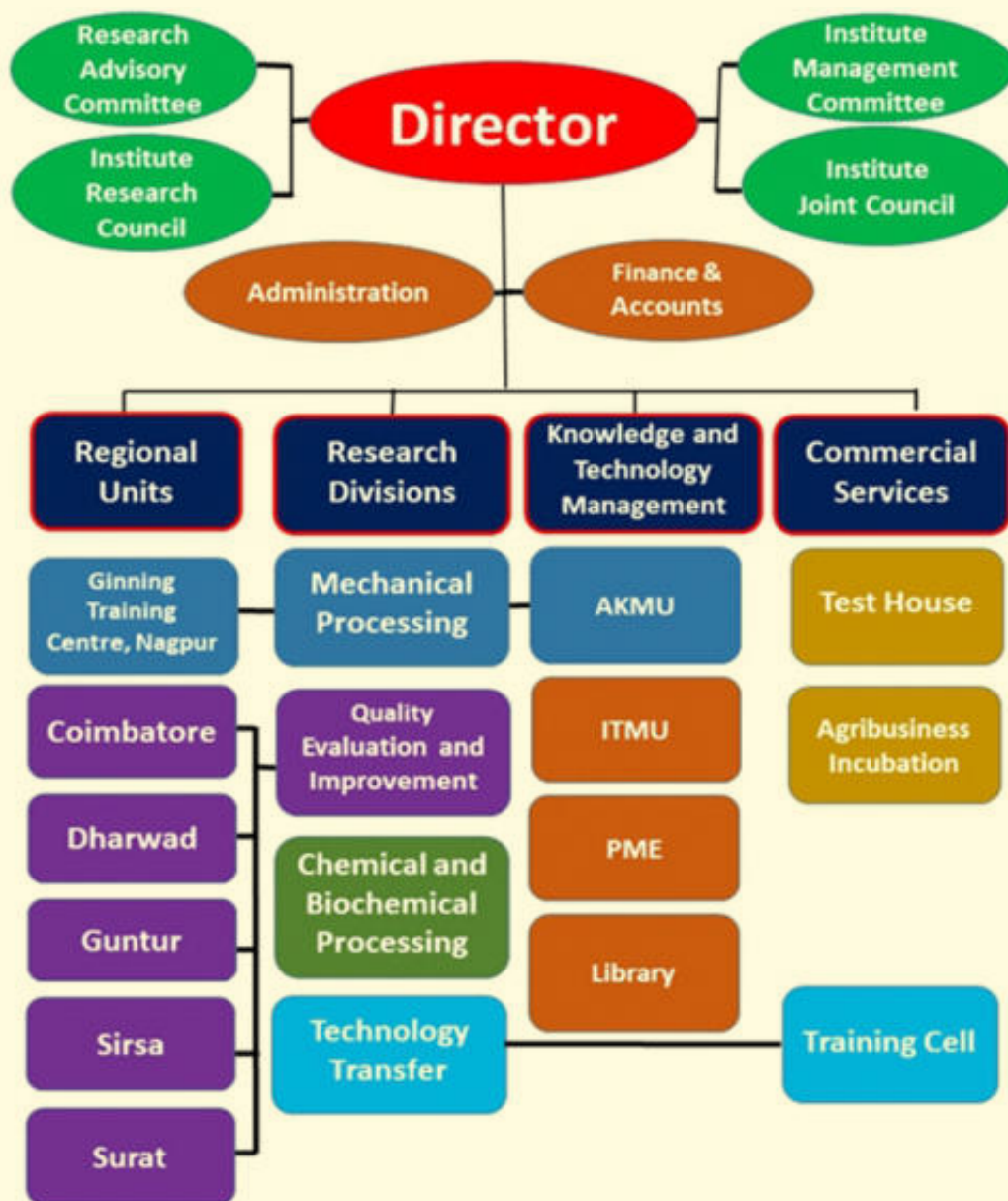


Figure 3.1. Organizational structure of ICAR-CIRCOT, Mumbai

3.3 Staff Strength as on 31.03.2022

The status of staff in position as on 31.03.2022 under various categories is listed in the Table below

Category	Sanctioned Strength	In-Position	Vacant
Director (RMP post)	01	00	01
HODs (Non RMP)	04	00	04
Scientific	48	30	18
Technical	112	62	50
Administrative	37	26	11
Skilled Supporting Staff	36	25	11
Total	233	143	90

1. Sanctioned Strength, in position vacancies of ARS Scientist discipline:

Sr. No.	Discipline	Scientist			Senior Scientist		
		Sanction	In position	Vacancy	Sanction	In position	Vacancy
1	Agricultural Structures & Process Engineering	09	08	01	03	02	01
2	Farm Machinery & Power	02	02	00	--	--	--
3	Computer Application & IT	02	01	01	--	--	--
4	Agricultural Microbiology	03	03	00	--	--	--
5	Textile Manufacture & Technology (Including Textile Chemistry)	08	06	02	03	02	01
6	Agricultural Chemicals	02	01	01	01	01	00
7	Agricultural Economics	01	01	00	--	--	--
8	Plant Biochemistry	02	02	00	--	--	--
9	Electronics & Instrumentation	04	01	03	01	00	01
10	Agricultural Statistics	01	00	01	--	--	--
11	Agricultural Physics	02	00	02	--	--	--
	Total	36	25	11	08	05	03
	Cumulative Total	44	30	14			

2. Sanctioned Strength, in position vacancies of Head of Division:

Sr. No.	Discipline	Sanction Strength	In Position	Vacancy
1	Head of Division	04	00	04

3.4 Infrastructure

The institute is well equipped with state-of-art research and testing facilities for conducting research in post-harvest processing of cotton and allied fibres. The facilities and infrastructures developed during 2017-2022 are given below.

- Video Conferencing facility
- Renovated Admn. I Section
- Renovated Finance & Accounts Section
- Record Room
- The New PME Cell
- ICAR-CIRCOT Sports Centre and Gymnasium
- Product Sales Counter
- National Laboratory for Advanced Material Characterisation

- Smart Textile Laboratory
- Biomass Pellet Demonstration Plant and Testing Facility at GTC
- Modern Saw Ginning Plant at GTC
- Conversion of four numbers of Type-I Quarters to Farmers' Guest house at GTC, Nagpur
- National Laboratory for Assessment of Trash in Cotton

ICAR-CIRCOT laboratories are well equipped with instruments and machinery for studies on post-harvest processing of cotton, technological evaluation of cotton and textile quality, structural studies, wet processing and finishing of textiles, preparation and characterization of nano materials, chemical and microbiological studies, cottonseed and cotton biomass utilisation including some pilot plant facilities.

3.5 Functions

CIRCOT functions according to ICAR-approved mandates and caters to the needs of cotton farmers, ginning, textile industry and provide consultancy and support to other stakeholders. The institute collaborates with various institutions to produce better cottons with desirable fibre qualities required by the textile industry and to develop technologies for the efficient use of cotton and its byproducts, while also promoting entrepreneurship in the country. The institute is the main agency for imparting training in modern ginning practices, enabling the processing industry to provide clean cotton to textile mills and other users. It also engages in capacity-building activities across various fields of cotton post-harvest technology. Additionally, CIRCOT prepares and supplies calibration cotton, which are in good demand from the industries in India and other countries. CIRCOT is a NABL-accredited laboratory under ISO 17025 and serves as a Referral Laboratory for testing textiles and cotton fibres. It received ISO 9001:2015 certification in June 2014 and has maintained this certification to date.

3.6 Management

The Indian Council of Agricultural Research (ICAR) has developed a system to ensure better research, administration and financial management for its institutes, it is updated in line with government directives. As per instructions from the Council, the MIS-FMS system has been implemented for all official work. All purchases are made through the e-procurement/GeM portal, applicable as per government directives. A biometric attendance system is in place for all staff, including contractual manpower. The QRT reviewed the schedules for holding meetings of various institute committees, such as the Research Advisory Committee, Institute Research Council (IRC) and the Institute Management Committee and observed that there have been good regularity in organizing these meetings.

(a) Institute Management Committee (IMC)

CIRCOT has a Management Committee constituted by the Indian Council of Agricultural Research (ICAR). The IMC of CIRCOT met five times during the reporting period to address the various issues, ensuring that decisions aligned with ICAR policies and the institute's mandate. The committee deliberated on the action taken on recommendations from previous meetings, progress of expenditure, progress of works, welfare measures and the functioning of the IJSC and Grievance Committee. By and large, the suggestions and recommendations have been implemented in compliance with ICAR's policies and decisions.

(b) Institute Research Council (IRC)

The CIRCOT's IRC meetings were held every six months and its actions were consolidated annually as per the requirements. All scientists, In-charges of Regional Units and Technical Officers participated in these IRC meetings. The new projects were approved based on merits, the progress of all on-going projects including externally funded projects was discussed and reviewed critically in these meetings. The research project files are maintained by the PME cell as per ICAR norms and copies of the approved file are sent to each concerned investigator.

(c) Research Advisory Committee (RAC)

The RAC, constituted by the council for CIRCOT, met once every year prior to the annual IRC meeting. The RAC reviewed the progress in R&D activities of the institute and suggested modifications, improvements and new programs wherever necessary, in line with the CIRCOT mandate. Most of the RAC's recommendations have been implemented by the institute and many of the new implementable programs suggested by the RAC have also been executed.

(d) Institute Joint Staff Council (IJSC)

The number of meetings held and decisions and action taken have been found to be as per prescribed procedures and ICAR Rules.

(e) Annual Reports of CIRCOT

CIRCOT has been diligent in the publication of its annual reports during the review period. All CIRCOT Annual Reports in English as well as Hindi have been published timely as per the ICAR norms. It is worth noting that all Hindi translations required for the Annual Report have been carried out by in-house staff.

3.6.1 Budget & Finance

3.6.1.1 Budget and expenditure for five years (Scheme and non-Scheme)

Budget for ICAR-CIRCOT

(Rs. In Lakhs)

Period	Plan	Grant-in-Aid Capital	Grant-in-Aid General	Total	% utilization
2017-18	Allocation	50.00	540.00	590.00	99.98
	Exp.	49.97	539.94	589.91	
2018-19	Allocation	135.94	489.87	625.81	99.99
	Exp.	135.92	489.82	625.74	
2019-20	Allocation	165.00	508.00	673.00	99.99
	Exp.	164.98	507.96	672.94	
2020-21	Allocation	35.00	460.00	495.00	100
	Exp.	35.00	460.00	495.00	
2021-22	Allocation	101.67	467.43	569.10	100
	Exp.	101.67	467.43	569.10	

Budget for SCSP**(Rs. In Lakhs)**

Period	Plan	Grant-in-Aid Capital	Grant-in-Aid General	Total	% utilization
2017-18	Allocation	0	0	0	99.99
	Exp.	0	0	0	
2018-19	Allocation	30.70	141.82	172.52	
	Exp.	30.70	141.81	172.51	
2019-20	Allocation	36.51	101.75	138.26	99.99
	Exp.	36.50	101.75	138.25	
2020-21	Allocation	40.00	110.00	150.00	100
	Exp.	40.00	110.00	150.00	
2021-22	Allocation	27.96	50.70	78.66	100
	Exp.	27.96	50.70	78.66	

Budget for CRP NF**(Rs. In Lakhs)**

Period	Plan	Grant-in-Aid Capital	Grant-in-Aid General	Total	% utilization
2017-18	Allocation	6.00	60.00	66.00	96.76
	Exp.	5.48	58.38	63.86	
2018-19	Allocation	7.59	61.00	68.59	99.90
	Exp.	7.59	60.93	68.52	
2019-20	Allocation	31.50	58.50	90.00	99.96
	Exp.	31.50	58.46	89.96	
2020-21	Allocation	2.00	40.00	42.00	100
	Exp.	2.00	40.00	42.00	
2021-22	Allocation	10.67	43.68	54.35	100
	Exp.	10.67	43.68	54.35	

3.6.1.2 Budget allocation**Centre-wise budget allocation for 2017-2022****(Rs. In Lakhs)**

Name of the Centre	No. of Projects	Grant-in-Aid Capital	Grant-in-Aid General	Total
ICAR-CIRCOT, Mumbai	21	94.76	135.68	230.44
ICAR-NIRJAFT, Kolkata	17	0.00	102.25	102.25
ICAR-CICR, Nagpur	3	6.00	10.00	16.00
AAU, Jorhat	3	0.00	24.75	24.75
ICAR-CSWRI, Avikanagar	2	0.00	11.25	11.25
TNAU, Coimbatore	4	0.00	20.75	20.75
Total	50	100.76	304.68	405.44

3.6.2 Resource Generation

Figures for the revenue generated by the institute through various means e.g. training, testing, licensing of technologies, royalty, consultancy, product sales, etc. are presented in the following table.

Revenue generated by the Institute over the period

Year	Rs. in Lakhs	
	Target	Revenue generated
2017-18	110.00	160.00
2018-19	146.00	175.89
2019-20	146.00	182.73
2020-21	113.00	331.66
2021-22	297.00	254.21
Total	812.00	1104.49

During the reporting period, i.e., 2017-2022, ICAR-CIRCOT generated a total revenue of Rs. 1104.49 lakhs, exceeding the ICAR target of Rs. 812.0 lakhs by 136%. In the previous period (2012-17), revenue generation was Rs. 498 lakhs, which equated to 100.3% of the set target.

3.7 Technology Management

(a) Institute Technology Management Committee (ITMC)

It is the committee constituted at the institute level. The ITMC is chaired by the Director, CIRCOT and it serves as a decision support system at the institute level. It aids in addressing IP-related matters of the institution.

(b) Institute Technology Management Unit (ITMU)

Various primary activities of the institute such as disclosure of IP contemplated or generated, patent search, filing of the application at concerned granting authorities, pre-grant and post-grant follow-up, offering, advertising for commercialization, commercializing, license fee/royalty collection, etc. are handled at the Institute Technology Management Unit.

A prioritization, Monitoring, and Evaluation (PME) Cell has been established in CIRCOT to review and provide suggestions regarding different ongoing projects.

Technical Information & Library has been clubbed together for smooth functioning and Hindi Cell has been transferred to the Administrative Section during the reporting period.

(c) Zonal Technology Management Committee (ZTMC)

Since its inception, ZTM-BPD, West Zone at CIRCOT, has been catering to the individual and collective needs of the various ICAR institutes in its catchment. It advises on, coordinates, and pursues the IP protection, maintenance, and transfer/commercialization-related matters of

these institutions. The ZTMC is supported by ICAR for enhancing the IP management capacities.

(d) ICAR-CIRCOT-ABI Centre

The ICAR-CIRCOT Agribusiness Incubation Centre (ABI) was established at ICAR-CIRCOT in 2016 to nurture cotton stakeholders and support their business endeavours. Located in Mumbai, the ABI Centre facilitates the incubation of new enterprises for innovative technologies by providing physical, technical and networking support and services. It offers services, facilities and tailored business support to startups and entrepreneurs, allowing them to test their ventures before establishing their own enterprises.

Since its establishment, the ICAR-CIRCOT Agribusiness Incubation Centre has admitted twenty-six entrepreneurs, with twenty-three incubatees graduating. It has facilitated the development and commercialization of nine innovative products, arranged funding for incubated entrepreneurs and created opportunities for employment generation through business-related activities.

(e) Remunerative Approaches for Agricultural and Allied Sectors Rejuvenation (RAFTAAR) Agribusiness Incubation Centre (R-ABI) (DAC&FW)

Entrepreneurship development in the agriculture sector gained momentum with the launch of the new component "Remunerative Approaches for Agriculture and Allied Sector Rejuvenation" under the revamped scheme of Rashtriya Krishi Vikas Yojana (RKVY-RAFTAAR) in 2018-19. RKVY-RAFTAAR supports startup incubation by leveraging innovations and technologies for venture creation in the agriculture and allied sectors. The programme aims to utilize the existing incubation facilities and expertise available at participating academic, technical, management, and R&D institutions across the country and harness their synergies.

The RKVY Division of the Ministry of Agriculture and Farmers Welfare, recognizing the commendable initiatives of the Agribusiness Incubation Centre of the institute in the field of post-harvest processing of cotton and its value chain, has designated CIRCOT as an Agribusiness Incubator under the RKVY-RAFTAAR scheme, effective from January 31, 2019. CIRCOT R-ABI stands out as one of the prominent among the 29 RKVY-RAFTAAR Agribusiness Incubators established across the country.

CIRCOT R-ABI operates two programmes under the RKVY-RAFTAAR scheme. The first programme, Uday, is a pre-seed stage funding program providing funds of up to Rs. 5 lakhs to agri-startups to translate innovative ideas into workable prototypes. The second programme, Ankur, is a seed stage funding program offering grant-in-aid amounts up to Rs. 25 lakhs to agri-startups to commercialize the MVP (Minimum Viable Product) or scale up their business activities.

Under this scheme, from the 1st to the 5th cohort (C1 to C5), 46 startups were supported, receiving a total grant-in-aid of Rs. 562.5 lakhs to flourish their agri-startups. Agripreneurs under the 6th and 7th cohort are currently in different stages of evaluation for the funding support.

S. No.		C 1	C 2	C 3	C 4	C 5
1.	Start-ups Incubated	15	26	12	19	8
2.	No. of Startups received grant in aid	14	12	08	07	5
3.	Grant in aid Amount sanctioned (Rs. in Lakhs)	144.5	153	97.75	102.50	65
4.	Prototypes Developed	04	04	03	02	03
5.	MVPs launched in Market	10	08	05	05	02
6.	Total Turnover by Startups (Rs. in Lakh)	224	428	202	265	50
7.	Employment generation (Direct)	48	77	31	50	12

3.8 Facilities for Staff, Transport and Guest House

(a) Departmental Canteen

The Institute canteen, which offer tea, coffee, snacks and lunch at subsidized rates, are operational at ICAR-CIRCOT, Mumbai and GTC, Nagpur. The institute has provided spacious canteen halls with tables and chairs, as well as well-equipped kitchens. The management of the HQ canteen is overseen by a committee consisting of seven members appointed by the Director of the institute whereas the GTC canteen is managed by the Officer In-charge, GTC.

(b) Recreation Facilities

Despite limited space at CIRCOT headquarters, facilities for playing indoor games such as Carom, Table Tennis and Chess are provided and employees are encouraged to participate in sports activities. Additionally, a gymnasium has been created in the basement of the newly constructed annexe of Yashwantrao Chavan Bhavan. This gymnasium offers various facilities including treadmills, multi-gyms, ab machines, as well as weights and dumbbells.

(c) CIRCOT Employees' Co-operative Credit Society

ICAR-CIRCOT co-operative credit society is operational which provide medium-term loan at nominal interest rate (currently 9% p.a.). A permanent staff member after completing his/her three years of joining can become the society member and avail loan from the society. The society grants loans up to Rs. 2,00,000 depending on the shareholding of individual members. Profits are distributed as dividends to eligible members at the end of every financial year. The society is governed by a managing committee comprising 9 members, including 7 elected members and 2 members nominated by the Director, who serves as the ex-officio President of the society. The accounts of the society are audited annually by an external auditor appointed by the registrar of cooperative credit societies.

(d) Transport Facilities

CIRCOT has maintained four office vehicles during the reported period in Mumbai for various official purposes such as official visits, local travel of visiting dignitaries, making local purchases, collection of cotton samples from railway stations and for trainees to visit various institutions as part of their training programmes. Additionally, the Ginning Training Centre of the institute has one vehicle designated for official use.

(e) Guest House/ Trainee Hostel

CIRCOT has guest house facilities at HQ office complex and at GTC, Nagpur. The guest houses are being managed by in-charges with administrative support provided by CIRCOT. At HQ guesthouse, there are a total of 13 rooms, consisting of six bedded 2 rooms, four bedded 1 room, three bedded 2 rooms, single bedded 1 room, 3 VIP rooms and two bedded 4 rooms. The maximum occupancy of the guest house is 37. All rooms in the HQ guesthouse are air-conditioned and equipped with TVs. Additionally, a dedicated lift facility is provided for the occupants.

At GTC, Nagpur, there are two guest houses: the Trainees' Hostel and the Farmers' Hostel. The Trainees' Hostel comprises of 10 double-bedded rooms. Out of 10 rooms, 3 rooms are equipped with AC and attached washrooms, while the remaining 7 rooms are non-AC with common washrooms. On the other hand, the Farmers' Hostel has 4 non-AC double-bedded rooms, with attached washrooms.

(f) CIRCOT Employees Welfare Fund (CEWF)

The CIRCOT Employees Welfare Fund (CEWF) was established by the former Director, Dr. S. Sreenivasan, with the aim of promoting the welfare of staff, comprising a total of 117 members. CEWF provides financial assistance to employees in need, particularly for medical expenses and educational purposes. Additionally, CEWF grants awards to the meritorious children of members who have successfully completed their S.S.C., H.S.C., Diploma, Graduation, and Post-Graduation.

(g) Staff Quarters

CIRCOT has provided housing facility to some of the staff members in the quarters located at Mahim and Ghatkopar in Mumbai and also at Nagpur. Details of the existing facilities are indicated below:

Place	Category	No. of flats
Mumbai (Mahim)	Type IV	8
Mumbai (Mahim)	Type II	34
Mumbai (Ghatkopar)	Type III	30
Mumbai (CIRCOT Premises)	Type V	2
Nagpur	Type III	2

3.9 HRD Efforts

Training the employees of any organization is an investment aimed at enhancing their performance, updating their skills, clarifying their roles and also serves as a motivational tool. Even senior-level officers and scientists benefit from periodic refresher courses to update their skills and stay motivated to excel in their roles. Details of training programs conducted and foreign deputation assignments are typically outlined in the Institute Background Report. This report serves as a comprehensive document that provides insights into the training initiatives undertaken by the organization, including both internal training programmes and

opportunities for foreign assignments. It offers a transparent overview of the efforts made to enhance the skills and knowledge of employees, as well as the exposure provided to them through international assignments.

While efforts have been made to provide relevant training to employees across all categories, there is a noticeable lack of foreign exposure in advanced areas. A significant portion of deputations is focused on providing training to African countries under cotton Technical Assistance Programme (TAP), rather than on skill updating. Given that a majority of scientists at the institute are young, they would greatly benefit from exposures and trainings at the advanced centres of knowledge worldwide.

3.10 Education

ICAR-CIRCOT has signed MoUs with educational institutions like VJTI Mumbai, Dr. BSKKV, Dapoli, UAS, Dharwad, SNDT, Mumbai, ICT, Mumbai to promote research and teaching in the sphere of cotton science and technology. The MoU helps in carrying out joint research work & creates an opportunity for perusing post graduate & Doctoral degree programmes. The University of Mumbai has accorded permanent recognition to ICAR-CIRCOT for guiding students leading to M.Sc. (by research) in subjects: Physics, Bio-physics, Microbiology and Organic Chemistry and Ph.D. in Physics and Microbiology. Four Ph.D. students from Mumbai University were guided during 2017-2022.

3.11 Sports

CIRCOT consistently participates in the ICAR annual Inter-Institute Zonal Sports Meet, with a contingent typically comprising 40-60 staff members, including both men and women. Over the five-year period under review, CIRCOT has achieved notable success, securing 15 gold and 22 silver medals across various events such as Athletics, Chess, Carom, Table tennis and Badminton at the West zone tournaments. It's particularly encouraging to observe that women have excelled in many of these events. Participation in the annual sports meet has not only contributed to the physical well-being of employees but has also fostered a sense of friendship and camaraderie among them. The QRT believes that this practice should be sustained with the same enthusiasm and commitment in the future.

Chapter 4

Programmes and Projects

4.1 Core Area and Projects

Institute research programmes are divided into five core areas. A list of the various institutional and externally funded projects undertaken at the institute under each core area are tabulated as follows:

Core Area I: Pre-Ginning and Ginning

S. No.	Name of the Project	Duration
1.	Design and Development of Single Locking Cotton Feeder for Enhancing Ginning Efficiency of Double Roller Gin	2016-2018
2.	Development of an Efficient System for Processing of Kawadi Cotton in Gineries	2018-2021
3.	Development of Trash Handling System for Control of Pink Bollworm in Cotton Gineries	2018-2020
4.	Development of a rotary Tubular Drum Dryer (RTDD) for Quarantine of Pink Bollworm infested Cottonseeds in Gineries	2018-2021
5.	Development of Digital Ginning Percent Indicator for Portable Cotton Gins	2020-2022
6.	Assessment of Suitability of Adoption of Seed Cotton Contamination Cleaner for Contamination and Trash Control in Industries in India	2020-2022
7.	Device for Seed Cotton Ginning Percentage Measurement	2020-2023
8.	Optimization of Groove Profile and Diameter of Chrome Leather Roller for Enhancing the Performance of Double Roller Gin	2020-2022
9.	Development of A Seed Cotton Trash Content Analyser based on Pneumatic Fractionation Methodology	2021-2023

Core Area II: Mechanical Processing, Technical Textiles and Composites

S. No.	Name of the Project	Duration
1.	Development of Activated Carbon from Cotton Stalk for Use in Protective Textiles	2016-2018
2.	Development of Durable Antimicrobial Cotton Textile through Fibre Blending Process	2016-2018
3.	Development of Activated Carbon-Based Protective Mask	2018-2020
4.	Development of High-Performance Cotton Pads for Wound Dressing	2018-2020
5.	Development of Cotton Based Smart Fabric for Warm Pads and Garments	2018-2020

Core Area II: Mechanical Processing, Technical Textiles and Composites

S. No.	Name of the Project	Duration
6.	Development of Composite Material based Sanitary C Pad	2018-2021
7.	Evaluation of Spinnability and Formulation of Guidelines for Spinning of Recycled Fibre from Fabric Waste and Develop Value Added Products	2020-2023
8.	Development of Cellulosic Nano Fiber Based Micronutrient Delivery System for Urban Farming	2020-2023
9.	Development of Filter Fabric for Indoor Decontamination	2020-2022
10.	Process Protocol for Cotton-based Multilayer Fabric for Cut-Resistance Gloves	2021-2024
11.	Development of eco-friendly fruit protection bags for quality enhancement (Collaborating institutes-ICAR-CIRCOT, Mumbai with ICAR-NRCG, Pune)	2021-2024

Core Area III: Characterisation – Cotton and Other Natural Fibres, Yarns and Textiles

S. No.	Name of the Project	Duration
1.	AICRP on Cotton (Quality Research)	2017-2021
2.	Design & Development of Lint Opener for Preparation of Samples for Micronaire Testing	2017-2019
3.	Development of Marker Fibres: A Tool for Traceability of Cotton Textiles	2017-2020
4.	Development of Electrically Conductive Cotton Materials	2021-2022
5.	Development of Machine Learning Model for Trash content Analysis based on High Volume Instrument and Gravimetric Method of Trash content Estimation	2021-2022
6.	Development of AI Based Prediction Model for Yarn Quality Characteristics	2022-2025
7.	Development of Bio Compatible Nano-Clay Polymer Composites and Nanoparticles with Reference to Retention and Release of Iron and Zinc in Grape (Visit Vinifera L.) [ICAR-NRC for Grapes, Pune]	2020-2023

Core Area IV: Chemical and Biochemical Processing and Biomass and By-Product Utilisation

S. No.	Name of the Project	Duration
1.	Development of Innovative Finishing Process for Cotton Garments	2015-2018
2.	Development of Suitable Solvent Extraction Process for Obtaining Low Gossypol Cottonseed Meal for Non- Ruminant Feed and Food Applications	2016-2018

Core Area IV: Chemical and Biochemical Processing and Biomass and By-Product Utilisation

S. No.	Name of the Project	Duration
3.	Development of Protocol for Extraction of Quality Protein from Cottonseed Meal	2017-2019
4.	Scale-up of the Microbial Process for Degossypolization and Nutritive Quality Improvement in Cottonseed Cake	2018-2020
5.	Development of Natural Fibre-based Fragrance Material for Well-Being	2019-2020
6.	Toxicological and Environmental Impact of ICAR-CIRCOTs Nanomaterial (Nanocellulose, nano silver and nano-ZnO)	2020-2023
7.	Development of Healthier Cotton Seed-Based Cooking Oil by Blending with Other Vegetable Oil	2020-2022
8.	Development of Health Drink from Cottonseed	2021-2022
9.	Development of Microbial Xylanase Enzyme-Based Process for Eco-Friendly Bleaching of Paper Pulp	2021-2023
10.	Efficacy Evaluation of ICAR-CIRCOT Nano ZnO as A Nano Fertilizer in The Field Crop (Collaborating Institutes-ICAR-CIRCOT with ICAR-IIPR, Kanpur, ICAR-CICR, Nagpur and ICAR-NIASM, Baramati)	2021-2024
11.	Development and Evaluation of Non-Steroidal Anti-Inflammatory Drugs (NSAIDS) Loaded Nanocellulosic Hydrogels [GMIPSR, Karnataka]	2022-2023

Core Area V: Entrepreneurship and Human Resource Development

S. No.	Name of the Project	Duration
1.	Popularization of CIRCOT Technologies on Compost and Oyster Mushroom Production using Cotton Stalks among the Cotton Growing Farmers of Vidarbha Region (2016-18)	2016-2018
2.	Application of Nano Cellulose in Cement Concrete, Rubber Composites, Pulp and Paper for Enhancement of Functional and Mechanical Properties	2016-2017
3.	Assessment of Factors influencing Adoption of Scientific Cottonseed Processing in India	2016-2019
4.	Impact Assessment of ICAR Flexi-Check Dam in Different Hydrological Regions of Maharashtra	2017-2019
5.	Applications of Nano Cellulose in Paint Formulations	2017-2019
6.	Design and Development of Nanocellulose Based Composites for Packaging Applications	2017-2019
7.	Development of Nanocellulose Based Edible Coating for Fruits and Vegetables	2019-2021

Core Area V: Entrepreneurship and Human Resource Development

S. No.	Name of the Project	Duration
8.	Refinement and Popularization of Nutrient-Enriched Compost Production from Cotton Micro-Dust	2020-2021
9.	Development of Process Protocol for Synthesis of Nano-Sulphur and its Application in Agriculture	2020-2021
10.	Efficiency Evaluation of ICAR-CIRCOT Nano-Sulphur as Fertilizer Formulation for Different Field Crops	2021-2024
11.	Impact Assessment of CIRCOT Technologies	2020-2025

CRP on Natural Fibre

S. No.	Name of the Project	Duration
1.	Utilization of Ligno Cellulosic Fibre based Biomass as Renewable Energy for Rural and Industrial Application	2015-2017
2.	Development of Building Materials using Natural Fibres and Other Fibrous Crop Residues (CIRCOT Centre)	2021-2025
3.	Eco-Friendly Method of Preparing Absorbent/ Surgical Cotton from Non-Spinnable Cotton	2015-2020
4.	Development of Cotton Incorporated Personal Protective Equipment (PPE) Body Suit for Healthcare Workers with Enhanced Comfort	2020-2022
5.	Development of Cotton Based Face Mask with Improved Particle Filtration Efficiency and Breathability Using Electro Spun Nano Materials and Antiviral Coatings	2020-2023
6.	Micro/Nano Lignocellulose from Lignocellulose Biomass Was Utilized in The Development of Moulded Products for Improved Performance	2015-2020
7.	Sustainable Green Technology for Dyeing of Cotton Textile	2015-2020
8.	Development of Natural Fibre-Based Composite for The Selective Automotive Applications	2022-2023
9.	Value Addition to Banana Pseudo stem Fibres	2017-2020
10.	Development of Nanocellulose Based Polymer Composites for Packaging Applications	2017-2020

Externally Funded Projects

S. No.	Name of the Project	Duration
1.	Preparation of Specialty Grade Pulp from Cotton Linters by Blending with Pulps from other Cellulosic materials for high end applications	2017-2019
2.	Valorization of Cottonseed Meal: Extraction of Quality Protein for improving the Livelihood of Cotton Farmers (DST)	2018-2020

Externally Funded Projects

S. No.	Name of the Project	Duration
3.	Design and Development of Pilot Plant for Extraction of Protein from De-oiled Cotton Cake and Value Addition/ (By Products Utilization)	2021-2022
4.	ICAR-CIRCOT Agri Business Incubation Centre	2015-2020
5.	An Inclusive Agribusiness Model for Sustainable Cotton Marketing in the State of Maharashtra (NASF)	2018-2021
6.	Remunerative Approaches for Agricultural and Allied Sectors Rejuvenation (RAFTAAR) Agribusiness Incubation Centre (R-ABI) (DAC&FW)	2018-2025

4.2 Balance between Basic, Strategic and Applied Researches

CIRCOT has a rich history of conducting fundamental studies on cotton, dating back to its inception when the technology for diversified utilization of cotton fibre was still in its early stages in the country. Studies on fibre morphology, chemical components, variations in fibre quality between seeds and within fibres on the same seed, strength of attachment between fibre and seed, inter-specific property variations and more have been meticulously undertaken. In the early decades, these studies relied on primitive techniques and machinery, but in later years, they were conducted more comprehensively using state-of-the-art equipment such as X-ray diffractometers, electron microscopes and advanced chemical analysis apparatus.

The wealth of data generated over the decades has provided a profound understanding of cotton fibre and its behaviour, laying the groundwork for applied research in subsequent years. With the transition of research divisions from traditional disciplines like physics, chemistry and microbiology to function-oriented designations such as MPD, QEID, and CBPD in 1997, scientists began to focus more on applied research problems, guided by directives from headquarters.

Over the past two decades, there has been a noticeable shift towards applied research, with projects spanning areas such as the development of blended textiles, utilization of by-products, eco-friendly textile processing, applications of nanotechnology in textiles and agriculture, and the design of ginning and allied machinery, etc.

During the review period, the CIRCOT scientists have ventured into emerging fields like nanotechnology and electro-spinning, exploring their applications in textiles and agriculture. CIRCOT scientists are exploring possibilities of using natural fibres as building materials. Moreover, scientists have also forayed into technical textile by developing cut resistant fabrics for industrial gloves and reuse of hard wastes of spinning mills for different value-added products. CIRCOT has also worked on uses of cotton stalk briquettes as alternative to wood based traditional cremation and pellets as fuel for cooking in restaurants. Scientists have also developed sustainable dyeing process for cotton that requires significantly less water and chemical as compared to traditional dyeing. However, the QRT emphasizes the importance of maintaining focused efforts on basic research to establish a solid foundation for future applied research endeavours.

Chapter 5

Major Achievements of Research

5.1 Core Area I: Pre-Ginning and Ginning

- Development of a single locking cotton feeder for double roller gin. Using this feeder for long and medium staple cotton resulted in a 22% and 25% increase in ginning output, respectively, along with a 12% and 13.5% reduction in specific energy requirements compared to the conventional system with an auto feeder. The single locking feeder also showed significant improvement in the colour grade of cotton, while other HVI and AFIS fibre quality parameters remained unaffected.
- Development of a 'Trash Handling System' for controlling Pink Bollworms (PBWs) in ginneries. This system includes a blower fan, ducting, a cyclone and a compactor, with a capacity to handle 2.5 tonnes of trash per hour.
- Development of an efficient system for processing of the kawadi cotton in ginneries. The developed boll opener raw kawadi cotton processing capacity was 6-8 quintals per hour, with a lint recovery rate of approximately 25%.
- Development of a Rotary Tubular Drum Dryer (RTDD) for quarantine of the pink bollworm from cottonseed in ginneries. The developed system was found to be effective for quarantine of the PBWs by indirectly heating cottonseeds to 65°C for 5-6 min duration.
- Economic surplus approach to assess the impact of CIRCOT Bajaj pre-cleaner was studied. With the estimates of the elasticity of demand (0.30) and elasticity of supply (0.23) for cotton lint, the overall economic benefit computed using the Economic Surplus approach on adoption of the CIRCOT-Bajaj Pre-cleaner was estimated at Rs.438 crores per annum.
- Development of Digital Ginning Percentage Indicator (DGPI) for portable cotton gins. It is expected that the developed system will aid in increased usage of portable gins and accelerate GP based trading of seed cotton in ginning industries and market yards and would empower farmers with premium rates for their cotton over and above 34% GP.

5.2 Core Area II: Mechanical Processing, Technical Textiles and Composites

- Development of cotton/ bamboo viscose blended fabric for active wear. The produced garment showed better smoothness, softness along with good moisture transport properties. This T-shirt can be used as a leisure wear as well as an active wear.
- The Developed cotton/PLA/bamboo blended garments showed the functionalities of improved smoothness and softness with better moisture wicking ability suitable for use as high end casual wear.
- Development of durable antimicrobial cotton textile through fibre blending. The cotton/

antimicrobial polyester fabric with the proportion 50/50 showed durable antimicrobial properties and can be scaled up for the production of apparel and home textiles.

- Development of a nanocellulose polymer-based PVA composite film. The tensile strength of composite films loaded with 2% and 5% nanocellulose improved significantly by 25% and 50.7%, respectively, compared to pure PVA film. Reinforcement of nanocellulose up to 10% also showed a marked increase in water vapor barrier properties, reducing WVP values by 14-29%.
- Production of an activated carbon-based protective mask. This mask is made of three-layer fabrics: the top and bottom layers are woven fabric for particulate matter filtration, while the middle layer is made of cotton-based activated carbon incorporated with nanocellulose fibrils or activated carbon-coated woven fabrics, which can adsorb gaseous pollutants from the atmosphere.
- Development of Natural fibre based herbal fragrance release product for well-being was attempted. Inside the packet, five layers of cotton nonwoven was used as core material. Fragrance based natural essential oil was incorporated in the middle non-woven layer of the cotton. According to standard mosquito repellency reports, the packet demonstrated 100% repellency against mosquitoes for up to four days of continuous use after opening.
- Process protocol for spinning of recycled cotton fibre extracted from pre-consumer knitted garment waste fabrics was prepared.
- Development of high-performance cotton pads for wound dressing. A cotton gauze fabric was developed with improved absorbency & wicking properties along with antimicrobial finishing through an in-situ technique using nano-silver. The developed fabric was kept as surface layer of cotton based non-woven pad produced by Needle punching technique. The developed composite had showed good antimicrobial and improved absorbency properties. The performance of the wound dressing pads was evaluated and clinical trial was carried out at KEM Hospital, Sion Hospital and Tata Memorial hospital. The overall performances of wound dressing were given a 5-star rating.
- Cotton based heating glove was developed using conductive yarn. It provides comfort to the wearer and also retains heat within the environment without much loss. The developed conductive yarn was placed wherever the heat is required. The heat was generated with DC power supply using 9V battery & 10 Ah power-bank. The heating pads, developed with conductive yarns, were optimized to generate the temperature of 40-45°C.

5.3 Core Area III: Characterisation-Cotton and Other Natural Fibres, Yarns and Textiles

- Under the AICRP, Institute evaluates fibre quality of samples required to be screened prior to identifying a variety, which is superior to an existing one. The process is repeated for a few years and spinning tests are also conducted at the Institute for samples of advanced trials to ensure that the variety when released is suitable for hassle-free processing.
- Some of the reports are discussed at the Zonal and All India Workshops and advice is

given by CIRCOT Scientists to the breeders on the improvements desired in respect of fibre characteristics. Further, whenever desired, norms are suggested for adoption during selection of the material.

- CIRCOT has been successful in ensuring that better yielding varieties meeting the expected quality requirements alone are released for commercial cultivation. Being strategically placed, CIRCOT through mill surveys finds out the projected requirement of cotton and advises the breeders who in turn reorient their breeding priorities.
- Total number of cotton samples received, tested and reported are listed below

Trial Name	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23
National	2239	2465	1457	1163	161	273
North Zone	180	166	154	110	208	118
Central Zone	704	590	535	449	266	107
South Zone	452	501	425	415	192	101
Agronomy	32	24	46	62	32	51
Bt	660	1272	1147	1297	1749	2596
Total	4293	5003	3764	3496	2611	3246

- Cotton varieties Identified and Notified through AICRP on Cotton:

S. No.	Year	Cotton varieties identified	Cotton varieties notified
1	2017-18	14	8
2	2018-19	9	19
3	2019-20	12	19
4	2020-21	91	91
5	2021-22	25	55
6	2022-23	63	60

- A status report on the contamination of Indian cotton was prepared. The survey identified major contaminants in cotton bales, including fibres and strings of woven plastic and plastic films, sand dust, grease and colour marks, cloth bits, jute and hessian, metal parts, and leaf bits. Plastic films were found to be particularly serious contaminants.
- Development of the 'ICAR-CIRCOT Cotton Lint Opener' for effective opening of cotton lint samples for fibre fineness or micronaire (Mic) testing in High Volume Instrument (HVI) laboratories. The capacity of the ICAR-CIRCOT Cotton Lint Opener is about 10 g/min, enabling the opening of approximately 30 cotton lint test samples of 20g each in one hour using this machine.

- Electrically conductive paste was developed at ICAR-CIRCOT using graphite and carbon powders.
- Cotton interlined sleeping bags for better comfort was developed. These sleeping bags had Inner layer made up of 100% cotton for better comfort and to avoid static charge generation. Outer layer was made up of high abrasive resistant, light weight Polyester fabric. Anti-bacterial inner cotton layer helped to avoid odour generation due to sweating. Sleeping Bag was provided with pockets to place mosquito repellent pouch as well. These sleeping bags can be modified to protect user in low temperature conditions also.
- Developed marker fibre for the traceability of cotton textiles.
- ICAR-CIRCOT provided the protocols for test parameters and acceptance criteria of cotton which is to be certified as Kasturi cotton.
- Developed technical textile technology “Cotton rich high comfort knitted fabric with smart drying property”. Using this technology a fabric was developed with good moisture management properties which can transport liquid moisture away from the body, provide dry feel next-to-skin and keep wearer more comfortable.

5.4 Core Area IV: Chemical and Biochemical Processing and Biomass and By-Product Utilisation

- Development of the mosquito repellent blankets using microencapsulated natural essential (Citronella) (300-600 nm) oil with finish durability of up to 5 washes.
- Development of the solvent extraction process for low gossypol cottonseed flour for edible/poultry feed purposes. A new, easily scalable, room temperature process for faster extraction of gossypol from cottonseed kernels using acetone and water without darkening of colour was developed with 92% and 49% reduction in free and total gossypol levels respectively.
- The friction grinding process was developed to produce nanocellulose from cotton fibres. The developed friction grinder consists of two ceramic nonporous grinders that was adjustable to have required clearance between the upper and lower grinding stones.
- Nano cellulose based kraft paper was prepared by reinforcing nanocellulose, which was produced from refining process using cotton linters as raw material. The improvement in tensile strength (3.5 times), bursting strength (1.2 times), folding endurance (6 times) and tearing strength (1.5 times) were observed.
- Microbial process for preparation of absorbent cotton with efficacy and uniformity was developed. The bleached cotton was found to meet the criteria prescribed for absorbent cotton by the Indian Pharmacopoeia (IP) and Bureau of Indian Standard (BIS).
- Process of colour removal from reactive dye bath effluent using adsorption technique was generated. Under this process, the effluent containing 20 ppm residual dye was passed through the activated carbon column. By this process, the residual colour of the reactive dye effluent was completely removed. The treated water was then reused for dyeing of cotton fabric along with a control dyeing using fresh water.

- Elementary Chlorine Free (ECF) bleaching protocol was developed for bleaching of banana fibres through which the banana fibre was bleached into whiter fibre with whiteness index (CIE 2000) of -5.4 units compared to the hydrogen peroxide and hypochlorite bleached fibres which showed whiteness indices of -77.35 and -42.82 units respectively.
- The usability of cotton fibre based nanocellulose as a rheology modifier in conventional water-based paint was explored.
- Developed process protocol for extraction of protein concentrates from cottonseed meal.
- An eco-friendly process was developed for preparation of absorbent cotton using short staple cotton and non-spinnable cotton.
- A process to decolourize the reactive dye bath effluent using multi-electrode-based electrolysis unit has been developed. By this process, reactive dye effluent was completely decolourized and the treated effluent was filtered for reuse.
- Wax emulsion-based coating process was developed to impart hydrophobicity to banana fibre-based plates.
- Hydrogen peroxide-Nano-silver based disinfectant formulation with very good stability was developed. The optimized formulation contains 10% hydrogen peroxide and 100 ppm nano-silver.
- A novel chemo-mechanical process for production of nano-sulphur was developed by dispersing the elemental sulphur in water using wetting agent, followed by friction grinding process.
- Process protocol to get bleached cotton linters with high degree of polymerization was developed.

5.5 Core Area V: Entrepreneurship and Human Resource Development

- Developed technologies for on-farm utilization of cotton stalks to restore soil fertility and bring additional remuneration to farmers by preparation of bio-enriched compost and cultivation of oyster mushroom using cotton stalks.
- Application of nano cellulose in cement concrete, rubber composites, pulp and paper for enhancement of functional and mechanical properties was attempted.
- Nano fibrillated Cellulose (NFC) was added in Cement Mortar which resulted in decreased bleeding rate and decreased length of cracks occurred with increasing percentage of NFC addition.
- Field surveys of the conventional screw press oil mills were carried out by visiting 41 conventional screw expeller type cottonseed processing units located in Maharashtra (Aurangabad, Beed, Jalna, Nagpur and Khamgaon), Haryana (Hisar, Hansi and Sirsa)

and Punjab (Bathinda). Screw press technology is being preferred by the entrepreneurs due to ease in operation and need of low investment as compared to scientific processing. There are certain Concern for marketing of by-products, viz., limited customers for linters, hulls and DOC (gossypol) in domestic level. Even though DOC contains high protein, gossypol factors is prohibiting its use as feed for poultry and fisheries.

- Three demonstrations of ICAR-Flexi check dams were carried out in Pune district at villages Kanse and Amonde by installations on the selected sites and now they are working in good condition.
- Developed nanocellulose based edible coating for fruits and vegetables. Nano emulsion-based coating formulation was optimized as 1.6% of sodium alginate, 0.17% of Carboxymethylated crystalline nanocellulose CNC and 0.9% of oleic acid. The result indicated extension in shelf life of pears, guava, banana and sapota in the nano-emulsion based coating as compared to uncoated fruits.
- Nutrient-enriched compost from cotton micro-dust was produced. The compost samples were enriched with carboxymethylcellulose (CMC) as sole carbon source and incubated at 55°C for 5 days.

5.6 CRP on Natural Fibre

- Developed model comprises of uprooting of cotton stalk from field using a tractor operated V-type up-rooter followed by sun drying and shredding by a tractor operated shredder.
- The Optimized the process for preparation of premium grade pellets from cotton stalks. It showed that 3 mm particle size, 20% moisture content and 8% cashew nut shell powders as optimum parameters for preparation of premium grade cotton stalk pellets.
- Indigenous instruments were developed for evaluation of various briquette and pellet quality parameters.
- An Eco-Friendly, Efficient and Rapid Burning Briquette Based Green Crematorium was developed. It consists of a compact trapezoidal shaped cage and a forced draft aeration system, which ensures requisite air supply at burning point leading to considerable reduction in smoke formation and Cox and NO_x emissions during cremation process. The cost of cremation using ICAR- CIRCOT Crematorium comes to Rs. 2500/- as against Rs. 5500 for traditional cremation.
- Developed a Continuous Feeding Pellet Stove (CFPS) that can handle pellets having higher 6-8% ash content. It is found to be economically viable as utilization of pellets for cooking saves over 50% costs on fuel as compared to LPG gas price.
- Coir fibre-based composite cubes were prepared using polyester resin with a fibre volume fraction of 20% with a cube density of 1.3 g/cm³. The concrete cube was prepared with the proportion of cement, sand, and the coarse aggregate ratio of 1:1.7:2 on a volume basis. The coir fibre composite cube was used to replace 10 mm coarse aggregate with a volume of 12%. It shows a 21% increment in compressive strength than the control sample.

- Developed an enzyme for absorbent cotton preparation in an eco-friendly manner. Optimized the process parameters at 60°C, pH 9 and process time 45 minutes.
- Developed cotton incorporated PPE using multi-layer technique. It was found that sandwiching cotton non-woven fabric (40 GSM) improved the moisture management properties (MMT) properties of PPE materials.
- Cool air circulation system (cooling belt) for active cooling of PPE kit was developed. The cooling belt works by drawing out the internal air present within the PPE suit and passing it into the Peltier module. In order to bring down the temperature of the circulated air effectively, an aluminium heat sink was designed and mounted on the cooling side of the Peltier module where the temperature can reduce up to 15°C. This setup is fixed into a closed chamber where the air can circulate continuously between the PPE suit and the cooling chamber. It was observed that the temperature can be reduced by 2°C, from 31°C to 29°C, within 20 minutes and that temperature is maintained throughout the wearing time. A normal power bank was used to operate complete system with 5 to 12V and 2A power supply.
- Equipment was fabricated for testing the efficacy of filter fabric to filter out the hazardous substances like particulate matter, volatile organic compounds, carbon dioxide.
- A three-layered engineered cotton fabric-based mask was developed using the treated fabrics with superior breathability, antimicrobial, wash ability and repellent properties. The Top & bottom layers of the mask were made up of fluorine free water repellent treated fabric which provided water repellent and quick drying properties to the mask. The middle layer of the mask was made up of 100% cotton fabric treated with institute developed non-leaching type antimicrobial agent.
- Bio-composite plug trays using cotton stalk reinforced with polyester matrix was developed for use in nursery. Bio-Based moulded products were prepared using a combination of banana fibres and cotton stalks.
- A new salt free dyeing (Based on the chlorotriazine and vinyl sulphone based reactive dyes) technology was developed using cationic polymer. This technology is sustainable as it can reduce the 80 % usage of chemical dye, 20 % recovery of water and 20 % time and energy saving. Furthermore, the advantage of new process is that the total organic carbon (TOC) and total nitrogen (TN) values of the effluent are 3 times less than earlier developed one.
- Banana filament fibre spinning machine was developed. The machine consists of two parts; feeding and spinning. Feeding of banana fibres was carried out manually. Spinning was operated by 0.5 hp single phase motor, speed of which can be controlled with the help of variable frequency drive (VFD).
- Dense paper from banana fibre was developed by kraft pulping method using pulp with 60°SR & 70°SR freeness. Dense paper coated with 5% carboxymethyl cellulose showed most compact structure with potential application for packaging of fatty foods like butter.

- Development of nanocellulose based composites for packaging applications The optimized film composition was 0.89% of nanocellulose (NC), 2.53% of glycerol (GL), and 1.89% polyvinyl alcohol (PVOH)), which showed significant ($p < 0.05$) in mechanical as well as barrier properties. The edible oil can be effectively stored in these packaging films for more than 3 months at ambient storage conditions without compromising the quality and edibility of oil.

5.7 Externally Funded Projects

- Prepared specialty grade pulp from cotton linters by blending with pulps from other cellulosic materials for high end applications. Blending of banana fiber pulp with cotton pulp (90:10 proportion) aided in the production of high-quality paper sheet.
- The process protocol for extraction of the protein from the cottonseed meal was optimized using alkali-salt extraction method.
- Potassium hydroxide and a combination of salt viz. sodium chloride and sodium sulphite were minimally used to completely solubilize the protein present in cottonseed meal.
- The isoelectric point and ethanol-based method of protein precipitation method was optimized.
- The obtained lyophilized protein was found to have minimal level of gossypol ($<0.045\%$ free gossypol) with more than 75% of total protein content. In addition, the optimization of protein hydrolysate ($>25\%$ of degree of hydrolysis) production from cottonseed meal was optimised with the help of pancreatin and pepsin enzyme.
- Green process protocol for extraction of protein concentrates from cottonseed meal was developed. The obtained lyophilized protein was found to have minimal level of gossypol ($<0.045\%$ free gossypol) with more than 75% of total protein content.
- To improve the bioavailability of the protein present in cottonseed meal, hydrolysate was prepared using enzymatic technology. A combination of pancreatin and pepsin enzymes resulted in degree of hydrolysis of $\sim 92\%$. Also the enzymatic method of preparation of hydrolysate is more environment friendly than chemical approach due to lesser effluent generation.
- Developed pilot plant for extraction of protein from de-oiled cotton cake, a value addition/ by products utilization of cotton. Microwave pre-treatment showed positive results in reduction of gossypol concentration in meal. The best optimized condition for microwave pre-treatment of CSM was 26% moisture content, 900 W microwave power level and 6 min time of microwave treatment.
- The ICAR-CIRCOT Agri Business Incubation Centre admitted twenty-six entrepreneurs, graduated twenty-three incubatees, facilitated development and commercialization of nine innovative products, facilitated funding for incubated entrepreneurs and created opportunities for employment generation through business related activities. Thirty four Start-up ideas have received Grant-in-aid support from RKVY RAFTAAR Division, DAC&FW, Ministry of Agriculture & Farmers Welfare, Govt. of India during 2019-22.

Chapter 6

Linkages

ICAR-CIRCOT, a premier research institute, is mandated to carry out basic and applied research in post-harvest processing of cotton and value addition to cotton by-products. There are mainly five major broad research core areas, namely: (I) Pre-ginning & Ginning, (II) Mechanical Processing, Technical Textiles & Composites, (III) Characterization of Cotton and Other Natural Fibres, Yarns and Textiles, (IV) Chemical and Biochemical Processing, Biomass and By-Product Utilization, and (V) Entrepreneurship and Human Resource Development, under which the institute undertakes various research projects. The institute has done pioneering work in the areas of nanotechnology and electrospinning for textile finishing, as well as the development of micronutrients for various agricultural applications. Apart from research, the institute also undertakes Skill Development and Business Incubation Services and functions as a Referral Laboratory for Cotton Fibres. Over the years, the institute has successfully completed many multi-disciplinary collaborative research projects and, in the process, has developed extensive and strong linkages and collaborations with many other research organizations, agricultural universities, academic institutions, industries, private organizations, startups, etc. both nationally and internationally.

ICAR-CIRCOT is also well known for its testing services. It has been accredited by the National Accreditation Board for Testing and Calibration of Laboratories (NABL), since 1999 and is now an ISO 9001 certified institute. The Institute has expertise and facilities for conducting more than 175 different tests on textile materials and cotton by-products, which are utilized by many textiles mills, government departments, research and academic institutions and the private sector.

The Institute continues to carry out commercial testing, consultancy projects and partnership MoU's with other research institutes, academic institutions, private companies, entrepreneurs, NGO's, start-ups, etc. and in the process establishing fruitful and effective linkages with varied agencies. ICAR-CIRCOT has linkages with NINFET, CIFT, ICT, VJTI, CICR, CIAE, Navsari Agricultural University, MPKV, Rahuri, VNMKV, Parbhani, Bombay Veterinary College, IIWM, IIT Madras, IIT Powai, Mumbai University colleges, DKTE, MGIRI, JDIET, Forech Mining & Construction, Fumalabs Private Ltd., Shree Agro Invent-tech Private. Ltd., Molbio Diagnostics Pvt. Ltd., Paras Gold Industries, Kotak commodities, Apricitas Technologies Pvt. Ltd., Rashtriya Chemicals and Fertilizers Ltd., Devdhar Chemicals Pvt. Ltd., SRG Apparels Ltd., AIC-NIFT Tea Incubation Centre for Textile and Appraisals, Vidarbha Sales, Kothari Distributors, Central Poer Research Institute, Super Hygienic Disposal India Pvt Ltd., Bhabha Atomic Research Centre, Plantbase Ventures, Pvt. Ltd., BNPM, Reliance Industries Ltd., ICAT, GMIPSR Davangere Karnataka, Apcotex Industries Ltd., Bajaj steel industries, Precision Tooling Engineers, etc.

ICAR-CIRCOT continues to be associated with the Bureau of Indian Standards and contributes a great deal to the development and standardisation of textile test methods. Many CIRCOT scientists have been chairman/ members of different sectional committees of the BIS and have been instrumental in the preparation of several standards for textile testing. A summary chart of the various linkages and collaborations is presented in Figure 6.1.

A summary chart of the various linkages and collaborations

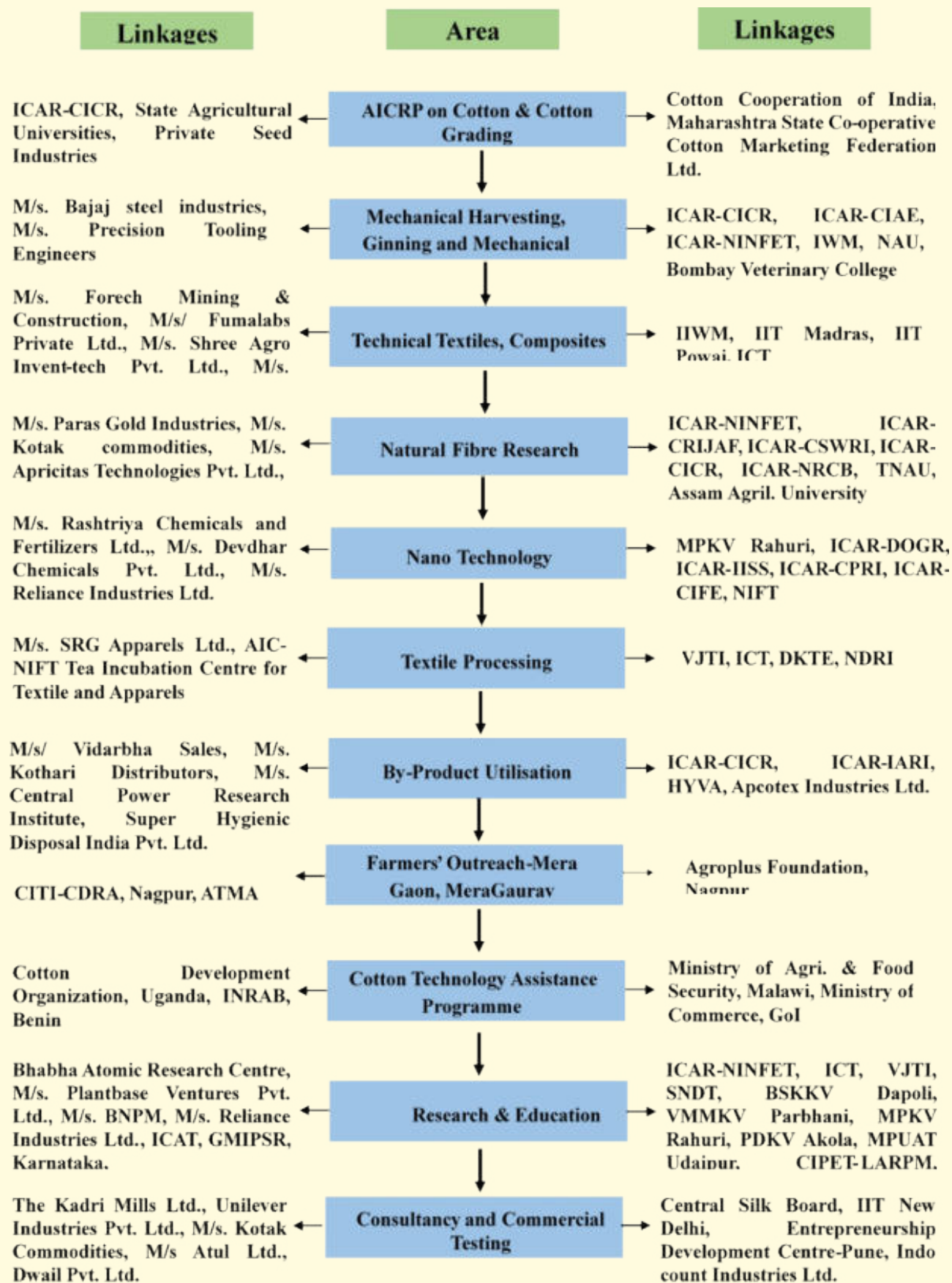


Figure 6.1: Schematic representation of various linkages of ICAR-CIRCOT

Chapter 7

Brief Achievements and Overall Assessment

Evaluation of CIRCOT on various parameters during 2017-22

S. No.	Parameter	Achievement (in numbers)				
1.	Externally funded projects during the period	6				
2.	New machinery and process/technologies developed	2017-18	2018-19	2019-20	2020-21	2021-22
		12	11	10	10	12
3.	Technologies licensed	9				
4.	Technologies commercialized	9				
5.	Patents filed and granted during the period	Filed			Granted	
		3			2	
6.	Research papers published in refereed journals (citations and h-index of the institutes)	Total	NAAS Rated		Citations	
		163	138		10799 (h index: 61)	
7.	Trainings conducted and Number of participants	No. of trainings			Participants	
		National	144		9634	
		International	2		25	
8.	National and International Awards received by scientists and institute	7 (Sardar Vallabhai Patel Best Institute Award during 2019)				
9.	National and International Awards received by institute	2				
10.	Media coverage (print and digital media separate)	Print Media			Digital Media	
		17			14	

i. Evaluation of public perception of the institute

CIRCOT is held in high esteem by its stake holders such as cotton trade, industry and Govt agencies dealing with cotton as well as researchers and people working on cotton. This was arrived at by looking at the feedback received from the parties availing its testing facilities, feedback from trainees attending its various training programmes and interaction with

stakeholders during various interactive meets at Mumbai and regional units. CIRCOT test results are considered highly authentic and in spite of higher charges, parties get samples tested here. Director, CIRCOT, is the member of cotton variety/hybrid identification and release committee. The variety/hybrid is released with the acceptance of CIRCOT for fibre quality. CIRCOT is part of the quality norms fixed by Government of India for branding Indian cotton as Kasturi. Many budding entrepreneurs got training at the institute before establishing their own industries. Students and researchers from many textile institutes and colleges and sister ICAR institutes avail of the testing facilities and guidance. Renowned companies have come forward to ask consultancy from it. GTC Nagpur conducted many training programmes even during Corona period. Feedback from trainees participating in numerous training programmes shows full satisfaction about the training content and its conduct. CIRCOT calibration cottons are in use by most HVI users in mills. These are promoted by HVI manufacturers also and repeat orders are received.

ii. Evaluation of the working environment of the institutes and scheme (by sampling of file/papers movements and time delay, by talking to individual scientists, admin and other staff etc)

Working environment in general at the institute is good. During the period, the procurement through GEM (Government E marketing) is made as mandatory. Time taken in file / papers movement is variable. Several contractual manpower have been hired for smooth functioning of administrative sections. Some papers such as those related to loan / withdrawal from GPF account get cleared in 1-3 days. Advances such as TA / CB advances are also granted within 2-3 days to one week. However, settling of the advances takes more time and that may vary depending upon the completeness of papers also.

iii. Impact assessment and economic gain due to the institutes/scheme

Impact assessment / Economic gains due to institute activities are summarized below

Technology

- The overall economic benefit computed as a result of the utilization and adoption of the CIRCOT-Bajaj pre-cleaner has been estimated at Rs. 438 crores per annum. Hence, an estimated amount of about Rs. 2200 crore benefit realised to the cotton processing industry in the reported period by the adoption of CIRCOT-Bajaj cotton pre-cleaner.
- The significant contributions in the area of ginning machinery research have helped the country to be self-reliant and also become net exporter of ginning machinery. An amount of over Rs. 1000 crore realized to Indian ginning industry by way of export of ginning and allied machinery during the reported period.
- The calibration cotton, Standard Reference Material for calibration of fibre testing instruments, developed by the institute is an import substitute to USDA calibration 47 cotton. Around 1500 containers of the calibration cotton worth Rs. 14 lakhs were sold during the last five years.
- The Institute extends technological support to the country's cotton breeding programme, for varietal development with improved productivity and quality that suits industry needs, under All-India Coordinated Research Project on Cotton (AICRP). Two hundred fifty-two (252) new cotton varieties have been released during the review period 2017-22.

- Commercial utilization of cotton stalks has resulted in reduction of greenhouse gas emission (Briquettes and Pellets) and improvement in soil health (Compost)
- Nano-based fertilizer is commercialized to M/s. Rashtriya Chemicals and Fertilizers Ltd, Mumbai and is likely to improve fertilizer use efficiency
- Eco-friendly wet processes for cotton textiles (salt free dyeing technology) have resulted in lesser use of water and chemicals.

Impact to Farmers

- CIRCOT has done yeoman service to cotton farmers by assisting the Govt. of Maharashtra in procurement of cotton at MSP during the corona period. The cotton prices fell down by Rs. 3000 per quintal after emergence of corona pandemic leading to distress sale of cotton by farmers. In order to address this issue, CIRCOT organized special training programmes on cotton grading and marketing to 200 agricultural officers of Govt. of Maharashtra and assisted them in procurement of cotton from farmers at MSP. **The farmers were benefited by additional income of Rs 3000 crore by selling their cotton at MSP in 2020-21.**
- The institute has developed effective technologies to address the issue of spread of pink bollworm from ginneries to nearby cotton farms
- The institute continued its efforts for commercial utilization of the cotton stalks (as briquettes and pellets) especially as source of renewable energy. Farmers can fetch additional remuneration by sale of Chipped cotton stalks @ Rs 3000 per hectare.
- Ginning Percentage (GP) of cotton plays a vital role in increasing the farm income and productivity of Indian cotton. ICAR-CIRCOT. It is estimated that every 3% increase in GP leads to 9% increase in the productivity of cotton. ICAR-CIRCOT is promoting to implement the benchmark values of GP (Short Staple - 39%, Medium Staple - 37%, Long Staple - 35% and Extra-long Staple- 33%) in the Variety Identification and Variety Release guidelines so that the productivity of Indian cotton and farm income can be increased significantly

Skill Development

- Capacity building both in India and Abroad (Africa).
- More than 6500 personnel/ginners were trained.
- Capacity building in the ginning sector resulted in the benefit to the tune of Rs. 150 crore per annum through Improvement in efficiency, Reduction in processing cost and Improvement in bale value
- “Regional knowledge cluster cum training centre on post-harvest and ginning Technology” was established at Benin, Africa under Cotton TAP programme

Impact on Environment and Sustainability

- The institute has developed solution for eco-friendly, efficient and rapid burning crematorium, an alternative to the traditional wood-based creation using briquettes made from cotton stalks and other agro-biomasses.

- CIRCOT has developed various niche products out of the naturally coloured cotton spun yarn such as Jackets, Handkerchiefs, Infant wears. These products are 100% chemical free, has very high wash durability (due to inherent colour), soft feel and skin friendly.
- ICAR-CIRCOT developed technology to produce value added products like high DP pulp, medical grade filter paper etc from cotton linter and transferred the technology to industries

Others

- One hundred and thirty eight research articles were published in NAAS rated journals with 10799 citations
- Nine technologies were commercialized, 26 incubatees were admitted to the Agri-Business Incubation (ABI) Centre and 45 MoU's were signed and 2 patents were granted to the institute.
- Eighty two consultancy projects have been undertaken to various stakeholder
- Forty six Agri startups have been supported under RKVY RAFTAAR programme and sanctioned Rs. 562.5 lakh as grant-in aid
- Institute generated Rs. 1104.49 lakhs revenue through technology transfer activities, skill development programmes, research consultancy and commercial testing services; which is about 29.8% of the Plan budget allocation

Overall Assessment (2017-2022)

S. No.	Performance indicators	Achievements/Remarks
1.	a. Research projects undertaken; Institutional: Externally funded b. CRP on Natural Fibre projects	49:6 10
2.	Technologies; Generated: Commercialized	55:18
3.	Patents; Applied: Granted	3:2
4.	Publications; Research Publication: Popular Article: Conference Paper: Book Chapter: Training manuals: Leaflets: Annual report	163:39:114:34:19:94:10 (473)
5.	Awards and Recognition	7 (Sardar Vallabhai Patel Best Institute Award during 2019)
6.	Trainings conducted: National: International	144:2
7.	Education; Ph.D. awarded: Ph.D. on-going	4:2
8.	HRD; National Training programmes attended by Institute staff	132
9.	Industry linkages – Stakeholders	70
10.	Regional Units management	Nagpur and Sirsa units are very good. Coimbatore is good. Surat, Guntur and Dharwad units need improvement
11.	Research Division Management	Good
12.	Seminars/Conferences/Workshops organized	6/6//19
13.	Library and computer facilities	Computers 149 with internet 137. Library is good.
14.	Financial management: Budget utilization	Almost 100% budget utilization
15.	Revenue generation	Rs. 1104.49 lakhs
16.	Administration: Recruitments/work culture/discipline	Very Good
17.	Grievance management	Good
18.	Meetings organised; IRC:RAC:IMC:IJSC	10:5:4:10
19.	Infrastructure development and maintenance	Very Good
20.	General: Social-cultural-sports activities	Very Good

Overall Assessment of Institute Performance: VERY GOOD

Chapter 8

Recommendations

The QRT has gone through the work on various aspects of all the mandated areas of the institute through deliberations with scientists, stakeholders, visits to regional units, interaction with technical, administrative, finance and supporting staff. Based on the inputs received, following recommendations are made.

S. No.	Observation	Recommendation
I. Research and Development		
1.	Double roller (DR) ginning technology is most widely used in India. However, the low productivity (70 kg/h) poses barrier in widespread adoption of the existing DR technology across the world. Moreover, cleaning systems employed in Indian ginneries has very low (20-30%) efficiency making it difficult to bring down the contamination and trash content in bales to the world standard. Also, lack of process automation in the ginning industry which further reduces the efficiency and deteriorates cotton quality parameters.	Institute should develop innovative pre-ginning and ginning processes using industry 4.0 practices viz. developing energy efficient high-capacity modern ginning machinery, refinements in pre and post cleaning systems, packing of raw cotton at farm level, application of sensors and AI for real-time monitoring and adjustment to improve the cotton quality.
2.	Unlike developed countries, entire Indian cotton is manually harvested. The high labour cost and shortage of labour for cotton picking pose major challenges in cotton cultivation. The mechanically harvested cotton contains higher amount of trash content (15-20%) as compared to around 4 % in hand-picked cotton. A series of pre-cleaning and post cleaning machinery are required for cleaning of mechanically harvested cotton.	The institute should focus on development of advanced indigenous pre and post cleaning machinery and protocols to bring down trashes to the acceptable level in mechanically harvested cotton. The institute should establish a pilot plant facility for processing of mechanically harvested cotton to pave the way for successful adoption of mechanization of cotton harvesting and making it a reality in the future.
3.	Presently, the quality assessment of fibre, yarn, fabric, etc. are carried out using sophisticated equipment, which are very costly, time consuming and not affordable to small and medium ginning and textile industries. Computer vision, machine learning and deep learning are rapidly evolving technologies with immense potential to reduce the cost of instrumentation, testing time and increasing the accuracy and repeatability. Moreover, the AI based instruments have immense potential	The institute should work on developing instruments using Computer vision, machine learning and deep learning technology for trash measurement, fibre quality parameters, yarn quality predictions, etc.

S. No.	Observation	Recommendation
	to judge the quality of cotton in the field level that will help farmers to fetch remunerative price to their produce.	
4.	Technical textile sector is rapidly growing worldwide, recognizing this potential, the Govt. of India has launched National Technical Textiles Mission (NTTM) to promote research and development in this sector. However, currently, cotton has very little presence in this sector. Cotton's natural breathability, absorbency and comfort, make it ideal for protective textiles like gloves and cut-resistant fabrics, while its hypoallergenic nature, makes it suitable for medical textiles. Moreover, the sports textiles benefit from cotton's moisture-wicking and cooling properties, enhancing athletic performance. Embracing cotton in these applications can lead to innovative and sustainable solutions across various technical textile sectors.	The institute should focus on developing cotton based technical textiles for protective, medical, agro and sports applications.
5.	ICAR-CIRCOT acts as a bridge between farmers and textile industry in developing the quality cotton required for the textile industry. ICAR-CIRCOT developed spinning quality norms based on ring spinning technology for release of varieties and hybrids many years ago, still been these norms are used by ICAR-CIRCOT for recommending the release of cotton varieties and hybrids in India. The institute does not have the spinning quality norms for release of varieties and hybrids for latest emerging vortex technology as well as for rotor spinning. Vortex spinning is the new upcoming potential cost effective and high-speed technology.	ICAR-CIRCOT should study the performance of Indian cotton and should develop breeding fibre quality norms, so that right quality cotton is available to Indian yarn manufacturers. The institute should also develop spinning quality norms for rotor spinning where short staple desi varieties are mostly utilized for spinning.
6.	Traceability is extremely crucial for brands and consumers who prioritize environmental and social responsibility to help in combating issues like child labour and unsustainable farming practices. Currently, the traceability has been given much emphasis by the developed countries, mostly while procuring bales and textile products. Several emerging	The institute should focus on developing indigenous cost-effective technologies for traceability in cotton value chain.

S. No.	Observation	Recommendation
	technologies such as marker fibres/ DNA/ block chain technologies have been used by different stakeholders for tracing the origin of the cotton produced and processed. Such technologies are very costly and unaffordable to small and medium scale industries.	
7.	Presently, circularity has been promoted by world bodies like United Nations and many developed countries for reducing pollution, achieving sustainable development goals, reducing carbon footprints and increasing the life of our planet. There is immense potential in cotton value chain for increasing the income of all stakeholders and achieving sustainability in cotton production by adding value to cotton biomass, cotton by-products and process wastes for production of niche products like viscose, torrefied pellets, bio-hydrogen, furfural xylitol, etc.	The institute should focus on adopting innovative products from cotton biomass, cotton by-products and process wastes having practical application for implementing circularity in cotton value chain.
8.	The overuse and misuse of textile processing chemicals and agro-inputs pose significant environmental risks, including soil degradation, water pollution and biodiversity loss. Also, extraction of fine chemicals from cotton biomass is not remunerative. Nanotechnological interventions need to be studied to reduce the chemical consumption in agri- and textile sectors and providing new functionalities in cotton textiles. This can lead to more precise and sustained system, reducing the amount of input needed and minimizing environmental impact.	The institute should explore use of natural materials and enzymes in cotton textile processing to reduce environmental footprints. The institute should work on new biotechnological tool like CRISPER-Cas9 technology for improved extraction fine chemicals from cotton biomass and by-products.
9.	ICAR-CIRCOT as a coordinator and lead centre of the Consortium Research Project (CRP) on Natural Fibres, along with co-operating centres has done excellent work towards increased availability and utilization of natural fibres for Apparel, Home textile and Technical textile sectors.	CRP on Natural Fibres should focus on providing solutions to bigger problems facing the natural fibre sector in consortia mode. It should develop technologies for blending of cotton with other natural fibres like hemp, ramie and Himalayan fibres etc and produce new products with unique texture. The project should also attempt to extract high-end products from the natural fibre biomass available in abundance.

S. No.	Observation	Recommendation
II. Extension Activities		
1.	Organizing regular training and awareness programs on various aspects of post-harvest cotton processing is essential to educate farmers on clean picking of cotton, post-harvest management and best management practices for utilization of cotton stalks, which can significantly improve the quality of cotton and enhance income of the farmer.	Institute should organize regular training/awareness programmes /field demonstrations on various aspects of post-harvest processing of cotton like clean picking of cotton, best management practices, lint percentage-based trading, grading, MSP operations, best practices for utilization of cotton stalks for compost production, pellets & briquette productions etc. for the benefit of farmers.
2.	ICAR-CIRCOT has an active Agribusiness Incubator (ABI) and RKVY-RAFTAAR-Agribusiness Incubators, (R-ABI) for technology transfer and providing incubation facilities for potential entrepreneurs. It is observed that the number of start-ups and incubation promoted by R-ABI in the field of post-harvest processing of cotton is limited.	The ABI and R-ABI centres of the institute should be strengthened to promote incubation and start up services to potential entrepreneurship especially in the field of post-harvest processing of cotton and value addition to biomass and by-products. The potential technologies developed by the institute should be promoted for incubation and start-ups.
3.	ICAR-CIRCOT has done pioneering work in Processing of cotton and its agro-residues, development of value-added products and quality assessment. It is imperative to improve institute's technology penetration through stakeholder analysis, assessment of cost economics of the all the technologies developed and policy research in cotton value chain.	Institute technology database should be developed and disseminated to stakeholders. Impact analysis of each technology developed by the institute should be ascertained by taking indicators.

S. No.	Observation	Recommendation
III. Infrastructure Development		
1.	ICAR-CIRCOT is a Referral Laboratory for cotton fibres and has been accredited with ISO/IEC 17025:2017 by National Accreditation Board for Testing and Calibration Laboratories (NABL). ICAR-CIRCOT has been accredited with ISO 9001:2015 for its Quality Management System by Bureau of Indian Standards (BIS). The institute is widely recognized for its contribution in testing, standardization and development of test methods for cotton and other different textile materials. The institute has also developed the calibration cotton, Standard Reference Material for calibration of fibre testing instruments, an import substitute to USDA calibration cotton.	Institute should transform as National Referral Laboratory (NRL) for cotton fibre by undertaking following measures. • Institute should get standard reference material (SRM) accreditation from NABL for its calibration cotton as per ISO 17034. • It should procure most sophisticated and worldwide accepted USTER high volume instrument in order to standardize and improve the quality of existing calibration cotton to international level. • Institute should organize national level Inter Laboratory Proficiency Testing (ILPT) to improve the testing capability as well as ensuring the quality of testing among the laboratories. For this, CIRCOT should get accreditation as proficiency test provider as per ISO 17043. • Institute should collaborate with ICAR-CICR, Nagpur and SAUs for cultivation of cotton, specially, suitable for calibration cotton production.
2.	ICAR-CIRCOT is a 100 years old institute and has played a significant role in development and commercialisation of post-harvest processing technologies. There is an acute shortage for office buildings, laboratories, guest house, staff quarters especially for scientific category and other amenities. Ginning Training Centre, Nagpur is one of the unique facilities in the world that caters to the needs of the technology generation, skill development, consultancy and transfer of	The Council may provide one-time catch-up grant of Rs. 60 crores to improve the infrastructure facilities such as: • Construction of new office buildings in Mumbai and Nagpur • Establishment of pilot plant for processing of mechanical harvested cotton • Augmenting cotton fibre testing facilities

S. No.	Observation	Recommendation
	technology, etc. particularly in the area of ginning and by-produce utilization. The centre is functioning in an old industrial building having space for sitting of 3-4 scientists and 5-6 technical staff. The available space is insufficient considering the activities being conducted at GTC.	• A multi-storey Type IV/IV (Spl) in the vacant space available at Mahim in Mumbai • Construction of three Type V quarters as a vertical expansion of existing Yashwantrao Chavan (ORL) Building Annex at Matunga • Renovation of existing staff quarters

IV. Strengthening of Ginning Training Centre, Nagpur

1.	The Ginning Training Centre in Nagpur has three extensive demonstration plants for particle board, cottonseed processing, and ginning. These facilities hold significant potential for technology development, skill enhancement, consultancy, and the transfer of technology, particularly in the areas of ginning and by-product utilization.	Institute should effectively utilize the pilot plants present in GTC Nagpur for training, business incubation and test marketing. The pilot plants also can be utilized to impart Entrepreneurship Development Programmes (EDP) to rural youths and budding entrepreneurs. Considering the large scale facilities available, GTC, Nagpur should be given Regional Station status by the Council.
2.	Mechanical harvesting of cotton is very much essential considering sustainability in cotton production and increasing farm income. Cleaning and ginning of mechanically harvested cotton is one of the bottlenecks in adoption on mechanical harvesting of cotton in India. ICAR-CIRCOT should take up dedicated research work for development and optimization of ginning and cleaning machinery for processing of the mechanically harvested cotton.	QRT recommends to establish a demonstration pilot plant facility at GTC, Nagpur for cleaning and ginning of mechanically harvested cotton. This demonstration facility would be useful for optimization of different process parameters and to create awareness among the cotton farmers, ginner and traders about the benefits of mechanization of cotton harvesting.

S. No.	Observation	Recommendation
V. Strengthening of Quality Evaluation Units (QEUs) of Institute		
1.	ICAR-CIRCOT has five regional quality evaluation units in the major cotton producing and utilization hubs viz. Coimbatore, Sirsa, Surat, Guntur and Dharwad. The units are currently run with one or two technical manpower. Except Sirsa and to some extent Coimbatore, other units' performance needs to be improved.	The performance of the QEUs of the institute located at Coimbatore, Sirsa, Surat, Guntur and Dharwad should be improved by taking following measures ▪ Units should create professional linkage with each and every industry, private seed cotton breeders and other stakeholders in the region to get more research and commercial samples for testing. ▪ They should do the quality mapping of cotton fibre available in the region. ▪ The Dharwad QEU should collaborate with RAS of UAS Dharwad for cultivation of cotton suitable for calibration cotton production.

Annexure - I

The action taken on recommendations (ATR) of the last QRT of CIRCOT (2012-17)

S. No.	Observation /Recommendation/ Comment	Council's Comments	Action Taken
1. Ginning Training Centre of CIRCOT			
	i. In view of lack of ginning training facilities in the world, efforts should be undertaken to upgrade Ginning Training Centre into International Ginning Training Centre (IGTC). Vacant land available in the premises of GTC, can be used for construction of Training & research block and amenities for the trainees. Ginning training available in USA is very costly; hence there is ample scope to provide similar type of training to Asian and African countries at a much lower cost. Centre already has the experience of training African participants.	Agreed. Upgradation of Ginning Training Centre at Nagpur, to International Ginning Training Centre was approved in principle during the XII plan, but due to non-availability of funds it could not be implemented. It will again be proposed in next SFC to be prepared for 2020-25	- During the period under report, the Centre has been strengthened in terms of new instruments and additional manpower. Three scientists and three technical officers have been posted. The details of new infrastructure created are as below. - Saw Ginning plant - High Volume Instrument - Establishment of trash lab with 10 trash analysers - Pelleting Plant - Cotton stalk chipper- 3 Nos - Bomb Calorimeter - Establishment of microbiology lab - Biomass testing lab - Custom Hiring centre 50 KV solar panel - Shifting of AFIS & Smart Energy meter from Mumbai - In view of the above, Centre is performing excellently well in the field of technology development,

S. No.	Observation /Recommendation/ Comment	Council's Comments	Action Taken
			organizing skill development programmes, testing and consultancy services to stakeholders etc. For further strengthening, a proposal for establishing COE for processing mechanically harvested cotton with the budget of Rs. 5.6 crores have been submitted to Council.
	ii. Centre needs to be strengthened with more scientific and technical manpower	Agreed. A new ARS discipline textile manufacture and technology is approved by the Council. Cadre review is being done by the Council, and the posts will be filled soon by completing codal formalities by the Council	Three more scientists and four technical staff have been posted during the period. More staff will be posted after filling up the vacancies by the Council.
	iii. Mechanical harvesting of cotton is the need of the hour due to labour shortage and high cost. So, suitable low cost mechanical harvester could be developed with the help of CIAE, Bhopal and CICR, Nagpur. Indigenous pre and post-cleaning machinery needs to be designed and developed to reduce trash content in mechanically harvested cotton	Agreed. Efforts will be put to bring all the stakeholders at one platform and project proposal will be put up in next SFC. However many pre and post cleaning machinery have been developed by the institute.	- Institute has developed a suitable low cost mechanical harvester based on brush type mechanical stripping principle in association with ICAR-CICR, Nagpur and Mahindra & Mahindra tractors. - The machine was tested in the field for three cotton seasons. Further, it is being fine-tuned in association with ICAR-CIAE, Bhopal. - Indigenous pre-cleaning machine was developed

S. No.	Observation /Recommendation/ Comment	Council's Comments	Action Taken
			for onboard cleaning of mechanically stripped cotton. In addition to this, a line of pre-cleaning machine for processing of mechanically harvested cotton was developed with M/s. Bajaj Steel Industries, Nagpur and same was tested under field conditions. The machine brought down the trash content from 30% to 7.5%. The above machine is being further refined for bringing down the trash content to the acceptable level.
	iv. Ginning Training Centre may be upgraded to a regional station of CIRCOT	Upgrading of GTC to the Regional Station was approved in principle in SFC 2017-20, without additional Manpower and budget. Necessary provision will again be made in next SFC 2020-25.	The requisite budget for upgradation of GTC into Regional Station could not be received from the Council in spite of its provision made in 2017-20 SFC. Hence, it could not be upgraded. Necessary provision is again made in the SFC for 2021-26.
	v. Extension activities on cotton by-products utilization need to be strengthened by educating young farmers	Agreed. Training and awareness programmes are regularly being conducted. Scientists are in regular contact with the farmers through Mera Gaon Mera Guarav (MGMG) programme. Institute research projects for utilization of the by-products for development	- The institute has been actively involved in training the farmers and other community-based farmers organization like FPO's on utilization of by-products. - During 2017-22, sixty training programmes were organized in association with ATMA

S. No.	Observation /Recommendation/ Comment	Council's Comments	Action Taken
		of value-added products have been already taken up.	for educating farmers. In their training programme, 2000 farmers mostly young farmers have participated and trained on by-product utilization.
2. Reorganisation of Institute			
	It is observed that Core area III- characterisation of fibres is a prerequisite for Core area II- Textile manufacturing activities. Therefore, the two Core areas can be clubbed together and Quality Evaluation and Improvement Division addressing to Core area III can be merged with Mechanical Processing Division addressing Core area II and the merged Division can be named as Fibre Science and Textile Manufacture Division. Thus, there would be following divisions: 1) Division of Fibre Science and Textile Manufacture 2) Division of Chemical and Biochemical Processing 3) Division of Technology Transfer 4) Regional Centre of CIRCOT/ IGTC Nagpur	Partially Agreed. The institute has 5 major core areas of Research. The Core areas of research has been identified to delineate broader research programmes of the institute for the underlying specific research activities. The QRT team has made a valid point in suggesting the reorganization of the Divisions, however ginning and biomass utilization is an important activity carried out by Ginning Training Centre, Nagpur. The SMD with consultation of Director of the institute propose following divisions for approval. 1. Ginning and biomass Utilization Division / Regional Centre, Nagpur 2. Fibre Science and Textile Manufacturing Division 3. Chemical and Biochemical Processing Division 4. Engineering Technology Transfer Division	• Ginning Training Centre, Nagpur could not be upgraded to Regional Station because of scarcity of fund and insufficient manpower during 2017-2022. Hence, reorganization of Institute divisions could not be taken up.

S. No.	Observation /Recommendation/ Comment	Council's Comments	Action Taken
	It is also recommended that discipline wise list of scientific staff for each Division/centre should be in place. As majority of cotton produced is utilised for textile purposes, scientific manpower at the institute should be in tune with this primary application.	Agreed. The suggestions have been taken care while reviewing scientific cadre of the institute	The revised scientific cadre with adequate representation of scientists from textile technology has been made. At present there are 7 scientists in this discipline working in the institute.

3. Providing Adequate Manpower

	There is severe shortage of human capital at the institute with about 38% posts lying vacant. Maximum crunch is seen in respect of scientists where 42% vacancies at the end of previous plan period have increased to 48%. Vacancies in technical cadre is also acquiring serious proportion with 39% vacancies. With many senior technical personnel due to retire in coming 4-5 years, research, testing and training functions of the institute would be badly affected. All four Head of Division posts are also vacant. This needs urgent attention and steps should be taken to fill the vacant positions.	Agreed. Cadre review of scientific and technical are in final stage at council. Once it is approved, all posts will be filled within a year or two by the council.	- Cadre review is done by Council. It has approved the recruitment of manpower under Textile manufacture and Technology discipline. - The institute scientist strength has been increased from 20 to 28 during the period under report by which vacancy percentage has been reduced from 58% to 42%. Institute is sending the request to ASRB for recruiting the remaining scientist post. - Six more technical staff was also added during the period. The process of recruiting T-1 by the Council is in final stage. The institute is about to get sizeable number of manpower.
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S. No.	Observation /Recommendation/ Comment	Council's Comments	Action Taken
4. Upgradation of Laboratories			
	Many of the sophisticated equipment required for day to day working of the institute are more than 10–15-year-old with some being even more than 20 years old. These need frequent maintenance and it is also difficult to get the spare parts. These could not be upgraded due to resource crunch. There is a need for providing sufficient funds for their upgradation to latest models as well as procurement of new state of the art equipment and machineries to enable cutting edge research and reliable test results. This is very much needed if the institute has to maintain its referral laboratory status in cotton fibre/ textile testing.	Agreed. As the Institute is marching towards its centenary year celebration by the year 2024, a proposal for a special grant to the tune of Rs.100 crores will be submitted to modernise the research laboratories and institute building in SFC 2020-25.	- The CIRCOT laboratories have been upgraded with the new instruments during the period and list is given in background report. - To name the few, five HVI instruments have been upgraded. New Advance Material Characterization lab has been created by including 6 major instruments. - The proposal to provide special grant to upgrade the sophisticated equipment has been submitted under Centenary Celebration Plan to the tune of Rs. 100 crores. However, SMD asked to put up the plan for Rs. 60 crores. Accordingly, proposal has been put up for active consideration of Council.
5. Regional Quality Evaluation Units			
QRT observed that the five regional units at Coimbatore, Sirsa, Guntur, Dharwad and Surat need to be upgraded in respect of infrastructure, facilities and staff. Specific recommendations in respect of each unit are listed below.			
	a. Coimbatore Unit: - Centre may be strengthened with scientific and technical man power to develop liaison with textile mills. - A workshop may be conducted at	Agreed. In the SFC 2020-25, the proposal to upgrade the GTC and Quality Evaluation Unit, Coimbatore into Regional Stations will be submitted for approval. One training	- The QEU at Coimbatore is strengthened with one additional technical manpower. - The proposal to make it into Regional Station could not taken up due

S. No.	Observation /Recommendation/ Comment	Council's Comments	Action Taken
	Coimbatore on calibration cotton to popularize CIRCOT calibration cotton among textile mills, in Tamil Nadu. Facilities may be developed to test comfort parameters as many textile mills are located in the vicinity of Quality Evaluation unit of CIRCOT.	and workshop in Coimbatore has been already conducted. It will continue for every year.	to shortage of scientific and technical manpower. - BIS has amended IS for Cotton Quality testing and mandated the use CIRCOT calibration cotton for calibrating HVI. - The institute is in forefront in popularizing calibration cotton and conducted stake holders meeting across the country including the one at Coimbatore during June 2019. - Due to our aggressive efforts, major HVI machine manufacturers who were previously using USDA calibration cotton have switched over to the use of CIRCOT calibration cotton.
	b. Guntur Unit: - The centre may be strengthened with Technical man power. - New HVI machine may be provided to the unit. This will help to strengthen the bond with the stake holders and increase in revenue generation. - Awareness workshop on CIRCOT technologies like calibration cotton and scientific processing	Agreed. Necessary action will be taken as soon as technical posts are filled and budget for HVI in next SFC is approved. Awareness workshops about CIRCOT technologies will be organized in this region within 6 months	- The centre is strengthened with one additional technical manpower. HVI is also upgraded. The centre is working in good condition. - Forty-two cotton processing units in the region were visited and awareness has been created about institute services and technologies.

S. No.	Observation /Recommendation/ Comment	Council's Comments	Action Taken
	of cotton seed should be conducted at the unit for their popularization and benefit of stakeholders (cotton ginners, textile mills, delinting units and oil mills).		
	c. Sirsa Unit: - The centre may be strengthened with scientific and technical man power to develop liaison with ginning mills, in Northern Cotton Zone. - New HVI machine may be provided to the Regional Quality Evaluation Unit so that CIRCOT's Revenue generation can be increased. This will strengthen the relation with the stake holders. - Demonstrations on cotton stalks composting technology were undertaken by the centre under Tribal Sub-Plan (TSP). Many progressive farmers in the area are now interested in the technology and need microbial consortium for adoption of technology. Facility for production of microbial consortium is therefore required at the centre. - For promoting cotton stalk utilisation, a chipping machine may	Agreed. Necessary staff will be posted as soon as recruited and for HVI machine provision will be made in SFC 2020-25.	- The provision for purchase of HVI is made in the SFC and in final stage of procurement. - Microbial Consortium is being supplied by ICAR-CIRCOT, Nagpur to the Sirsa unit as and when required. - Purchase process has been initiated for procuring one chipping machine to Centre.

S. No.	Observation /Recommendation/ Comment	Council's Comments	Action Taken
	be provided for demonstration purpose. Cotton stalk chips could be used by brick kilns and for mini power generation plants (7-10 mw).		
	d. Surat Unit: - Centre needs to be strengthened with technical manpower. - New HVI machine may be provided to the Regional Unit. - Awareness workshop may be arranged to strengthen ties with all stakeholders in Gujarat.	Agreed. Necessary staff will be posted as soon as recruited and for HVI machine provision will be made in SFC 2020-25.	- The Quality Evaluation units at Surat has been strengthened with posting of two additional technical manpower and the upgradation of existing HVI machine. Due to this, the Centre is functioning in good condition. - Twenty-nine awareness workshops have been conducted through offline/online mode to strengthen ties with stakeholders.
	e. Dharwad Unit: - Centre needs to be strengthened with more number of technicians. - Proper space should be provided to the unit by the university as presently allocated space is not sufficient for taking up the testing activities. - New HVI machine may be provided, this will help in increasing CIRCOT's Revenue generation.	Agreed. Technicians will be posted immediately after recruitment. For more space, matter will be discussed with university and necessary action will be taken. Fund provision for new HVI, within 6 months and other for demonstration purpose will be made in next SFC 2020-25.	- The centre has been strengthened by providing additional technical manpower. - University has allotted new space for the lab during 2019. - The HVI machine present at Quality Evaluation, Dharwad was upgraded.

S. No.	Observation /Recommendation/ Comment	Council's Comments	Action Taken
6. Research Suggestions			
i.	All technologies developed by the institute over the years should be compiled and reviewed to find out their present day relevance and if relevant, their drawbacks and shortcomings can be examined and improved upon	Agreed. Actions have been initiated to compile the technologies developed by the institute and to study their impacts. It may be completed within 6 months	- The technologies developed by the institute have been compiled and based on the relevance the technologies have been categorized as Commercialized Technology, Technology ready for commercialization and Technology with potential for commercialization. - The impact of the technologies viz., Pre-cleaner, calibration cotton, and technology for value addition to cotton biomass has been carried out. - The technologies improved upon are - Portable ginning machine improved with Digital ginning percentage indicator - DR ginning system improved with single locking feeding system - Toxicology studies carried out for the Nano Zn, Nano Cellulose and Nano Sulphur developed by the institute.
ii.	Mechanization of cotton harvesting is the need of the hour due to labour shortage for picking.	Institute has developed the machinery for processing of the machine picked cotton and the	Research work in collaborative mode is continued on mechanical harvesting

S. No.	Observation /Recommendation/ Comment	Council's Comments	Action Taken
	Therefore, work undertaken on cleaning machinery for mechanically harvested cotton undertaken under TMC programme should be continued.	institute is committed to continue its work on mechanization of cotton harvesting and processing.	and cleaning machinery in collaboration with CIAE and CICR and with private industries Developed brush type stripper, On-board cleaner, process protocol for cleaning of machine harvested cotton, developed seed cotton trash content analyser for machine harvested cotton and assessed effectiveness and acceptability of hand-held mechanical cotton picker.
iii.	Work should be initiated to develop/ improve BIS standards for cotton bales, ginning machinery and also cotton by-products	Agreed. The revised BIS standard 12171 has been proposed with modified bale packaging for cotton. Necessary efforts are being taken for the development of BIS standard for cotton and BIS standard for pellets made from cotton stalks.	- On the persuasion of ICAR-CIRCOT, recently revised BIS standard 12171: 2019 Cotton bales-specifications has been adopted by Ministry of textiles and has issued Quality Control Order (QCO) for mandatory certification of cotton bales under specification No. IS12171: 2019-Cotton Bales to augment supply of good quality cotton to the textile industry. - The BIS standard for cottonseed delinting machine (surge bin and preheating machine) has been under review. - BIS test code on "Cylinder type cotton pre-cleaner" is developed and is under approval.

S. No.	Observation /Recommendation/ Comment	Council's Comments	Action Taken
			The Ministry of Power, GOI has already released Pellet standard with the inputs from ICAR-CIRCOT.
iv.	Efforts should be made for improving the efficiency of ginning machines	Agreed. Attempts are being made in collaboration with Gin manufacturers to increase the efficiency of the ginning machines through collaborative research projects.	- Research efforts were made for improving efficiency of ginning machines in collaborative mode with industry. - Single locking cotton feeder enhanced ginning output of DR gin by 23%, 25% and 62 % for long, medium and short staple cottons respectively. - Optimization of roller groove profile enhanced ginning output by about 20%. - Kawadi cotton opener improved lint recovery by 18%.
v.	Effect of insect infestation on fibre properties of cotton may be investigated and package of practices in ginneries for management of such infested cotton may also be worked out.	Agreed. Project in this line has already been initiated to address the issue of Pink Bollworms through appropriate technology and management at ginnery.	- Studied effect of Pink Bollworm infestation on fibre quality which showed 17%, 14% and 11% reduction in ginning percentage, fibre length and tenacity respectively. - Developed. Rotary Tubular Drum Dryer for quarantine of pink bollworms from cottonseed and Gin Trash Treatment System to destroy pink bollworm and prevent dissemination from ginneries.

S. No.	Observation /Recommendation/ Comment	Council's Comments	Action Taken
			Developed BMPs to prevent dissemination of PBW from cotton ginning industries.
vi.	There is a general perception that Indian cottons are weaker in strength. A comparative study on strength characteristics of Indian and foreign cottons may be undertaken.	Agreed. The study in this direction will be initiated soon. Most of the countries test the fibre attributes in HVI mode whereas in India many resort to ICC mode. By shifting to HVI mode of testing it has been observed that Indian cotton is almost at par with foreign cotton except for Supima and Egyptian Cotton. Institute has already made significant efforts to create awareness about shifting to HVI mode of testing and introduced the HVI mode in AICRP on Cotton Platform.	- Due to the continuous efforts of ICAR-CIRCOT, HVI mode of testing has been adopted almost 100% by the Indian textile industries. - In ELS cotton category, the strength to length ratio (SLR) of our cotton is 1.11 which is at par with Supima cotton and slightly lesser than Giza cotton which has SLR of 1.2 - Research is going on under AICRP on Cotton to develop cotton with higher strength.
vii.	Institute has done good work by conducting a survey to bring out the real status of trash content in Indian cottons in view of the ITMF presenting Indian cottons as trashy. Institute should work with other stakeholders for establishing the brand value of Indian cottons in view of the much cleaner handpicked cotton	The institute is working with the stakeholders to create awareness about the contaminant free cotton and will continue its efforts to establish the brand value of Indian Cottons	- The institute is working in association with Cotton Corporation of India Limited and NAHACOT for improving the bale value of cotton. - ICAR-CIRCOT has developed protocol for reduction of trash and contamination in cotton and branding as “Kasturi Cotton” to Ministry of Textiles in the direction of benchmark of Indian cotton brand. - The recent QCO by BIS implementing IS12171

S. No.	Observation /Recommendation/ Comment	Council's Comments	Action Taken
			mandates the maximum permissible level of trash in bales. • Institute is regularly organizing awareness programmes about clean picking of cotton and best post harvest management practices to the cotton farmers.
viii.	Development of green composites as an alternative to glass-reinforced plastics may be taken up.	The research activities in the area of development of green composites has already been initiated.	• Banana fibre based composite panel embedded with different designs and dried flower was prepared and have been installed in the Directors room and conference hall. • Bio-composite plug trays using cotton stalk reinforced with polyester matrix was developed for use in nursery. • The banana pseudo stem fibre based eco-friendly and bio-degradable moulded kitchen utensil was prepared by imparting hydrophobicity using commercially cheaper emulsified bee wax/sugarcane wax.
ix.	Cotton has limited application in technical textiles. Besides surgical cotton, development of cotton wovens and nonwovens for use in filtration and medical textiles should be explored.	Research initiatives to use cotton in technical textiles are under way to development of Activated Carbon-Based Protection Mask, High Performance Cotton Pads for Wound Dressing etc.	• Cotton based high performance wound dressing pad (Medical textiles) with better absorbency and antimicrobial property was developed. The nano silver based wound

S. No.	Observation /Recommendation/ Comment	Council's Comments	Action Taken
			dressing showed excellent activity with more than 99.00 % reduction for both Gram-negative and Gram-positive bacteria. Developed activated carbon coated to woven and nonwoven fabrics for face mask application(filtration). The particle filtration and bacterial filtration efficiency for activated carbon coated was 74.43% and 22.4% respectively.
x.	Development of multifunctional cotton-based smart textile materials can also be attempted.	Agreed. A new project has been initiated for Cotton Based Fabric for Warm Pads and Garments.	- Developed cotton-based heat generating textiles which are flexible, light weight, safe and has better comfort properties. - Heat generation of 50°C is achieved within 15 seconds by using 5 to 12 Voltage DC power supply, having current 1 to 2 Ampere. - Smart textile products namely automobile seat covers, thermal jacket, heating gloves, warm mouse pads and heating pads are designed with safety concern in which water repellent and flame-retardant treatments are also given to avoid water permeability and short circuit fire accidents.

S. No.	Observation /Recommendation/ Comment	Council's Comments	Action Taken
xi.	Work on eco-friendly textile processing and dyeing techniques including the use of natural substances and enzymes should be continued and efforts should be made to transfer such technologies to the unorganized cottage and small scale units.	Agreed.	• I C A R - C I R C O T is continuing the use of natural substances (like chitosan, citronella oil and enzymes) for development of eco-friendly textile processing. Eco-friendly Salt free cotton dyeing technology is licensed to M/s. SRG Apparels Ltd., through Tirupur Exporters Association • Technologies developed for application of natural dyes have been popularized through conduct of workshops (4 nos.) and exhibitions. Institute has contributed to the development and validation of 10 BIS and ISO standards on identification of Natural dyes. • E n z y m a t i c and microbial methods as well as low input single step chemical process for preparation of absorbent cotton have been standardized and been popularized through trainings and EDP programmes (7nos.)
xii.	Research work on reducing the effluent load, effluent treatment strategies and its reuse should be taken up in view of the current zero liquid discharge norms	The work in this direction is under progress in a CRP project "Sustainable Green Technology for Dyeing of Cotton Textile" and a very encouraging results are expected.	• Process technologies for reducing the effluent load and reuse of the dyed water has been developed under the project Sustainable

S. No.	Observation /Recommendation/ Comment	Council's Comments	Action Taken
	introduced for textile wet processing industries.		Green Technology for Dyeing of Cotton Textiles. Projects have been undertaken to utilize natural biodegradable materials for imparting functional finishes to cotton such as U V protective, antibacterial, mosquito-repellent etc.
xiii.	Lot of good work has been carried out on nanotechnology. Care should also be taken to study toxicological and environmental safety aspects of nano materials as well as treated textiles.	Agreed. The study will be taken up in the upcoming research programme of SFC 2020-25.	The toxicology and environmental safety aspects of the Nano particles developed in the institute has been studied and the safety limits has been established.
xiv.	Much effort has been directed towards the utilisation of cotton stalks but cottonseed which forms the major part of seed cotton produced has not received desired attention. As it is now a major edible oil source and also a source of linters, hulls and protein rich meal, constraints in its proper utilisation should be identified. Efforts should be undertaken to find out proper cottonseed processing techniques which result in best utilisation of this valuable resource.	Agreed. Necessary research projects will be taken up in 2019-20.	- Scientific cottonseed Processing yields linters, hull and protein rich meal along with 6% higher oil yield. A project was undertaken at the institute to find out the appropriate cottonseed processing technique. Mechanical delinting with 4 TPH and 2 TPH capacity for first and second cut, respectively have been found as ideal technique for delinting in the scientific processing of cottonseeds. - One DST funded project is also under final stage of completion for development of pilot plant for extracting protein.

S. No.	Observation /Recommendation/ Comment	Council's Comments	Action Taken
xv.	Presence of Gossypol pigment hinders utilisation of cottonseed meal for non-ruminant/ human feed. Efforts to reduce gossypol by various means should be continued. Cottonseed is processed by different methods across the country. Effect of various processing operations on its nutritive value should be undertaken.	Agreed. The institute has taken research project to reduce the gossypol content through microbial as well as solvent extraction method.	- A solvent extraction process developed was able to reduce gossypol from de-oiled kernels using GRAS solvent almost up to the level required for edible cottonseed flour. - Ultra- low gossypol cottonseed protein isolates (<100 ppm gossypol) have also been successfully prepared from cottonseed meal by pre-treating with microwave irradiation followed by alkali extraction of protein.
xvi.	Development of an efficient cotton stalk uprooting and chipping machine should be undertaken as chipping is a prerequisite for any cotton stalk utilization activity.	Agreed. Work in this line will be initiated 2020-25.	Work in this line will be initiated.
xvii.	Cotton stalks are rich in minerals, therefore their on farm usage for composting/ mushroom growing should be promoted as it that can reduce cost of cultivation by reducing fertilizer requirement.	Institute is organizing training programmes, awareness meets and also providing culture for composting to promote on farm usage of compost from cotton stalks. The spawn culture is also distributed to the farmers for growing of oyster mushroom.	Institute is continuously promoting cotton stalks for on farm usage for composting and mushroom growing

Annexure - II

Details of the Meetings and visits of QRT to ICAR-CIRCOT & its Regional Units

Meetings	Date	QRT Meetings/ Visit to Institute/ Regional Units	Participants
The First Meeting	31.01.2023	Introductory Meeting	• Dr. S.N. Jha, DDG (AE), ICAR • Dr. K.K. Singh, Chairman, QRT • Dr. K. Narsaiah, ADG (PE), ICAR • Dr. S.K. Shukla, Director, CIRCOT
The Second Meeting	06.06.2023	The Planning Meeting at ICAR-CIRCOT, Mumbai	• Dr. K. K. Singh, Chairman, QRT • Dr. S. N. Jha, DDG (AE), ICAR • Dr. K. Narsaiah, ADG (PE), ICAR • Dr S. K. Shukla, Director, ICAR-CIRCOT, • Dr. G. S. Nadiger, Member • Dr. A. J. Shaikh, Member • Dr. Kanchan K. Singh, Member • Dr. S. Patel, Member • Dr. A. S. M. Raja, Member Secretary • HoD's, SAO and AFAO of ICAR-CIRCOT
		Stakeholders Meet	• Shri Suresh Kotak, Kotak Commodities • Shri Pranjvi Harlalka, Gini Silk Mills Limited • Shri Surendra Yadav, Gini Silk Mills Limited • Shri Sunil Dhumal, Aditya Birla Science & Technology Company Pvt. Ltd. • Dr Sachin, Aditya Birla Science & Technology Company Pvt. Ltd. • Mr.Keshav Kulkarni, D Décor • Mr.Kaushal Dongare, Paawak Foods • Dr Santosh Sahane, Forecast Agrotech Innovations Pvt Ltd. • Mr Kapil Kumar, Marketing Manager, RK Pellets • Mr Nitin Khade, Director, PIMANI Udyog • Mr Manish Daga, Cotton Guru • Mr Ark Agrawal, Parag Copigraph Pvt Ltd

Meetings	Date	QRT Meetings/ Visit to Institute/ Regional Units	Participants
			• Mr Goraksha Gadekar, Relegare Agro Life Bio Science Pvt Ltd • Shri L.K.Gupta, CCI • Shri Vijay Kuradagi, (Marketing), CCI • Shri S K Panigrahi, Chief General Manager Marketing • Shri Mayur Patil, Rashtriya Chemicals and Fertilizers Limited, Mumbai • Dr RC Sharma, Rashtriya Chemicals and Fertilizers Limited, Mumbai • Dr. Farukh Hussain Researcher, Biofac Inputs Pvt Ltd., Hyderabad • Shri. Sudhanshu Agrawal, Kanhaiya Chemicals, Navi Mumbai • Dr. Manisha Jadhav, Godavari Biorefineries Ltd. Mumbai • Er. Lalit Meisheri, TECH KNOW CONSULTANTS • Er. Anant Shinde, Sukhakarta Electromech Engg Pvt Ltd • Dr R D Kokane, Naturalism Food Labs Pvt Ltd • Mr Amir Sheikh, Zydex industries • Dr.Vishwa, Shaktiman group • Shri Prafulla Pandey, GM Business, Mahindra & Mahindra • Shri Rajesh, MD, Oscar enterprises, Mumbai • Shri Ram Bohra, Managing Director, Cotton Plants (India) Pvt. Ltd
The Third Meeting	24.07.23 & 25.07.23	Meeting with Staff of ICAR-CIRCOT, Mumbai	• Dr. K. K. Singh, Chairman, QRT • Dr S K Shukla, Director, ICAR-CIRCOT, • Dr. G.S. Nadiger, Member • Dr. A.J. Shaikh, Member • Dr. Kanchan K. Singh, Member • Dr. S. Patel, Member • Dr. Prashant Mohota, Member • Dr. A.S.M. Raja, Member Secretary • Dr. S.K. Shukla, Director, ICAR-CIRCOT

Meetings	Date	QRT Meetings/ Visit to Institute/ Regional Units	Participants
			• Heads of Divisions, SAO, AFAO, Scientific and Technical staff
		Meeting with staff and various committee of ICAR-CIRCOT, Mumbai	• Administrative and Supporting staff, Representative of Institute Joint Council, Women's Complaint Committee etc.
The Fourth Meeting	10.10.23 & 11.10.23	i) Visit to Ginning Training Centre, Nagpur	• Dr. K. K. Singh, Chairman, QRT • Dr. G.S. Nadiger, Member • Dr. A.J. Shaikh, Member • Dr. Kanchan K. Singh, Member • Dr. S. Patel, Member • Dr. Prashant Mohota, Member • Dr. A.S.M. Raja, Member Secretary
		ii) Stakeholders meeting	• Dr. M.K. Sharma, M/s.BISL, Nagpur • Mr.Kalantri, M/s.BISL, Nagpur • Mr. J.P. Mahajan, Nodal Officer, SMART Cotton • Mr. G.H. Wairale, CTTCDRI, President, Agro Plus Foundation • Mr. Rahul Bharatwal, President, CIS Lab, Nagpur • Mr. Girish Rathi, M.R. Ginning & Pressing, Talegaon • Mr. Ravindra Daftari, M/s.Daftari Seeds, Selu • Mr. Amol Taori, M/s.Mahalaxmi Industries, Dhapewada • Mr. Ram Ghate, Zellweger Uster Technologies • Mr. Y.N. Kobra, Farmer (Progressive) • Mr. M.T. Vergis, M/s.Grace Enterprises • Mr.Suyog Junghare, M/s.BISL, Nagpur • Mr.Yogesh Gajajalwar, Sanjivani & Vidarbha Agro, MIDC, Nagpur • Mr.Atual Panat, Super Hygine • Mr.Saurabh Lakhwear, Mr.Arohi Biocoal, Karanja

Meetings	Date	QRT Meetings/ Visit to Institute/ Regional Units	Participants
		iii) Meeting with ICAR, CICR Nagpur	• Dr. Y.G. Prasad, Director • Dr. G. Balasubramani, Principal Scientist • Dr. K. P. Ragavendra, Sr. Scientist • Scientist staff, ICAR-CICR
The Fifth Meeting	05.12.23	Meeting with Incharges of All Quality Evaluation Regional Units & GTC, Nagpur	• Dr. K. K. Singh, Chairman, QRT • Dr S K Shukla, Director, ICAR-CIRCOT, • Dr. G.S. Nadiger, Member • Dr. A.J. Shaikh, Member • Dr. Kanchan K. Singh, Member • Dr. S. Patel, Member • Mr. Prashant Mohata, Member • Dr. A.S.M. Raja, Member Secretary • Dr. K. Pandiyan, Scientist & Officer Incharge, GTC, Nagpur • Dr. Hamid Hasan, CTO & Officer Incharge, QEU, Sirsa • Shri M. Bhaskar, Technical Officer, QEU, Coimbatore • Mrs.Vijaylaxmi Udikeri, Sr.Technical Officer, QEU, Dharwad • Shri Dhawal Dhodiya, T-2, QEU, Surat • Shri Sohel N. Shaikh, T-1, QEU, Guntur
The Sixth Meeting	18.01.2024 & 19.01.2024	i) Visit to Quality Evaluation Unit at Coimbatore	• Dr. K. K. Singh, Chairman, QRT • Dr. S K Shukla, Director, ICAR-CIRCOT, • Dr. A.J. Shaikh, Member • Dr. Kanchan K. Singh, Member • Dr. S. Patel, Member • Dr. A.S.M. Raja, Member Secretary • Shri K. Thiagarajan, Officer Incharge, QEU Coimbatore • Dr. A.H. Prakash, Head of the Research Centre, CICR, Coimbatore • M/s.Shantalaxmi Ginning Mills
		ii) Stakeholders Meet	• Mr. Neeraj Kumar Bhatt, CCI • Mr.R. Ramkumar, M/s.Statex Engineering Ltd.

Meetings	Date	QRT Meetings/ Visit to Institute/ Regional Units	Participants
			• Mr.S. Bhuvaneshwara, M/s.Mag Solvics Ltd. • Mr.M. Yuvaraj, M/s.Mag Solvics Ltd., • Shri V Dr. U. Shivakumar, Department of Microbiology, TNAU • Dr. Ravindra Naik, PS & Head, ICAR-CIAE, RS CBE • Dr. A. Subramanian, Principal Scientist & Head (Cotton), TNAU • Mr.C. Prabhakaran, Technical Manager, Uster Technologies India • Mr.Narendraa Dave, Spinhin Enterprises, Coimbatore
The Seventh Meeting	24.04.2024	Visit to Quality Evaluation Unit of ICAR-CIRCOT located at Main Cotton Research Station (MCRS), Surat of Navsari Agricultural University Surat	• Dr S K Shukla, Director, ICAR-CIRCOT, • Dr. A.J. Shaikh, Member • Dr. A.S.M. Raja, Member Secretary • Dr. M.C. Patel, Research Scientist (Cotton), NAU • Dr. Pankaj Gandhi, Director, MANTRA • Dr. Hitesh Jariwala, Deputy Director, MANTRA • Shri Dhawal Dhodiya, Technician • Dr. Himanshu R. Desai, Associate Research Scientist, NAU • Dr. D.H. Patel, Associate Research Scientist • Dr. G.O. Falelu, Associate Research Scientist • Dr. M.M. Patel, Associate Research Scientist • Dr. P.R. Parmar, Assistant Research Scientist • Prof. D.N. Patel, Associate Research Scientist
The Eighth Meeting	14-15th June 2024	Visit to Quality Evaluation Unit of ICAR-CIRCOT located at Hebbali farm, Dharwad, of University of Agricultural Science, Dharwad	• Dr. S.K. Shukla, Director, ICAR-CIRCOT, Mumbai • Dr. G.S. Nadiger, Former Director & QRT, Member, Textile Committee • Dr. A.J. Shaikh, Former Director, ICAR-CIRCOT, Mumbai, QRT Member • Dr. B.N. Khadi, Former Dean, UAS Dharwad

Meetings	Date	QRT Meetings/ Visit to Institute/ Regional Units	Participants
			• Dr. Venkatesh R. Kulkarni, Sr.Scientist (Pl.Path.), ARS, UAS, Dharwad • Dr.S.M.D. Akbar, Scientist (Bio chem.), ARS, UAS, Dharwad • Shri K.N. Ojha, Deputy Manager, CCI, B.O. Hubli • Shri Rupesh Kumar, Commercial Officer, CCI, Hubli • Mrs. Poornima Matti, Scientist (Ent.), ARS, UAS, Dharwad • Shri Kiran Purohit, Senior Commercial Officer, CCI, B.O. Hubli • Mr. Pintu Basak, CAI, Hubli Lab • Dr. A.S.M. Raja, Principal Scientist
The Ninth Meeting	5-6 July 2024	ICAR-CIRCOT, Mumbai. QRT-IMC interface meeting & finalisation of report	• Dr. K. K. Singh, Chairman, QRT • Dr S K Shukla, Director, ICAR-CIRCOT • Dr. K. Narsaiah, ADG (PE), ICAR • Dr. G.S. Nadiger, Member • Dr. A.J. Shaikh, Member • Dr. Kanchan K. Singh, Member • Dr. S. Patel, Member (Online) • Dr. A.S.M. Raja, Member Secretary • Dr. Sharad Gadak, Vice Chancellor, PDKV, Akola • Dr. A K Thakur, Principal Scientist, ICAR • Dr. Vinita Gotmare, Principal Scientist, ICAR-CICR, Nagpur • Dr. R.K.Viswakarma, Principal Scientist, ICAR-CIPHET, Ludhiana • Dr. D.P.Ray, Prin. Scientist, ICAR-NINFET • Shri. R.K.Singh, comptroller, ICAR-CIFE • Shri.M M Korde, Snehnagar, Sillod • Shri. Navin Kumar, Sr.AO, ICAR-CIRCOT • Shri. Sumit Saurabh, FAO, ICAR-CIRCOT • Smt. T.P.Mokkal, AO, ICAR-CIRCOT • Director of Agriculture, Govt. of Maharashtra • Dr. D.M. Kadam, Head, ETDD, ICAR-CIRCOT, Mumbai • Dr. Sujata Saxena,Head, CBPD • Dr. N.Shanmugam, Head, MPD

ANNEXURE-III

List of Technologies Developed

Sr. No.	Technology
1.	Development of Single Locking Cotton Feeder for Double Roller Gin
2.	Cotton/ Bamboo Viscose Blended Fabric for Active Wear
3.	Development of Cotton/PLA/Bamboo Blended Garments
4.	Durable Antimicrobial Cotton Textile Through Fibre Blending
5.	Status Report on the Contamination of Indian Cotton
6.	Low Temperature Refining Process for Production of Nanofibrillated Cellulose
7.	Nanocellulose Production Through Friction Grinding
8.	Development of Cotton Based High Quality Currency Grade Pulp
9.	Nano Cellulose Based Kraft Paper with Improved Functionality
10.	Solvent Extraction Process for Low Gossypol Cottonseed Flour for Edible / Poultry Feed Purposes
11.	Microbial Process for Preparation of Absorbent Cotton with Efficacy and Uniformity
12.	Microencapsulated Herbal Formulation for Mosquito Repellent Finish
13.	Development of Experimental Setup for Burning of Dead Bodies Using Cotton Stalk Briquettes
14.	Optimised Process for Single Locking Cotton Feeder for Enhancing Ginning Efficiency of Double Roller Gin
15.	Pellet Stove for Cotton Stalk (Biomass) Pellets
16.	Nanocellulose Polymer Based PVA Composite Film
17.	Process of Colour Removal from Reactive Dye Bath Effluent Using Adsorption Technique
18.	ECF Bleaching Protocol for Banana Fibres
19.	Nanocellulose as A Rheology Modifier in Water Based Paints and Coatings
20.	Process Protocol for Extraction of Protein Concentrates from Cottonseed Meal
21.	Enzyme for Production of Surgical Cotton
22.	Home Textiles with Eco-Friendly Mosquito Repellent Finishing
23.	Process for Preparation of Activated Carbon from Cotton Stalk by Chemical Activation
24.	Trash Handling System for Control of Pink Bollworm in Cotton Ginneries
25.	Development of Activated Carbon-Based Protective Mask
26.	Banana Filament Fibre Spinning Machine

Sr. No.	Technology
27.	Natural Fibre Based Herbal Fragrance Release Product for Well-Being
28.	Development of Cotton Based Smart Heating Gloves
29.	Development of Conductive Yarn
30.	Electrodialysis Process for Decolouration of Dyeing Effluents
31.	Cotton Gauze with Improved Absorbency Property for Wound Dressing
32.	Development of Bio-Based Hydrophobic Coating for Lignocellulosic Molded Products
33.	Banana Fibre Based Kraft Pulping for Packaging
34.	Rotary Tubular Drum Dryer for Quarantine of Pink Bollworm from Cotton Seed
35.	Cotton Interlined Sleeping Bags for Better Comfort
36.	Heat Generating Smart Textiles Products
37.	Marker Fibre for The Traceability of Cotton Textiles
38.	Hydrogen Peroxide-Nanosilver Based Disinfectant Formulation
39.	Chemo-Mechanical Process for Production of Nano-Sulphur
40.	Process Protocol to Get Bleached Cotton Linters with High Degree of Polymerization
41.	Biodegradable Wound Dressing Pad with Antimicrobial Properties
42.	Processed Cotton Linters for Filter Making Applications
43.	Green Process Protocol for Extraction of Protein Concentrates from Cottonseed Meal
44.	Economic Surplus Approach to Assess the Impact of CIRCOT Bajaj Pre-Cleaner
45.	Low-Cost Energy Efficient Cotton Stalk Briquette Based Crematorium
46.	Digital Ginning Percentage Indicator (DGPI) for Portable Cotton Gins
47.	Process Protocol for Spinning of Recycled Cotton Fibre Extracted from Pre-Consumer Knitted Garment Waste Fabrics
48.	Process Protocol for Branding Indian Cotton As “Kasturi Cotton India” For Export
49.	Equipment for Evaluation of Air Filtration Evaluation of the Fabric
50.	A Revised Model For Relationship Between Count And Count Strength Product (CSP)
51.	Marker Fibres for The Traceability of Naturally Coloured Cotton Textiles
52.	Cotton Rich High Comfort Knitted Fabric with Smart Drying Property
53.	Enzymatic Preparation of Protein Hydrolysate from Cottonseed Meal
54.	Cotton Based Reusable Face Mask with Breathability and Antimicrobial Property
55.	Environmental Impact of ICAR-CIRCOT Nanocellulose

Annexure IV

Technology Commercialised/ licenced/incubated

Sr. No.	Name of Technology
1.	Production and Supply of Technical Textile Reinforced Rubber Composite Sheets for Installation of ICAR FLEXI CHECK DAMS
2.	Eco friendly, Efficient and Rapid Burning Crematorium using Cotton Stalk/Biomass Briquettes
3.	Preparation of Value-Added Products using Banana Fibre
4.	Preparation of Value-Added Products using Naturally Coloured Cotton
5.	Mechanical Property Testing of Paddy Straw of Particle Boards and Use Facilities of ICAR-CIRCOT
6.	ICAR-CIRCOT Continuous Pallet Feeding Stove
7.	Preparation of Biodegradable Products using Agro Bio Mass (Banana, Rice Straw, Bagasse)
8.	Development of Starch-Based Film
9.	Conceptualization, Design and Development of Technically Advanced Textile Materials and Conversion to related Products
10.	Gin Trash Handling System to Destroy Pink Bollworm from Cotton Ginneries
11.	Technology for Developing Banana Fibre based Composite Materials and Preparation of Microcrystalline Cellulose (MCC) using Banana Fibres
12.	Technology for making Specialty Filter Paper from Bleached Cotton Linter
13.	Production and Supply of Technical Textile Reinforced Rubber Composite Sheets for installation of “ICAR FLEXI CHECK DAMS”
14.	ICAR-CIRCOT Trapezoidal Shaped Low-Cost Briquette-Based Crematorium
15.	Technology for Developing Banana Fibre based Composite Materials and Preparation of Microcrystalline Cellulose (MCC)
16.	Technology for Development of Thermal Seat Covers for Automotive Applications
17.	ICAR-CIRCOT Nanosulphur as Fertilizer and Pesticide
18.	ICAR-CIRCOT Trapezoidal Shaped Rapid Burning Briquette Based Crematorium

Annexure V

Patent Granted / Filed

Sr. No.	Complete Filing Date	Patent Application No.	Technology/ Innovation	Name of Inventors
1.	11.03.2022	2022210113740	Novel Chemo-Mechanical Method for Preparation of Nano-Sulphur	Bharimalla Ashok Kumar, Mahawar Manoj Kumar, Vigneshwaran N, Arputhraj A, Dhakane-Lad Jyoti, Saxena Sujata
2.	04.08.2022	202221044541	Air Cooling and Circulating System for Improving Thermal Comfort of Impermeable Apparels	Jagajanantha Palaniappan, Mandhyan Pradeep Kumar, Raja ASM, Arputharaj Anthonysamy, Jalgaonkar Kirti, Patil Sharmila, Bharimalla Ashok Kumar, Saxena Sujata
3.	23.12.2022	202221074766	Woven Fabric Architecture for Enhanced Particle Filtration in Face Mask Fabric	Gobi Thavasiappan Venkatesh Prabu, Raja A S M, Vigneshwaran Nadanathangam, T Senthil Kumar, G Krishna Prasad, Bharimalla Ashok Kumar, C Sundaramoorthy, Saxena Sujata

Patent Granted (2017-2022)

Sr. No.	Title	Patent application no.	Patent no.	Date of grant	Inventors
1.	Biological Softening of Lignocellulostic Material for Preparing Binderless Board	361/MUM/2009	289209	03.11.2017	R. H. Balasumanya, A. J. Shaikh, R. M. Gurjar
2.	Process for Dyeing of Textiles using Solvent Extracted Marigold Flower Waste	367/MUM/2009	422638	22.02.2023	S. Saxena, P. V. Vardarajan, R. R. Mahangade, R. S. Narkar

Glimpses of Visits



Planning Meeting of QRT at ICAR-CIRCOT, Mumbai on 6th June 2023



Interaction with Scientists at ICAR-CIRCOT, Mumbai on 24th July 2024



Interaction with Technical staff at ICAR-CIRCOT, Mumbai on 25th July 2024



Visit Ginning Training Centre, Nagpur on 10th October 2023



Interaction with stakeholders at GTC Nagpur on 10th October 2023



Visit to Precision Tooling Engineers, Nagpur on 10th October 2023



Chairman inaugurated High Productivity Lab Model Machine at GTC Nagpur on 10th October 2023



Visit to ICAR-CICR, Nagpur on 10th October 2023



Interaction with MD of Gimatex, Nagpur on 11th October 2023



Visit to Gima Biotech Industry, Nagpur on 11th October 2023



Meeting with QEU's at ICAR-CIRCOT, Mumbai on 5th December 2023



**Visit to Premier Evolvics Pvt. Ltd.,
Coimbatore on 19th January 2024**



**Interaction with stakeholders at QEU,
Coimbatore on 19th January 2024**



**Visit to Mag Solvics,
Coimbatore on 19th January 2024**



**Visit to ICAR-CIAE Regional Station,
Coimbatore on 19th January 2024**



**Visit to Santalaksmi Ginning Mill,
Pollachi on 19th January 2024**



**Visit to Statex Engg. Pvt. Ltd.,
Coimbatore on 19th January 2024**



**Meeting with ICAR-CICR Regional Station,
Coimbatore on 18th January 2024**



**Field visit to ICAR-CICR RS,
Coimbatore on 19th January 2024**



Visit to QEU, Surat on 24th April 2024



**Visit to QEU of ICAR-CIRCOT,
Dharwad on 14th June 2024**



**Interacted with Vice Chancellor,
UAS Dharwad on 15th June 2024**



**Visit to Mahim Staff Quarters
on 5th July 2024**



QRT-IMC Interface Meeting at ICAR-CIRCOT, Mumbai on 5th July 2024



Meeting with Scientists at ICAR-CIRCOT, Mumbai on 5th July 2024



Visit to CIRCOT staff quarters at Ghatkopar, Mumbai 6th July 2024



QRT at ICAR-CIRCOT, Mumbai on 6th July 2024





**KASTURI COTTON
BHARAT**

