



CONTRIBUTION OF AICRP ON COTTON IN CHANGING INDIAN COTTON SCENARIO

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India was recognised as the cradle of the cotton industry for over 3000 years (1500 BC to 1700 AD). It also has the distinction of having the largest area under cotton cultivation which is about 41% of the world area under cotton cultivation ranging between 12.5 and 13.5 million hectares in recent years. Cotton is one of the principal crops of India and plays a vital role in the country's economic growth by providing substantial employment and making significant contributions to export earnings. The cotton cultivation sector not only engages around six million farmers, but also involved about 40 to 50 million people relating to cotton cultivation, cotton trade, and its processing.

During the late eighteenth and early nineteenth centuries, cotton was one of the most important industrial inputs. Its production stimulated economic activity and institutional changes of major historical importance. Two countries-India and the US dominated world cotton exports during the nineteenth century. The US was the leading exporter, supplying more than 70 percent of the quantities and India was the second-largest exporter of cotton, supplying almost 30 percent of the quantities traded on the world market during much of the period.

The British government had made several attempts to expand cotton cultivation in India since the early nineteenth century as part of a larger effort to diversify British trade. In 1820, the Agricultural and Horticultural Society of India (AHSI) was set up in

Calcutta. By the 1830s, the British East India Company (EIC) had established experimental farms all over EIC-controlled India, with the assistance of American cotton planters, but only the coarse local Indian varieties of cotton continued to be widely cultivated throughout the nineteenth century. It was not until the early twentieth century that it became possible to increase the yield of foreign varieties of cotton in India, thanks to investments in irrigation.

The organized cotton improvement program was however launched at the beginning of the twentieth century with several states lodging on cotton research and development. In 1921, Indian Central Cotton Committee (ICCC) was established by the Government of India to fund and coordinate cotton research in the country. ICCC sponsored several hundred research schemes relating to the breeding of new varieties, improved agronomy practices, disease and pest management, and marketing, which helped in the improvement of cotton in the country. With the abolition of ICCC in 1966, it was decided for setting up an independent body for coordinating the Research and Development of cotton in the country and which led to the establishment of ICAR-ALL INDIA COORDINATED RESEARCH PROJECT ON COTTON (AICRP) in 1967 with its Headquarters at Coimbatore (Tamil Nadu) with adequate funding from Indian Council of Agricultural Research (ICAR) to improve both quality and quantity of cotton considering the needs of

domestic textile industry and export. The office of the project started to function at ICAR-IARI Regional Center, Coimbatore till 1976. Later ICAR constituted ICAR-Central Institute for Cotton Research at Nagpur in the year 1976 and made this IARI Regional Center as ICAR-CICR Regional Station. AICRP on Cotton is headed by the Project Coordinator (Cotton improvement), who gets necessary directives from the Deputy Director General (Crop Science) / Assistant Director General (Commercial Crops), ICAR, New Delhi, and technical advice from the Director, ICAR-CICR, Nagpur for effective and smooth functioning of the Project. To give new thrust and direction in terms of multi-disciplinary and multi-centre approaches for improved cotton cultivars and other novel cotton production and protection technologies for ensuring sustainable cotton cultivation, the ICAR ensured the active involvement of 21 participating centres from 17 State Agricultural Universities across the cotton-growing states by knitting them together under the aegis of AICRP on Cotton. The ICAR-Central Institute for Cotton Research (ICAR-CICR), Nagpur (Maharashtra), and its Regional Stations at Coimbatore (Tamil Nadu) and Sirsa (Haryana) provide basic research support and also take part in certain strategic research and evaluation activities of the AICRP on Cotton. The ICAR-Central Institute for Research on Cotton Technology (ICAR-CIRCOT), Mumbai, and its regional centre spread across the country are closely associated with AICRP on Cotton in assessing the fiber quality parameters of cotton besides ensuring value addition to cotton.

Decades of cotton in India

At the time of independence, 97% of the area was under *desi* cotton and only 3% was occupied by *G. hirsutum*. Presently, 95% of the cotton area is being occupied by *G. hirsutum* varieties and hybrids. In India, the conditions are favourable for growing all the

four cultivated species of *Gossypium*, viz., *Gossypium arboreum* and *G. herbaceum* (Asian or diploid cotton), *G. hirsutum* (American upland cotton), and *G. barbadense* (Egyptian cotton) besides hybrid cotton. *G. barbadense* is grown in a very little area (1%) in the States of Tamil Nadu and Karnataka. *G. herbaceum* is limited to the States of Gujarat and northern Karnataka. *G. hirsutum* and *G. arboreum* are grown in all the major cotton-growing states in India. The species composition and cotton-growing zones are given in table 1.

During the year 1947-48, the production of long and extra-long-staple cotton production increased from nil to 78% (2019-20) of the total production. Whereas, medium staple production reduced from 66% to 20%, and short-staple production reduces from 33% to 2% (Fig. 1). Outstanding research efforts have brought significant change in the fiber production combination, notably the concentration shift from diploid cotton to upland cotton in the country.

Before the institution of AICRP on Cotton, the average cotton area in the country was 73.79 lakh hectares and production of 45 lakh bales with the productivity of 104 kg/ha (Fig. 2). Due to various research development by AICRP, the average cotton area increased to 108.33 lakh hectares and production to 273.73 lakh bales with the productivity of 420 kg/ha between the years 2002 and 2020. The introduction of Bt Cotton along with improved Cotton production and protection technologies developed by public sector agencies have made the average cotton area 122.72 lakh hectares and average production of 334 lakh bales with the productivity of 464 kg/ha (Fig. 2).

Table 1: Cotton species composition across India

Zone	Species grown	Area (%)	Production (%)
North zone (Punjab, Haryana, Rajasthan)	<i>G. hirsutum</i> , <i>G. arboreum</i> & Intra- <i>hirsutum</i> hybrid	12.84	17.81
Central zone (Maharashtra, Madhya Pradesh, Gujarat, Odisha)	<i>G. hirsutum</i> , <i>G. arboreum</i> , <i>G. herbaceum</i> , Intra- <i>hirsutum</i> , and Inter-specific diploid hybrids	59.11	54.79
South zone (Karnataka, Telangana, Andhra Pradesh, Tamil Nadu)	<i>G. hirsutum</i> , <i>G. herbaceum</i> , <i>G. arboreum</i> , <i>G. barbadense</i> , Intra- <i>hirsutum</i> and Inter-specific hybrids	27.98	26.85

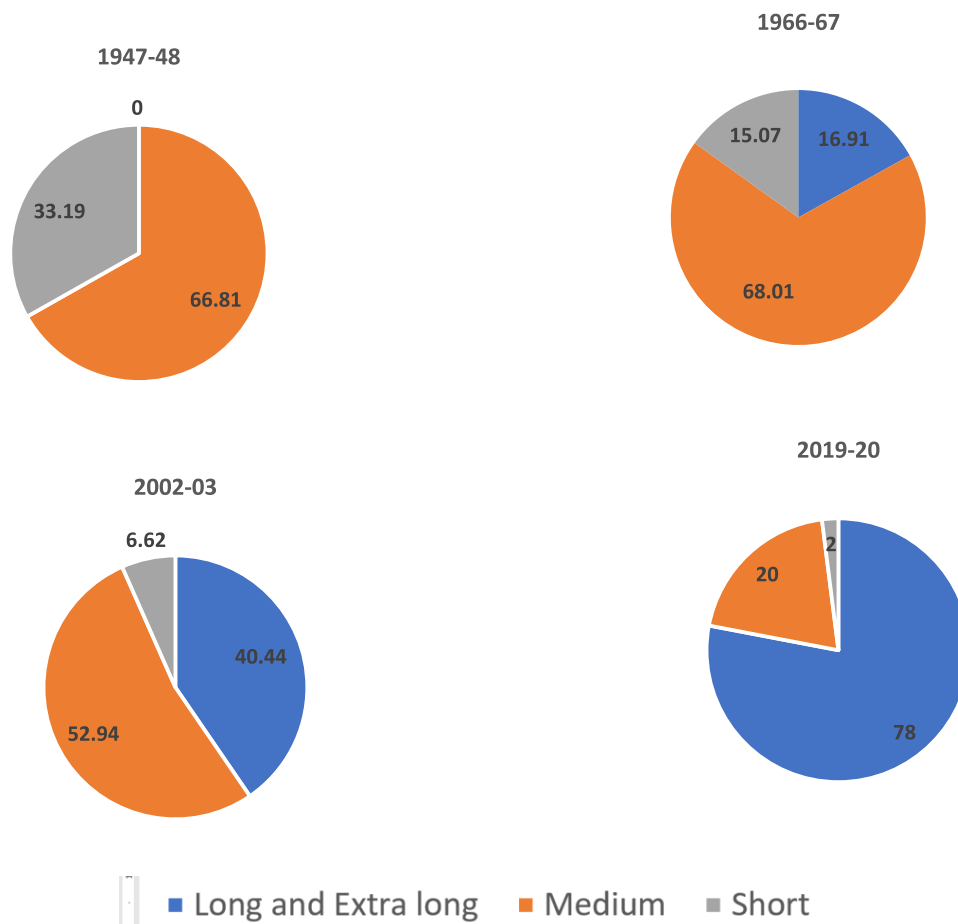


Fig. 1: Staple wise cotton production in India (%)

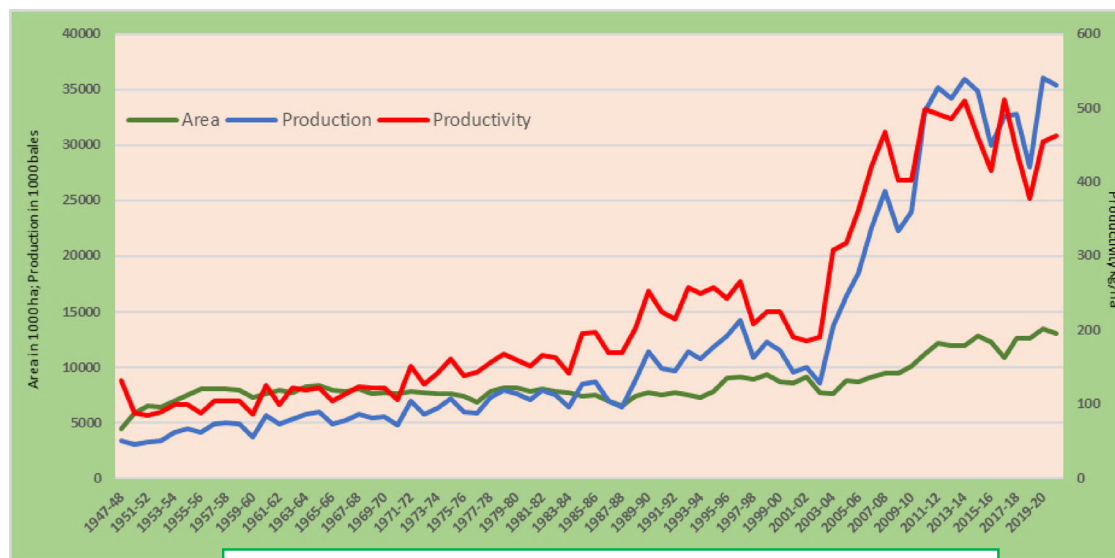


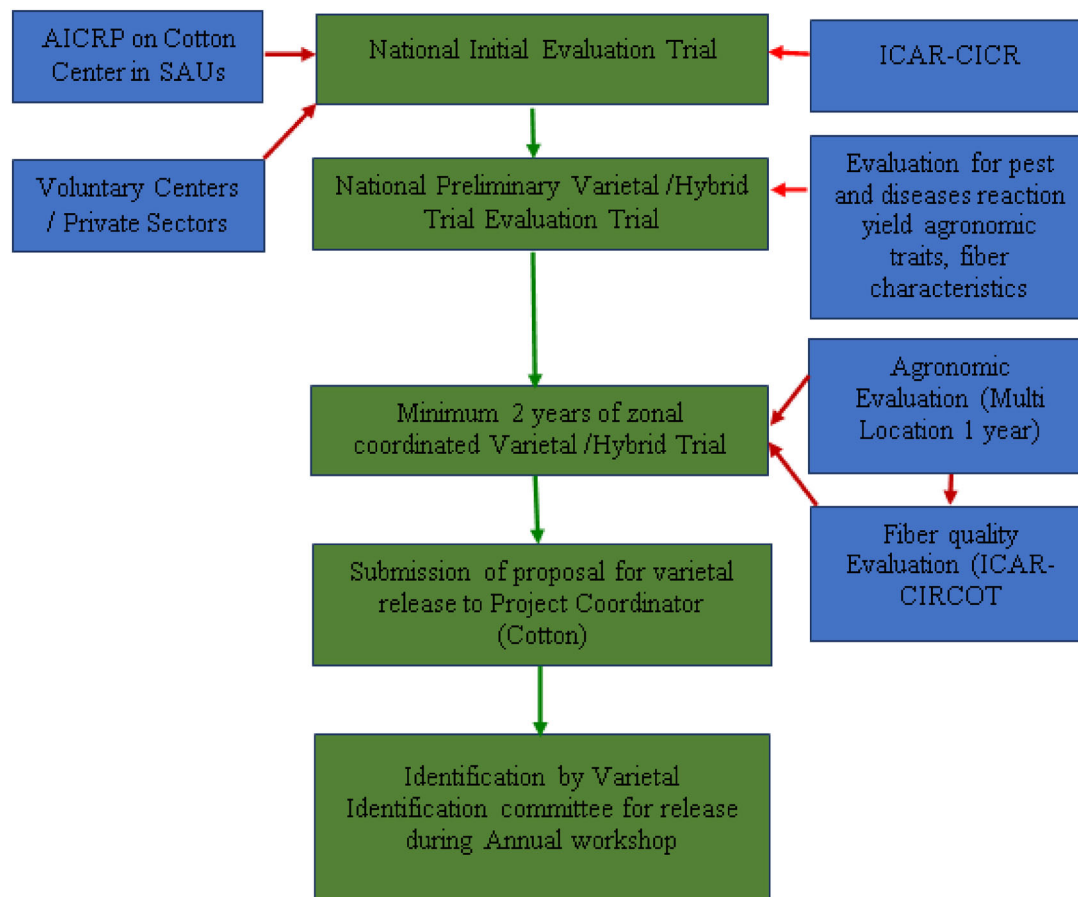
Fig. 2: Cotton area, production and productivity

Functions of AICRP

The mandate of the AICRP on Cotton is to develop cotton cultivars and hybrids best suited for different agro-climatic zones of India; to develop viable and economical area-based agro-techniques for realizing maximum yields/profits from improved cotton cultivars for both irrigated and rain-fed conditions including management of abiotic stresses, and to develop economic and effective pest and disease management practices under different agro-biological conditions. The Project Coordinator ensures concurrent testing of cotton varieties and hybrids including Bt Cotton under strict coding and development of location-specific cotton production and protection technologies.

Once a cotton entry is sponsored in AICRP trials, it takes around four years of rigorous evaluation for yield, abiotic & abiotic stresses, and fiber quality under varied agro-ecological conditions (Fig. 3). The good performing entries are identified for release as new varieties in the annual workshops of the AICRP by the Variety Identification Committee constituted under the Chairmanship of Deputy Director General

(Crop Sciences). This will be later submitted for Notification by the Central/State Variety Release Committee the Department of Agriculture and Cooperation, the Ministry of Agriculture, Government of India.



Historic role by AICRP in Indian cotton scenario

The initial stages of AICRP emphasized the improvement of productivity of medium-long and long-staple cotton production to meet the demand of the domestic textile industries. The development worlds first-ever hybrid H4 hybrids from Gujarat Agricultural University become popular in the 1970s in the central zone. The production and productivity enhancement of hybrid cotton especially in dryland conditions made the hybrid cotton revolution in the country. Research efforts, since the formation of AICRP in 1967, have led to the release of around 362 Cotton varieties and hybrids for the different cotton-growing tracts of the country and the

development of the economical and eco-friendly package of practices for realizing enhanced productivity. The world-class cotton varieties & hybrids like Suvin, DCH 32, Varalaxmi, LRA 5166, Surabhi, MCU 5, LRK 516, H4, H6, H8, RG 8, PKV Hy 2, TCHB 213, NHH 44, LHH 144, Suraj, RAJ DH 9, G. Cot 14, AKH 081, G. Cot DH 7, G. Cot DH 9, Abhadita, are the significant outcome from the AICRP to name few.

Features	Varieties/hybrids
Extra Long Staple	Suvin (spin count upto 120s), DCH 32, DHB 915, TCHB 213, TNB 1, CCH 2623, Subiksha, Suchitra, Sunantha, Suraksha, CCB-51
Long Staple	MCU 5
Long-staple <i>arboreum</i> G.	PA 255, PA 812, PA 528, CNA 1037
Long-staple <i>herbaceum</i> G.	G. Cot.21, G. Cot.23, G. Cot.DH.7, G. Cot. DH.9, RAHS.14, RAHS.131, DB.3-12
Colour cotton	JCC-1
Compact Genotype	Anjali, Pratima, Shruthi, Sunantha
Short duration	H 777, LH 900, Kiran, LD 230, Sangam, LAHH-1, Yaganti, Srinandi
Wide adaptable	LRA. 5166
Cytoplasmic Male Sterile	PKV Hy.4, PKV Hy.5
Suitable for organic farming	DDHC.11,
Suitable for HDPS	Suraj, PA 812, Sunantha, Phule Dhanavanthri
Waterlogging tolerant	LRA 5166, LRK 516, Anjali, Savita, AAH-1, F 1861, HHH 287, G. Cot.Hy.12 Parbhani Turab, DHH 11, RAHS 14
Drought tolerant	LRA 5166, MCU 5 VT, NHH 44, G. Cot.15, G. Cot.16, G. Cot.19, Jawahar Tapti, PKV Hy 5, AKDH 5 AKDH-7 G. Cot. MDH 11, PDKV DH-1, Pratap Kapi, Wagad Kalyan, PA 402, PA 225, G. Cot.18, NH 545, JK 4, AKA 5, AKA 7, AKA 8, Surya, RCH 2, KC 2, Bunny, Surabhi, LAHH 4, SVPR 3 Sumangala, DLSa 17
Saline tolerance	CICR-2, RAJ DH9, G. Cot 27, G. Cot.13, G. Cot. DH 7, G. Cot. DH 9, G. Cot.17, G. Cot.21, G. Cot.23, Jayadhar, DHB 105, RAHS 14, DDHC 11, AAH.1, CICR.2,
Sucking pest tolerant	Suraj
Verticillium wilt tolerant	Surabhi, MCU 5 VT
Fusarium Wilt	MCU 5, CICR 1
Leaf Curl Virus resistant	LD.327, HD.123, RG.8, RS.810, RS.2023, F.1861, LH.1556, H.1098-i, HHH.223, CSHH.198, F.1867, CSHH 238, CSHH 243, H 1236

AICRP has achieved the objectives with tangible technological back-stopping. However, Cotton plant growth is prone to dynamic changes with changing weather and socio-economic condition. This necessitates continuous monitoring and subsequent development of appropriate management strategies to overcome the biotic and abiotic stresses for sustainable yields, in an indeterminate crop like cotton.

There are scores of genotypes to name (Table 2), for meeting the demands of the textile industry and also products of the objectives for which AICRP on Cotton was founded. In addition, numerous crop production and protection technologies that were developed through AICRP on Cotton have been well adopted by the cotton farmers

for sustainability as well as enhancing the productivity to realize an additional profit.

AICRP on Cotton could take pride in successfully conducting evaluation trials and recommended the Bt hybrids and varieties for commercial release since 2002. The significant change in the cotton production system in the country, since the introductions of Bt cotton hybrids by the private sectors, the AICRP on cotton researchers have rendered their services by way of developing improved crop production and protection technologies for Bt cotton hybrids cultivation.

The technologies developed under AICRP on Cotton are being demonstrated among cotton farmers across the country through Front Line Demonstrations (FLD) to realize enhanced productivity and profit from the crop. Major technologies transferred over the years include the popularization of new cotton varieties and hybrids, Integrated Plant Nutrient Management practices, IPM strategies, IDM practices, hybrid seed production, Intercropping, drip irrigation, seed treatment with biofertilizers, soil moisture conservation techniques, foliar nutrition and residue management including vermicomposting have found that 15 to 20% productivity enhancement over conventional farmers practices.

Constraints and solutions through research in the cotton growing states:

There is stagnation in cotton productivity in the country due to various constraints and some are can be mitigated through research and policy decisions (Table 3).

Tasks ahead:

The production of cotton has been on an average 360 lakh bales for the past one decade with a productivity around 500 Kg lint/ha. In order to meet the emerging needs of textile industry including high demand for extra-long staple cotton and other specialised cottons for textile purposes to cater to domestic and export market, the production

needs to be increased to 500-550 lakh bales by the end of 2025-26. There is a vital need to enhance the productivity to the tune of another 30% from the present level. In addition to yield improvement, the fiber quality needs to be improved to the requirements of user industry, country's domestic and international needs. The quality of the raw material viz., cotton fiber plays a vital role in the processability and the ultimate yarn quality. High fibre strength, high maturity, higher fibre elongation, low variability in fibre properties, low short fibre content coupled with negligible trash contents are the essential cotton fibre quality attributes that fit into the making of quality yarn and in turn value addition to cotton. In the emerging technological improvement in the textile industries, the high-speed roto bar and jet spinning require high strength cotton fibre to ensure continuous spinning for production of fine and super fine clothes. In the present environmental scenario, especially due to climate change, many new biotic and abiotic stresses are emerging (like whitefly, cotton leaf curl virus, mealy bugs, pink bollworm, Mirid bugs, moisture stress during fruiting stage, and scores of other micronutrient deficiencies) which need a closer watch on the crop improvement and management through a different perspective and in-depth manner in a coordinated fashion.

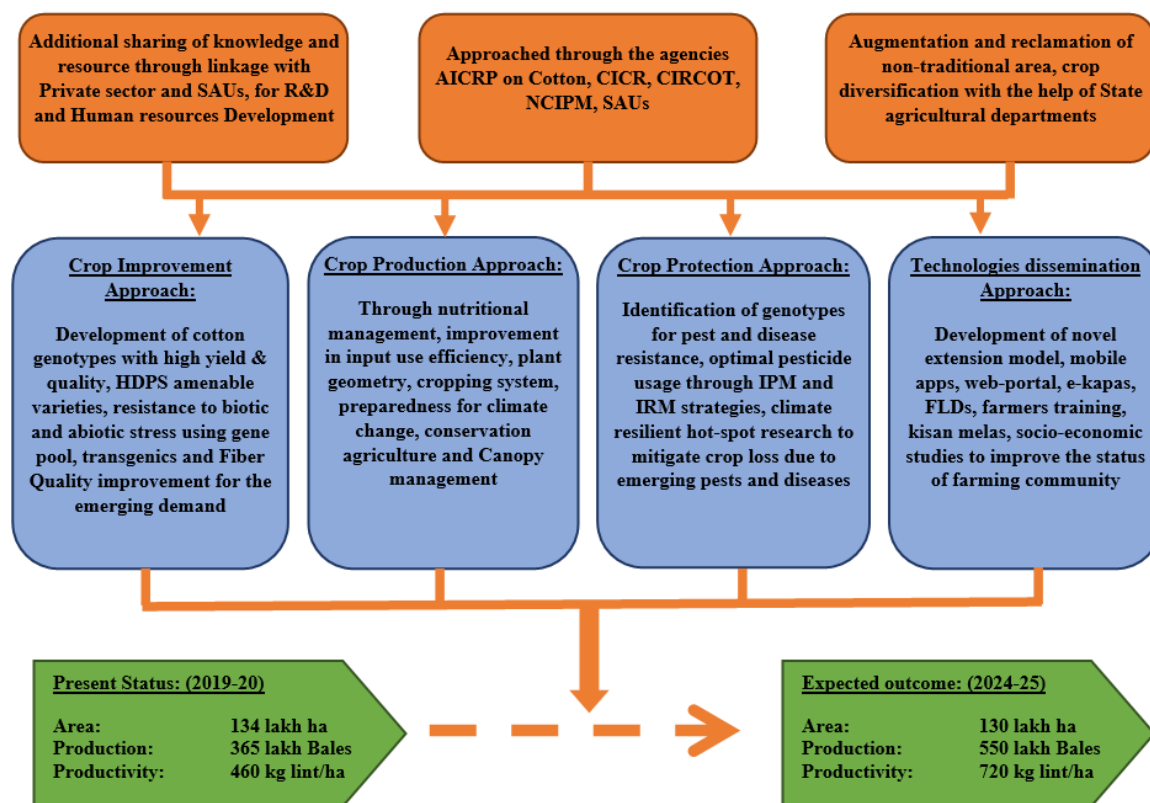


Fig. 4: Roadmap showing the strategical approach for cotton production

To meet this increasing demand, the country needs cotton research and development agenda suitably tuned with an eye on better natural resource management, resource augmentation, employment generation, self-sustainability, loss minimization, effective cost-benefit ratio for resource poor farmers, ecofriendly approaches, suitable mechanization in farm related operations, foreign exchange earnings. AICRP on Cotton shall also address emerging researchable issues, technology generation, speedy dissemination of adoptable technologies and midcourse corrections, wherever needed. The yield gap that exists between potentially higher yields and the yield realized in farmers' fields is even now high necessitating a very strong role for AICRP on Cotton in the coming decades. Scope for raising average

productivity around 700 to 750 kg lint/ha is very much possible with present cotton cultivable area. Towards this goal, the AICRP on Cotton shall prioritize the future research agenda (Fig. 4) in collaboration with other R&D agencies of both public and private, would bring radical changes in the cotton cultivation scenario in the country.