PROJECT COORDINATOR'S REPORT

India is the only country where all the four cultivated species of Cotton are even now grown on fairly commercial scale in a total coverage of ten million hectares. Cotton cultivation has to be knowledge-based and market-driven and needs to evolve continuously through innovations in frontier sciences to break yield barriers and quality barriers for satisfying not only present and future national needs but also attaining global competitiveness with larger spin-off benefits to India. Qualitative and quantitative transformation has taken place in cotton production scenario in India. Area-wise, India ranks first in global scenario (about 33 % of the world cotton area) but with regard to production, it is ranked second, next to China. The production increased from a meagre 2.79 million bales (170 kg lint/bale) in 1947- 48 to a high of 17.6 million bales in 1996-97 and an all time record of 31.5 million bales during 2007-08 (AICCIP, 2008). During current year also, around 30 million bales is projected, thereby indicating sustainability of the production system and also pointing to the need for generation of further input responsive genotypes, newer technologies and innovative approaches to scale newer heights. In this context, it is pertinent to mention that an urgent need has arisen to enhance the productivity from present levels to moderately higher levels (i.e.) from the existing range of 500 - 700 kg/ha to 1000 kg / ha under irrigated conditions and from the present range of 300 - 350 kg / ha to 500-600 kg lint per hectare under rainfed conditions. There have been several instances of higher productivity in research fields, demonstrations and progressive farmers' fields through appropriate crop management interventions that can suitably be adopted on wider scale for realizing higher productivity and in turn laudable production.

In India, Cotton is grown under diverse agro-climatic conditions. Cotton is the most important commercial crop contributing nearly 65% of total raw material needs of textile industry in our country. India has achieved significant breakthrough in cotton yarn exports besides increasing its global market share in cotton textiles and apparels. About 60 million people of our country are involved directly or indirectly in cotton production, processing, textiles and related activities.

In a historical perspective, it is worth mentioning that the abolition of ICCC in 1966 led to the establishment of ALL INDIA COORDINATED COTTON IMPROVEMENT PROJECT (AICCIP) in 1967 with its Headquarters at Coimbatore (Tamil Nadu) with timely funding from **Indian Council of Agricultural Research (ICAR).** Concerted efforts by various AICCIP centres for cotton improvement and strides that the country made in cotton production in recent years are well-recorded in the history. **The AICCIP of ICAR knitted together 21 participating centres in 16 State Agricultural Universities involved in Cotton research**. The Central Institute for Cotton Research, Nagpur and its Regional Stations at Coimbatore and Sirsa continue to provide excellent basic research support and also take part in select research activities of the AICRP on Cotton. The Central Institute for Research on Cotton Technology (CIRCOT, ICAR), Mumbai and its Regional units located at Sirsa, Surat, Nagpur, Dharwad, Guntur and Coimbatore are closely associated with AICCIP in rigorously assessing the fibre quality parameters of cotton lint besides ensuring value addition to cotton. The stellar role played by CIRCOT through development of fibre quality standards and systematic evaluation of Cotton fibre quality samples from AICCIP trials has ensured a better place among quality conscious sector for Cotton in India. The present modern cultivars and cotton production and protection technologies developed through conscious efforts of the scientific personnel under All India Coordinated Cotton Improvement Project (AICCIP of ICAR) and visualized production and protection technologies through multidisciplinary and multi location research under AICCIP need to be given further impetus for effective follow up to meet the ever increasing challenges. The phenomenal achievements made through deployment of large number of Private Sector Bt cotton hybrids in the cotton production

scenario have brought in welcome change as regards production gains are concerned. Here again, the AICCIP personnel have rendered their services by way of unbiased evaluation through multilocation trials. *All these combined efforts have ensured the AICCIP earn a deserving place in the Cotton R & D sector in the Country by way of the Coveted Chaudhary Devi Lal Outstanding AICRP Award being conferred on AICCIP on 16th July,2007 by the Hon'ble Union Minister of Agriculture in the august presence of Hon'ble Minister of State for Agriculture and Hon'ble Director General of ICAR.*

The role of AICCIP in ensuring sustainability of cotton production, employment generation, foreign exchange earnings and improving general cotton scenario and agricultural economy of the country assumes greater significance; and hence, the programmes being carried out and proposed under AICCIP need to be continued with more fervour and vigour by all concerned in the years to come. Here again, the visionary role needs to be played by AICCIP personnel to realize the achievable goals well in time.

World and Indian Cotton Scenario

World Cotton production is projected at 24.1 million tonnes in 2009-10 (ICAC, 2010). However, India registered a noticeable increase in area with 10.2 million hectares and production of around 5.33 million tonnes. As regards Indian situation, the average yield per hectare (productivity) has been noticed to be a cause of concern calling for serious attention by AICCIP Scientists and other stakeholders towards improvement in performance of cotton genotypes in stress situations and management of crop performance in the challenged situations of deficit rainfall, leaf curl virus disease, mealy bug menace, other sap sucking pest incidence, leaf reddening problem and timely availability of canal irrigation water etc., all these problematic issues have resulted in a noticeable decline in total productivity.

However, the Indian cotton scenario looks brighter as compared to many other countries in the world. While the year 2007-08 was a record year of sorts for Indian cotton scenario with the highest production of 315 lakh bales and exports touching a high of 85 lakh bales, the current year scenario with production estimate of 290 - 300 lakh bales and 500 kg/ha calls for integrated efforts in sustaining and consolidating all avenues for continued higher output. The Cotton Advisory Board has estimated cotton exports during 2009-10 at 55 lakh bales.

Cotton Balance Sheet (October-September) (in Lakh bales of 170 kg per bale)

	2006-07	**2007-08**	**2008-09**	**2009-10***
Supply				
Opening Stock	52.0	47.50	35.50	71.50
Cotton Crop Production	280	315.0	290.0	295.00
Imports	5.53	6.50	10.00	7.00
Total Supply	**337.53**	369.0	335.50	373.50
Demand				
Mill Consumption	194.89	203.0	190.00	207.00
Consumption by SSI units	21.26	23.0	20.00	23.00
Non-mill consumption	15.88	15.0	19.00	20.00
Exports	58.0	85.0	35.00	55.00
Total Off-take	**290.03**	**326.0**	**264.00**	**305.00**
Closing Stock	47.50	43.0	71.50	68.50

* Estimated

(Source: Cotton Advisory Board & South India Cotton Association)

State-wise Cotton Scenario

The trend in area, production and productivity of cotton is presented in following Tables. Notable progress is seen in case of Gujarat, Rajasthan and Maharashtra. However, much progress is desired as regards per hectare productivity is concerned necessitating further R & D efforts from the point of view of enhanced yielding ability and harnessing the full genetic potential further for improved gains in the coming years.

State wise cotton area (lakh ha) from 1999-00 to 2009-10

State	99-00	00-01	01-02	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10*
Punjab	4.75	4.74	6.00	4.49	4.52	5.09	5.57	6.07	6.41	5.37	5.36
Haryana	5.46	5.55	6.10	5.19	5.26	6.21	5.83	5.30	4.83	4.55	5.20
Rajasthan	5.83	5.10	3.47	3.86	3.44	4.38	4.54	3.50	3.68	2.23	4.44
Gujarat	15.39	16.15	16.90	16.34	16.50	19.06	20.77	23.90	25.16	24.17	26.24
Maharashtra	32.54	30.77	29.80	28.00	27.70	28.40	28.89	30.70	31.91	31.33	35.03
Madhya Pradesh	5.25	5.06	6.23	5.45	5.91	5.76	6.35	6.39	6.62	6.55	6.46
Andhra Pradesh	10.39	10.22	10.00	8.03	8.37	11.78	9.72	9.72	10.96	13.45	13.19
Karnataka	5.40	5.60	5.91	3.93	3.13	5.21	3.81	3.75	3.88	3.90	3.95
Tamil Nadu	1.85	1.93	2.00	0.85	1.03	1.29	1.52	1.22	1.30	1.20	0.87
Others	0.45	0.64	0.90	0.53	0.51	0.68	0.80	0.87	0.80	0.98	0.78
Total	87.30	85.80	87.00	76.70	76.00	87.90	88.20	91.40	95.55	93.73	101.52

State wise cotton production (lakh bales) from 1999-00 to 2009-10

State	99-00	00-01	01-02	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10*
Punjab	7.85	9.50	9.25	7.50	10.35	16.50	21.00	26.00	22.00	17.50	16.00
Haryana	10.70	10.00	5.50	8.75	11.50	15.50	14.00	16.00	16.00	14.00	13.00
Rajasthan	13.00	10.80	7.00	5.00	9.15	11.00	11.00	8.00	9.00	7.50	10.00
Gujarat	27.50	23.80	32.50	30.50	50.00	73.00	89.00	101.00	112.00	90.00	95.00
Maharashtra	38.00	18.30	34.30	26.00	31.00	52.00	36.00	52.00	62.00	62.00	67.00
Madhya Pradesh	15.50	19.30	20.00	18.00	19.65	16.00	18.00	18.00	21.00	18.00	18.00
Andhra Pradesh	22.50	25.30	26.80	19.80	27.40	32.50	30.00	35.00	46.00	53.00	48.00
Karnataka	7.00	7.75	7.00	5.00	4.20	8.00	6.50	6.00	8.00	9.00	9.00
Tamil Nadu	5.50	5.50	5.00	3.00	3.75	5.50	5.50	5.00	5.00	5.00	5.00
Others	1.50	1.00	0.75	1.00	1.00	1.00	1.00	1.00	2.00	2.00	2.00
Loose Supply	7.00	9.00	10.00	11.50	11.00	12.00	12.00	12.00	12.00	12.00	12.00
Total	156.00	140.00	158.00	136.00	179.00	243.00	244.00	280.00	315.00	290.00	295.00

State wise cotton productivity (kg/ha) from 1999-00 to 2009-10

State	99-00	00-01	01-02	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10*
Punjab	281	341	262	284	381	551	610	728	583	554	507
Haryana	332	306	153	287	356	424	373	513	563	523	425
Rajasthan	379	358	343	220	379	427	397	389	416	572	383
Gujarat	304	250	328	317	475	651	794	718	757	633	615
Maharashtra	199	101	195	158	191	311	213	288	330	336	325
Madhya Pradesh	502	647	546	561	468	472	494	479	539	467	474
Andhra Pradesh	368	420	454	418	565	469	527	612	714	670	619
Karnataka	220	235	201	216	204	261	268	272	351	392	387
Tamil Nadu	505	484	425	600	613	725	668	697	654	708	977
All India	304	278	308	302	404	470	478	521	560	526	494

*Estimate, Source: Cotton Advisory Board (CAB)

Growth of Cotton Production: It is very heartening to note that India has registered highest growth as regards cotton production is concerned with a share of 22 % in the global production of cotton, more than double its share of 9.6% in 1980-81. However, it is again stressed that significant progress is needed as regards productivity is concerned.

Growth in Average yield of Cotton (kg lint per hectare)

Year	China	USA	India	World
1980-81	550	453	169	411
1990-91	807	711	267	574
2000-01	1093	1008	278	612
2006-07	1286	912	521	770
2007-08	1278	985	560	797
2008-09	1270	911	526	767
2009-10	1260	868	502	725

Similarly, the productivity of cotton in India has also rallied to a higher level despite the major cotton growing areas remaining still under rainfed conditions with monsoon playing truant many times, at least in areas that matter most. Even though, it is very noteworthy to mention that Indian average lint yield has jumped to touch 500-555 kg/ha (70 % of world average), the need for overcoming the gap between potential yields and realizable yields still exists and efforts have to be made by all concerned for recording overall growth. Here again, it is imperative that the AICCIP Scientists need to synergize their efforts in enhancing the cotton productivity and in turn production, even under any eventuality through identification of innovative technologies and translate them in reality.

Cotton productivity in various countries during the last decade

YIELD									
Kilograms of Lint per Hectare									
Country	**01-02**	**02-03**	**03-04**	**04-05**	**05-06**	**06-07**	**07-08**	**08-09**	**09-10**
USA	790	746	818	958	931	912	985	911	868
ARGENTINA	394	445	451	389	429	437	493	404	465
BRAZIL	1025	1153	1190	1101	1212	1389	1487	1446	1460
EGYPT	1031	976	885	971	736	909	901	888	905
BURKINA FASO	440	419	443	466	464	382	411	408	400
MALI	451	405	474	425	406	366	356	429	400
ZIMBABWE	221	315	395	253	331	260	299	267	269
TURKMENISTAN	357	302	364	369	358	433	436	441	415
UZBEKISTAN	727	719	641	800	845	818	831	769	780
GREECE	1028	1049	917	1040	1185	1067	950	960	975
CHINA	1108	1186	973	1132	1161	1286	1278	1270	1260
AUSTRALIA	1842	1751	1768	2096	1785	2077	2000	1932	1942
INDIA	**308**	**302**	**389**	**470**	**472**	**521**	**567**	**526**	**502**
PAKISTAN	580	621	571	751	708	698	620	688	670
MYANMAR	206	206	206	206	206	208	208	208	209
SYRIA	1246	1248	1255	1289	1333	1190	1250	1233	1245
TURKEY	1330	1248	1255	1289	1333	1190	1250	1233	1245
WORLD	**647**	**652**	**651**	**754**	**747**	**770**	**797**	**767**	**725**

Source : Cotton World Statistics, ICAC, September, 2009

General Crop condition, Climate, Pest and Disease Situation

- The general weather and crop condition during the cotton growing period in all the three zones were by and large conducive for cotton crop growth and development, with monsoon playing truant in Central India and parts of South India. Identification and Development of abiotic stress tolerant genotypes, especially moisture stress tolerant cotton varieties/hybrids needs to be given further emphasis by AICCIP breeders, physiologists and biochemists.
- Significant cotton production, especially driven by higher yields due to cultivation of Bt cotton hybrids on a larger scale, adoption of effective integrated nutrient and weed management practices, integrated pest and disease management strategies, moderately favourable weather besides lesser insect pest load, especially bollworms, cumulatively led to notable yields, almost a repeat performance like last year.
- As seen during previous years, there are certain issues that need to be attended to like minor pests like mealy bugs becoming major threat in intense cotton growing tracts in Central and South zone, mirid bugs in certain locations, problem of pink bollworm in many areas, thrips and diseases like CLCuV in North Zone and grey mildew in Central and South Zone.
- A National Level alert by Central Institute for Cotton Research, Nagpur, AICCIP and various level intense proactive steps by National Centre for Integrated Pest Management (NCIPM), New Delhi could effectively address the menace of mealy bugs in cotton in North zone and several cultural, mechanical, biological and need-based chemical control measures have been worked out and propagated.
- As stressed during last year, the issue of use of banned chemical pesticides, untested dosages and cocktails of insecticides in the control of mealy bugs and sap sucking pests calls for

concerted efforts from the plant protection group for everlasting solution (Source: NCIPM Newsletter, July-December,2009). The issue needs to be addressed by Scientists of AICRP on Cotton within a specified timeframe and zeal so that the gains made so far in the production front are not challenged in the coming years.

- Parawilt has been noticed in Bt cotton hybrids again in certain areas. Practice of illegal/spurious Bt cotton hybrid seeds including F_2 seeds for planting still poses serious problems in respect of yield realization, susceptibility to pests/diseases besides adverse impact on fibre quality. The issue is being addressed adequately and effectively by **Central Institute for Cotton Research, Nagpur through Bt referral laboratory** besides the rigorous testing of relevant Bt events in the transgenic cotton hybrids identified by Event Based Approval Mechanism.
- This year has also witnessed problem of leaf reddening calling for urgent attention of cotton production specialists for alleviating the stress and ensuring productivity levels at a higher plane even in adverse situations, especially in Central zone areas.

Special emphasis for control of Mealybugs

- Three species of mealybug are found on cotton in our country. The *Solenopsis* mealybug, *Phenacoccus solenopsis* (Tinsley), and the pink hibiscus mealybug, *Maconellicoccus hirsutus* (Green), were found to infest cotton plants from all nine cotton growing states of the country. The main species of the mealy bug reported from all the nine cotton growing States is Phenacoccus solenopsis, comprising 95% of the samples examined from 47 locations representing 9 cotton growing states of India. Papaya mealy bug *Paracoccus marginatus* Williams and Ganara de willink also infests cotton and was found to be sporadic cum potential pest in South Zone (Coimbatore).
- This species with the multiple advantages of parthenogenesis and ovisacs for population explosion, ability to withstand extremes of temperatures from 0°C to 45°C during the crop free periods and availability of the equally attractive alternate hosts almost round the year, is all set to be even more dreaded than the earlier major pest *Helicoverpa armigera*.
- All over the country, several parasitoids (predominantly *Aenasius* sp.) and coccinellid beetle predators are now found to keep mealybug populations under control, thereby preventing spread and damage. Recent collection new hymenopterous parasitoids, *Aenasius* sp. (Chalcidodea: Aphelinidae) from Delhi and Coimbatore with 82 per cent parasitisation and *Promuscidea unfasciati* Girault (Chalcidodea: Encyrtidae) from Parbhani (Maharashtra) on *P. solenopsis* with 30–80 per cent parasitization in nature has added new hopes for management of this pest with biological control.
- An efficient lepidopteran predator *Spalgis epius* (Lycaenidae) was also recorded on *Paracoccus marginatus* from Coimbatore. The caterpillar can feed voraciously on young nymphs of the mealybug. Each full grown caterpillar is capable of eating as many as 300 nymphs per day.

Chemical control can be resorted when only severe infestations (>25% incidence) with severity (>grade 2,) where reproducing females and crawlers are found at least on any one branch of plant with chemical application in the entire field/area. Chemicals such as profenophos 50 EC or chlorpyriphos 20 EC or buprofezin 25FS or dimethoate 30 EC @ 2 ml/lit of water, or imidacloprid 17.8 SL @ 0.6 ml or thiomehodxam 25 WG 0.6 g/lit of water are suitable. Proper dosage and coverage of plants and fields should be ensured to prevent the subsequent flare up. (Inadequate spray coverage and lower dosages of pesticides lead to further spread of incidence). Second insecticidal spray a week after the first spray may be done, if necessary following careful

monitoring. Good agricultural practices such as field sanitation, regular weeding, frequent monitoring through field visits, removal and destruction of plant parts and use of clean farm implements should be the basic strategies for tackling the spread of this mealybug before applying insecticides after outbreaks (***Source Courtesy: Director, NCIPM, New Delhi***)

Study on emerging cotton pest : Mirid bug

- Mirid bugs are now attaining status of important sucking pests on cotton. Taxonomic identity of the three mirids (Miridae; Hemiptera) *viz*., *Campylomma livida* Reuter, *Creontiades biseratense* Dist and *Hyalopeplus lineifer* Walker occurring on cotton was established. While the *C. livida* and *C. biseratense* are specific to central and south cotton production systems, respectively, *H. lineifer* is common to both regions.
- Adults and nymphs can attack the plant throughout its growth, causing reduced yield. Mirids can be controlled in conventional broad spectrum sprays. But these products disrupt beneficial organisms. Their use should be limited in order to conserve beneficials. Concerted research, both basic and applied, are needed to gather in-depth information to suppress this new insect in better way.

Organic Cotton

Organic Cotton contributes 0.55% of global cotton production as per latest estimates. Textiles made from organically grown cotton fibre have also achieved significant penetration in some markets, such as the UK, Germany, Switzerland, Japan, and the United States. Organic Cotton Production in the 2007/08 season was estimated at 1,45,872 metric tonnes of fibre. The IFOAM basic standards state that "Organic agriculture (also known as "Biological" or "Ecological" agriculture or protected equivalent forms of these words (in other languages) is a whole system approach based upon a set of processes resulting in a sustainable ecosystem, safe food, good nutrition, animal welfare and social justice. Organic production therefore is more than a system of production that includes or excludes certain inputs' (IFOAM, 2008; Simon Ferrigno *et al*., 2009).

Improving the technological package available in organic cotton by managing costs and improving knowledge on agronomic approaches, while offering adapted seeds will make the system more attractive. Development of technologies requires a system that supports research and extension services to develop new approaches to managing organic cotton production, to develop seed varieties and seed banks, and to improve the overall sectoral sustainability. (Source Courtesy: ICAC Recorder, 2009)

Biotech cotton is not eligible for certification as organic. The rapid adoption of insect resistant biotech cotton cultivars into many cotton growing agro-climatic zones reduces the benefit of organic cotton and limits the spread of organic cotton cultivation to new areas. Promotion of Organic cotton in the desi cotton *(G.arboreum and G.herbaceum*) belt in India (Gujarat and Karnataka) will augur well in the presently grown area of about 0.5 million hectares under desi cotton cultivation in India. In addition conventional varieties like LRA 5166, Surabhi, MCU 5 besides newer version Suraj can also be thought of in select areas in Tamil Nadu, Karnataka, Orissa, West Bengal and Tripura for production of organic cotton to meet niche market demand with matching premium price. Desi types like HD 123 can be thought of for Haryana. Initially, organized organic cotton cultivation may be promoted in these areas where the input use in cotton is less and is traditionally non-chemical. **(Source Courtesy: Dr. K. R. Kranthi, Director, CICR, Nagpur)**

Gadgets for pest scouting

Simple gadgets can be designed to scout insect pests, without having to count any insects. Some plants have seen found to help cotton fight pests. Insects make ultrasonic sounds or release pheromones or cause plants to emit ethylene that can be detected by simple gadgets for farmers to precisely detect insect infestations, even from home.

Insect injury causes signal transduction. The signal transduction pathways leading to the release of plant volatiles have been found to alert other plants in the neighborhood. The scent of jasmine reduces populations of jassids, aphids, and the *H. armigera*, and enhanced populations of predators and parasitoids in cotton fields. AICCIP crop protection personnel need to interact and incorporate in their programme in collaboration with CICR for wider adaptability and newer approaches.

Impact of Climate change on cotton production

Cotton crop productivity is sensitive to climate-induced effects like temperature, rainfall, radiation, CO_2 concentration, and changes in soil, pests and diseases. Work carried out at the Central Institute for Cotton Research (CICR), indicates that select conventional cotton varieties/hybrids are well adapted to elevated CO_2 levels due to better morpho-physiological and biochemical attributes. Elevated levels of CO_2 significantly increase plant height, node number, sympodia number, leaf number, leaf area, dry matter production, reduced shedding of bud and bolls an delayed senescence of leaves. Productivity of cotton in terms of total number of bolls and weight increased significantly with an increase of 70 %. Fibre quality improved significantly under elevated CO_2 atmosphere. Although it appears that cotton crop will do better in the changed atmospheric scenario during the later part of the 21 st century, studies indicate that the pest problem will be aggravated further leading to an increased use of pesticides. AICCIP personnel need to pay attention to these impending issues in future.

Mechanization of Cotton Production

Cotton production is labour intensive in almost all developing countries. Cotton production demands labour all through, starting from sowing to harvesting which include several operations including inter-culturing and hand weeding. Cotton in several countries is cultivated in small scale production systems, which demand smaller machines that are affordable for small scale farmers. Several attempts are underway to develop machines for picking and other important operations in cotton cultivation in small scale production systems. Research needs to be done to ensure that new machines are developed such that crop production operations are not stalled in rainy days, which is normally the case with labor-intensive operations. Collaborative efforts are needed at this critical juncture for fruitful mechanized harvesting so that all stakeholders stand to gain.

High yields with narrow spacing and nutrient management

Ultra narrow row spacing is highly popular in China. Uzbekistan and several other countries where plant populations of 100,000 to 200,000 per hectare gave yields of 7,000-8,000 kilogram of seed cotton per hectare. The same approach should help other countries to identify and develop varieties through ‘ideotype breeding’ of compact genotypes suited for ultra narrow spacing, with specific fibre traits for specific locations. Additionally, the compact genotypes with specific fibre traits can be converted to insect resistant biotech cotton. Such location specific,

high yielding varieties will ensure sustainable production in major cotton growing countries of Asia and Africa in the future. (**Kranthi, 2009**). Suitable adaptive trials can be given a thought for experimentation and field validation.

Improved ELS Cotton production packages: Existing ELS Cotton variety and interspecific hybrids including transgenic ELS cotton hybrids have been extensively studied at many AICCIP centres and CICR Regional Station at Coimbatore for effective agronomic and crop management practices. The integrated nutrient, water and weed management strategies have all been worked out and the packages have also been demonstrated in Farmers' fields through Front Line Demonstration in Cotton, wherein improved yields have been conclusively demonstrated with higher net benefits. Large scale demonstrations had also been initiated during 2008-09 season and followed up in 2009-10 season through NAIP scheme of CIRCOT, Mumbai at CICR, Nagpur for long staple and at CICR Regional Station, Coimbatore for extra Long staple cotton. Cotton Value Chain demonstrations brought out the usefulness of cotton value chain, byproduct utilization, value addition etc in respect of ELS Cotton besides long staple cotton. All these measures are expected to act as a stimulant for further expansion in ELS cotton area and productivity in south zone leading to overall improvement in ELS cotton production to meet national needs in coming years and save foreign exchange. Appropriate thrust needs to be given by AICCIP centres like Coimbatore, Guntur, Dharwad, Surat and Rahuri.

Progress of Implementation of PPV legislation 2001

As a nodal centre of cotton for Implementation of PVP legislation 2001, several important activities were undertaken. Proposals for the registration of extant cotton varieties were prepared for which breeders from north zone, central zone and south zone centers were requested to provide suitable information to PC's Cell, AICCIP, Coimbatore for taking up follow up action. Around 85 application forms comprising of new and extant varieties of Cotton were submitted by Project Coordinator (Cotton) to PPV&FRA, New Delhi routing through NBPGR, New Delhi by availing its expertise. Another important mandatory requirement of Implementation of PVP legislation is the conduct of DUS trials of new cotton varieties. Field trials with *G. hirsutum, G.barbadense and G. arboreum* candidate varieties along with reference varieties were conducted during 2009 season simultaneously at CICR, Nagpur and its Regional Station, Coimbatore and the National Seed Project centre of UAS, Dharwad, PAU, Ludhiana and CCSHAU, Hisar. A monitoring team under the Chairmanship of Dr.A. K. Basu (Ex-Director, CICR) was constituted and the committee visited the trials during November, 2009 at CICR, Nagpur, Coimbatore and UAS Dharwad. Dr. S. Nagarajan, Chairperson of PPV&FRA also visited the DUS trial plots. Maintenance breeding and seed multiplication of several extant reference varieties were undertaken during 2009-10 and the seeds of these varieties are available for distribution to other centers as a reference variety for conducting DUS trials in future.

Front Line Demonstration in Cotton

It is more often seen that the results of cotton research do not reach the farmers in time. Often, it is observed that the extension efforts are handicapped due to inadequate interaction with the research efforts and non-availability of latest technological information for ready transfer. It is essential that the developments that benefit the producer and consumer is translated into action, quick enough to meet the growing challenges of the future. It is also vital to understand the socio-economic implications of new technologies and understand the constraints limiting the transfer of technology. The Indian Council of Agricultural Research (ICAR) has always

underlined the importance of Scientist-Farmer linkage for the effective transfer of latest agricultural technologies. Towards this goal, an extension programme called "Front Line Demonstration (FLD)" has been launched and is being implemented with the active cooperation of the ICAR Institutes, State Agricultural Universities and Extension personnel of the State Department of Agriculture. In cotton, this novel programme is being implemented from 1996-97 onwards to demonstrate newer varieties/hybrids, cotton production and protection technologies through All India Coordinated Cotton Improvement Project (AICCIP) net working centres. This programme ensured not only the quick dispersal of technologies by linking the cotton scientists, extension personnel and the farmers but also helped scientists to get a feed back on the response of farmers to the latest technologies. The objectives of the FLDs are

- ✯ To demonstrate the usefulness of the latest improved crop production and protection technologies to the farmers as well as extension workers with a view to reduce the time gap between technology generation and its adoption.
- ✯ To enable Scientists obtain direct feedback from cotton farmers and suitably reorient their research programmes and develop appropriate technology packages.
- ✯ To create effective linkage among Scientists, Extension Personnel and Farmers.

Implementation of FLDs

The main emphasis was given to the demonstrations for enhancing the production of cotton in low productivity areas / problematic areas, where total improved package was demonstrated. A list of beneficiaries and their plot numbers were notified in the local Block Development / Panchayat Office. Farmers were selected in consultation with local Agricultural Officers and Panchayat Samiti. These officials formed part of the FLD team. Bench mark survey was conducted before taking up the trial which included information on the crops and cropping system of the area, inter cropping, the average yields of cotton and the local practices adopted in terms of irrigation, use of fertilizer, plant protection, etc., Information on the cost of cultivation was also collected for the area as a whole. An impact analysis after the harvest was carried out in the light of reduction in insecticide use, reduction in cost of cultivation, awareness of modern technology etc., Further in accordance with the decision of Government of India (GOI) regarding implementation of Special Component Plan (SCP) for Scheduled Caste and Tribal Sub Plan (TSP) for Scheduled Tribes and Gender Budgeting, the beneficiaries were selected for the Front line demonstration programme.

FLDs on Cotton Production Technology

Under FLDs on Cotton Production Technology, each demonstration was conducted in one acre plot. High yielding varieties and hybrids suited for various agro-climatic conditions, approved transgenic cotton hybrids, Integrated Nutrient Management (INM), Integrated Pest Management (IPM), use of bio-fertilizers, bio-pesticides, water management, application of growth regulators, intercropping system, etc., were the production technologies demonstrated through this component. An amount of Rs.2000/ was allocated per demonstration. Out of this, Rs.1400/- was used for essential inputs for demonstration and the rest was utilized for POL, hiring of vehicles, Travel allowance, Kisan Melas, printed materials, reports, demonstration boards etc.,

FLDs on IPM in Cotton

In order to popularize the location specific IPM modules, this component was implemented. The location specific IPM modules were executed in 10 hectare blocks to 50 hectare blocks.

FLDs on Farm Implements

To popularize the use of machineries in cotton cultivation and avoid drudgery, this component was carried out. The area under demonstration was ensured that it should not be less than 25 hectare. Per unit of implement demonstration, an amount of one lakh rupees was earmarked. The various farm implements recommended by the Central Institute of Agricultural Engineering (CIAE), Bhopal for demonstrating under this component are

1. Manually Operated Equipments : Naveen dibbler, peg type dry land weeder, single wheel hoe, manually operated knapsack sprayer, cotton seed sorter, ultra low volume sprayer, cotton seed delinter and cotton seed treating drum.
2. Animal Drawn Equipments : Animal drawn patella harrow, animal drawn cultivator, animal drawn cotton planter(CICR), Jyoti planter, TNAU sweep, Brahma animal drawn sprayer.
3. Power tiller operated equipments: Power tiller operated weeder and Power tiller operated boom sprayer
4. Engine operated equipments: Self propelled high clearance sprayer, motorise knapsack sprayer (Mist Blower), cotton stalk shredder and Lilliput gin
5. Tractor drawn equipments: tractor drawn mould board plough, rotavator, pneumatic cotton planter, cultivator, aero blast sprayer, electrostatic sprayers, boom sprayers, cotton stalk puller, up rooter and roto slasher.

Front Line Demonstration conducted by the AICCIP centres

During the year 2009-10, around 1600 Front Line Demonstrations (FLDs) on cotton production technology, 19 unit demonstrations on cotton Integrated Pest Management (IPM) and 19 unit demonstrations on Farm Implements were conducted all over India with a budget outlay of Rupees Sixty Lakhs. The details of the technologies demonstrated by the centres during the year 2009-10 are given below.

Details on the technologies demonstrated by the centres during the year 2009-10

North Zone

PAU, Faridkot	:	• Improved varieties RCH 134 Bt, RCH 314 Bt, RCH 308 Bt, MRC 7017 Bt, MRC Bt 6304 Bt, NCS 950, Ankur 2226, JASSI, RCH 134 BG II, JK 1947, Bioseed 6488 BG II, Yuvraj, Time of Sowing, optimum plant population, weed control and balanced nutrition. • Use of pheromone traps, trap crops, growing of bird perches, bio insecticides and integrated use of all with selected chemicals. • Hybrid cotton planter, Sealer, Planker, Cultivator, Disc harrow, Aero blast sprayer and Rotavator.
HAU, Hisar	:	• Yield maximization of Desi cotton hybrid AAH -1, Desi cotton variety HD-123 and American cotton variety H-1117 , H-1226 and Bt cotton hybrids Om 333Bt, MRC 6304 Bt, MRC 6025 Bt, RCH 134 Bt, Bio 6488 Bt, NCS 913 Bt, MRC 6301 Bt, TUlsi 4 Bt, Smarat Bt, Amar 009 Bt and Nam. Cotton 33 Bt. • Deep ploughing, Seed treatment, regular monitoring of pest, spraying at ETL level, spraying proper dose of pesticide and water. • Sub-soiler for deep ploughing and rotavator for hoeing.
RAU, Sriganganagar	:	• RCH 134 Bt, MRC 6025 Bt, MRC 6304 Bt, NCEH 6, RG 8 and JKCH 1947 Bt • RAU IPM Module • Aero blast sprayer
MPUAT, Banswara	:	• H-8 , PA 255and DCH 32 with ICM practices • Deep summer ploughing, seed treatment, Okra as trap crop, hand picking of early shoot borer damage, use of pheromone traps and use of neem products. • Rotary tiller, self propelled power weeder, ridger plough, power sprayer, local improved weeder, cotton up rooter, wheel hoe and tractor mounted high capacity sprayer.
CICR, Sirsa	:	• CICR 2, CISAA 2, CISA 310, CSHH 198 and hybrid seed production of CICR 2 and CSHH 198 • Deep ploughing after harvest of the wheat, FYM or decomposed compost application, recommended fertilizers application, resistant/Bt hybrid/variety against insect- pest & diseases, use of pheromone traps, application of pest management interventions based on pest surveillance and ETL and use of plant products & bio-agents depending on availability. • Aero blast sprayer, Knap sack sprayer and Rotavator

Central Zone

NAU, Surat	:	• Varietal demonstrations on G.Cot Hy.10, G.Cot Hy 12, G.Cot 21, G. Cot 23 , Bt cotton Hybrids, Agronomic practices viz., spacing, alternate furrow irrigation, spraying 2% KNO3, intercropping and advance sowing. • Integrated Pest Management techniques
JAU, Junagadh	:	• Jai Bt BG II, Tulsi 4 BG II, RCH 2 Bt BG II, Rambo Bt BG II, Mahyco – Nina, Gnaga Kaveri BG II, Rambo Bt 2 BG II, Neno BG II, Sanny BG II, RCH 2 BG I, JK 666-1, Ajeet-177 BG I, Vikram 5, Pratik BG II, Bunny Bt, Sarju BG II, Vikram BG + Soybean, Mallika Bt BG II, Sigma 1501 BG II, Maharaja Bt, Ajeet 155-1 BG I, Ankur Jai BG II, Mallika BG I, Express Bt BG I, Bijdhan 2 and RCH 2 Bt, intercropping, Micronutrients application, irrigation management, fertilizers management and drip irrigation techniques. • Integrated Pest Management techniques
JNKVV, Khandwa	:	• Gabbar, Mallika, Nath fusion Bt, JK 99, Tulsi – 4, NCA 145, Bunny Bt, Ankur 9, Ankur 651 and RCH 2Bt . • Integrated Pest Management techniques
JNKVV, Indore	:	• RCH 530 BG II, RCH 377 Bt, RCH 118 Bt, RCH 2 Bt, GK 205 of Ganga Kaveri, DCH 32, JKHy 1, JK 35, VBCH 1009, 1010 and 1018.
PDKV, Akola	:	• AKH 8828, PKV rajat, AKA 8, AKA 7, AKDH 5, hybrid seed production of PKV Hy 5, PKV Hy-4, PKV Hy-2, soil management in shallow soil, *in-situ* soil moisture conservation, crop canopy management and opening of ridges and furrows in cotton. • Release of *Trichogramma* in non-Bt, installation of pheromone traps and bird perches, hand collection of big sized larvae in Non-Bt, de-topping in arboretum varieties, sowing of 20% refugia in Bt field and ETL based sprays of chemical insecticides against sucking pests and bollworms. • Roto slasher, self propelled pneumatic sprayer and inter row cultivator.
MAU, Nanded	:	• PA 255, PA 402, NH 545, PH 348, NH 615, BN Bt, NHH 44 Bt, soil moisture conservation techniques for rainfed cotton, application of vermicompost and FYM, optimum plant population, intercropping of green gram (1:1) in Bt cotton under rainfed cotton, intercropping of black gram (1:1) in Bt cotton under rainfed cotton, intercropping of soybean (1:1) in Bt cotton under rainfed cotton, intercropping of red gram (6:2) in Bt cotton under rainfed cotton, spraying of KNO3 under rainfed condition, spraying of micro nutrients and spraying of 2% urea and DAP. • Integrated Pest Management

MPKV, Rahuri	:	• Intercropping of green gram and pigeon pea in rainfed cotton, INM, IDM,I WM and performance of JLA 794, Y-1, Phule-492, NHH 44, Mallika Bt, Bunny Bt, RCH-2 and Brahma. • Two spraying of heiokil, neemark and endosulfan alternately, growing of maize and cowpeas at borders, growing cowpea, maize, sateria as trap crop after every eighth row of cotton and pheromone traps. • Tractor drawn sowing machine, Tractor drawn sara yantra, reversible plough and cultivator.
OUAT, Bhawanipatna	:	• ICM practices for improved cotton varieties and hybrids • Integrated Pest Management techniques • Taiwan sprayer and disc plough
CICR, Nagpur	:	• Integrated Nutrients Management, Cotton based intercropping, cotton + soyabean, performance of Bt hybrids NHH 44 Bt, NCS 145 Bt, RCH 2 Bt, Management of reddening, foliar application of DAP and MgSO4 and Weed management. • Integrated Pest Management • Battery operated sprayer
IGKV, Raipur	:	• ICM practices
BCKVV, Mohanpur	:	• Complete production technology variety LRA 5166, NPK-80:40:40, Seed rate – 7. kg/ha, Time of Sowing : June-July and Spacing – 75 cm x 35 cm.

South Zone

ANGRAU, Guntur	:	• Cultivation of BG II at closer spacing of 90 x 60 cm • Integrated Pest Management • Inter cultivator
UAS, Dharwad	:	• DDHC 11, RAHS 14, NHH 44 Bt, intercropping of Bt cotton with green gram, beans and onion, leaf reddening and square dropping management in Bt cotton, integrated crop management in Bt cotton, new RDF for Bt cotton, management of foliar diseases, INM in Bt cotton. • Integrated Pest Management • Power weeder and sprayers
TNAU, Coimbatore	:	• RCH 2 BG II, Bunny Bt, Mallika Bt, Tulis 9 BG II, Bunny Bt II, Super Bunny Bt II, Tulsi BG II, Tulsi Bt and PA 255. • Integrated Pest Management
CICR, Coimbatore	:	• Suraj, Bt cotton hybrids RCH 530 BG II, RCH 2Bt, RCH 20 Bt, ELS cotton hybrids RCH 708 Bt, DCH 32, , Intercropping with pulses, Pre-emergence application of weedicides, Use of Bio- fertilizers, Management of stem weevil, Management of Mealy bugs, Leaf reddening management, application of growth regulators, Foliar spray and soil test based fertilizer recommendation. • Integrated Pest Management • Junior hoe, ridger, chisel plough, roto slasher and power weeder.

Monitoring of AICCIP Trials: Monitoring of AICCIP trials and also the FLD trials besides plots of Cotton Breeder Seed production and maintenance of Nucleus Seeds by the AICCIP centres have been carried out by specially constituted team of AICCIP scientists. As in the earlier years, independent monitoring teams were constituted for monitoring of trials and suggestions made by them shall be discussed during the Annual Group Meeting for follow-up action.

State	Breeder	Agronomist	Entomologist	Pathologist
Punjab, Haryana & Rajasthan (Sriganga Nagar)	Dr. S. Manickam (CICR, RS, Coimbatore)	Dr. C. S. Praharaj (CICR, RS, Coimbatore)	Dr. P.Jeyakumar [NCIPM, New Delhi]	Dr. D. Monga (CICR, RS, Sirsa)
Gujarat and Banswara of Rajasthan	Dr. M. Gopinath [ANGRAU, LAM, Guntur]	Sh. V.K. Khargkharate [MAU, Nanded]	Dr. N.V.V.S.D. Prasad [ANGRAU, LAM, Guntur]	Sh. U. V. Ingole Dr.PDKV, Akola
Madhya Pradesh	Dr. Sangwan (CCSHAU, Hisar)	Dr. B.C. Patil (UAS, Dharwad)	Dr. K.K. Dahiya [HAU, Hisar]	Sh. S.N. Chattannavar [UAS, Dharwad]
Maharashtra	Dr. Pankaj Rathore (PAU, Faridkot)	Dr. Basavanneppa (UAS, Siruguppa)	Sh. S.S.Udikeri [UAS, Dharwad]	Dr. Jagdish Beniwal (CCSHAU, Hisar)
CICR, Nagpur & Bhavanipatna	Dr. M.S.Gill [PAU, Ludhiana]	Dr. P. L. Nehra (RAU, Sriganganagar)	Dr. Vichiter Singh [RAU, Sriganganagar]	Dr. P.S. Sekhon [PAU, Ludhiana]
Andhra Pradesh	Dr. D.P.Saini [MPUAT, Banswara]	Dr. V. Kumar [NAU, Surat]	Dr.S.M.A.Mandal [OUAT, Bhawanipatna]	Dr. P.V.Patil (NAU, Surat)
Karnataka	Dr. Ramalingam (TNAU, Srivilliputtur)	Dr. R.S.S. Tomar [JNKVV, Indore]	Dr. Murugesan (TNAU, Srivilliputtur)	Dr. P. P. Shastry (JNKVV, Khandwa)
Tamil Nadu	Dr. Deosarkar (MAU, Nanded)	Prof. J.G. Thokale [MPKV, Rahuri]	Sh. A. V. Kolhe (Dr.PDKV, Akola)	Dr. R.R. Perane [MPKV, Rahuri]

Issues and Tasks that lie Ahead – Visionary role with Missionary zeal for AICCIP stressed

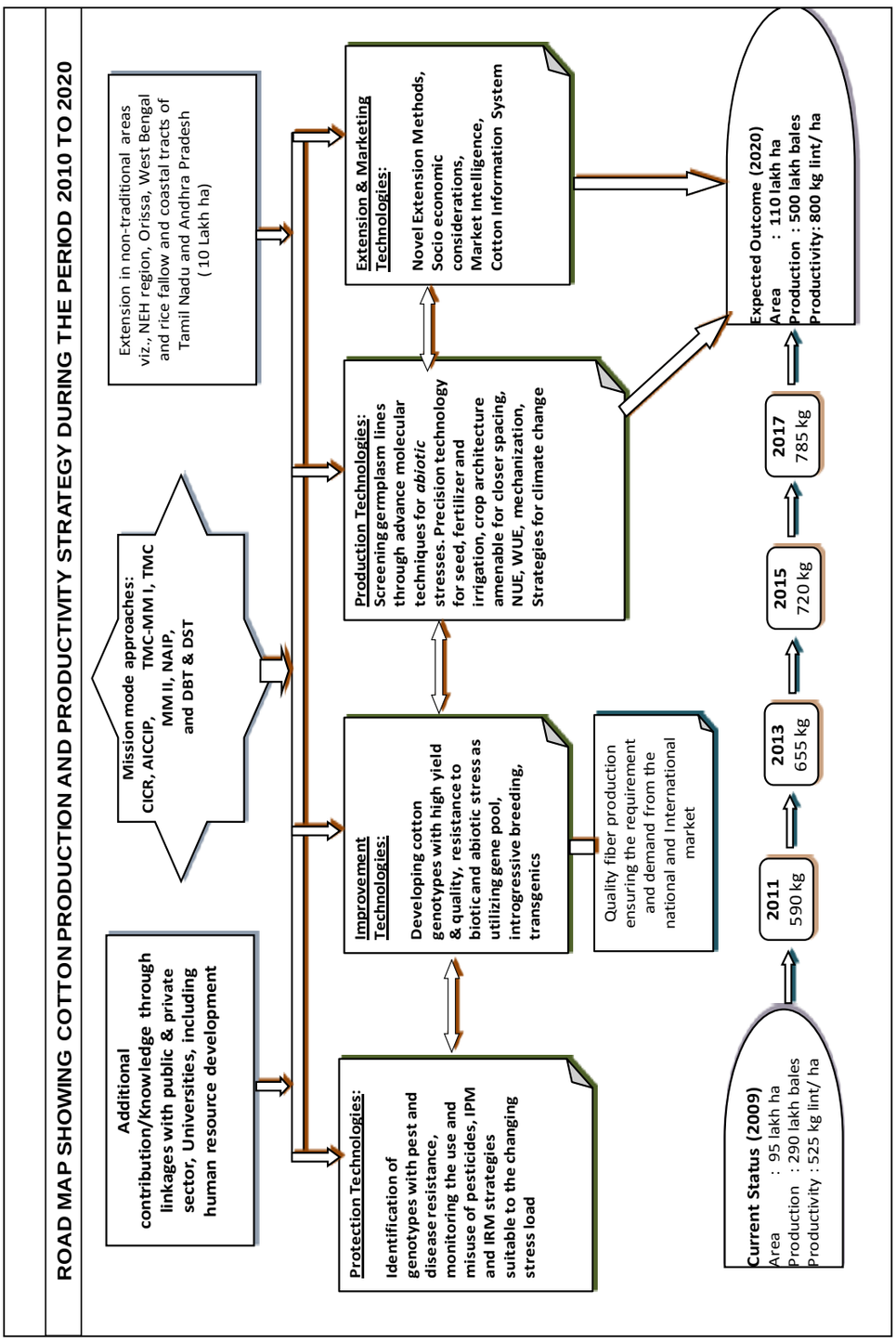
The directives of the Council from time to time and also clues from stakeholders in different platforms need to be properly channelised; this endeavour necessitates that the AICCIP needs to further address emerging researchable issues, fine tuning their existing research programmes, suitable and profitable technology generation, speedy dissemination of viable technologies as per specific locations and priorities.

The following are few that need to be given further probed by the AICCIP fraternity in collaborative, consortium mode so that the fruits of such labour are translated in farmers' fields for ultimate realization of profitable yields and sustainability assumes greater significance.

- ***Development of biotic and abiotic stress tolerant genotypes***, *especially with special attention to resistance to Cotton leaf curl virus, mealy bug, mirid bug, pink bollworm, drought and salinity/waterlogging stress.*
- *Conscious efforts are needed for developing efficient genotypes suitable to shallow soils, especially for Vidarbha region.*
- *Enhancement in productivity of quality Extra long staple cotton hybrids besides suitable high yielding cultivar in G. barbadense matching extraordinary fibre qualities of* ***Suvin.***
- *Development of high yielding* ***desi hybrids*** *with improvement in fibre quality.*

- *Identification and adaptive experimentation for ideal plant types for closer spacing and efficient nutrient uptake with fair amount of biotic stress tolerance.*
- *Irrigation as an input combined with integrated nutrient and pest management can trigger higher productivity in Central and South Zone.* ***Modern Drip and Fertigation system*** *in the Central and South Zone states, besides increasing the Irrigation Water Use Efficiency in the Northern states.*
- *Efficient crop management strategies, successful extension of INM and water harvest programme and fine tuning of IPM approaches hold the key for record production in Central zone.*
- *Natural Resource Management:* ***Efficient and sustainable management of water resources****, soil health monitoring, ICNM approaches, precision agriculture to tackle inadequate replenishment of nutrients to soil, global warming issues for sustainable cotton crop production so that overall input use efficiency is ensured.*
- *On-Farm experimentation shall receive priority for testing and dissemination of technologies and improving the livelihood of resource-poor farmers.*
- ***Classical Intercropping Systems*** *that have been evaluated under AICCIP trials over the years need to be fine-tuned and can be further successfully adopted and disseminated to farm holdings for sustainability and profitability besides nutritional security.*
- *Cotton yields are reduced by 50-85%, with unchecked weed growth or ineffective weed control.* ***Fine-tuning weed control strategies*** *augurs well for cotton that includes integrated approaches in a long term perspective.*
- ***Insecticide Resistance Management*** *strategies with better options of IPM with Bt cotton hybrids and INM that have been generated by CICR/TMC MM II need to be continuously followed through FLDs under the supervision of AICCIP personnel for effective resource utilisation.*
- *Novel approach towards* ***mechanization of cotton cultivation*** *in the face of acute shortage of farm labour and need for overcoming drudgery is a felt need- an oft repeated issue.*
- ***Cotton Value Chain*** *as approved by NAIP and being pursued by CIRCOT, CICR & Super Spinning Mills in a Public-Private partnership mode needs further attention by all concerned for replication in a location specific manner.*

The details of technologies to be developed by the AICCIP centres will be disseminated through brochures / bulletins / technical handouts etc. in English, Hindi and Regional languages and also through mass media. Besides, the information will be put on Website for the use of farming community with regular updates and news and views that matter to the clientele. All stakeholders are requested to post information on cotton and related issues to the Project Coordinator (Cotton improvement) & Head, Central Institute for Cotton Research, Regional Station, Lawley Road, Coimbatore – 641 003 (Tamil Nadu) so that the same can be incorporated on the basis of suitability and need in official website of CICR and AICCIP *viz*., **www.cicr.org.in**, which is periodically updated for the benefit of all stakeholders for effective dissemination of cotton related technologies.



This road map is only suggestive and indicative of the emerging needs with a wish to urge AICCIP Scientists and other cotton Stakeholders for possible follow up action.