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TECHNOLOGY TRANSFER IN COTTON

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1. Introduction

Agricultural development system represents a complex organization including research, education, extension, training and clientele groups. The Indian textile industry occupies a pivotal place in the country's economy. With over 1500 mill units, about 40 lakhs handlooms, 17 lakhs power loom units, the textile industry is the single largest industry of the country. It accounts for 20 per cent of industrial production and 7.5 per cent of GDP. The different sectors of the industry provide employment to about 27 million people. Besides, a large population is engaged in cotton growing and ginning, manufacture of man made fibres, chemicals, trade, transport, banking, insurance, etc; derives its livelihood from the indirect employment generated by the textile industry. Thus, technology transfer in cotton production for sustainable cotton development becomes imperative since there are considerable gaps in research and development (R & D) activities to cotton and also it becomes more cost intensive and complex.

At present four extensions services / transfer of technology systems are in vogue in cotton development in the country as given below:

1. First-line Extension System (FLES) of technology transfer programmes as commonly conceived in the ICAR system.

2. General Extension system (GES) of Ministry of Agriculture, Government of India, Directorate of Extension.

3. Special Extension Programme of Cotton Development, Directorate of Cotton Development, Ministry of Agriculture and Co-operation, Government of India.

4. Extension efforts or TOT programmes of Non-Government Organization (NGOS)

2. Front-Line Extension System (FLES):

The Front Line or First-Line Extension services (FLES) is a catalytic force for the General Extension system (GES) which involves a higher level of extension interaction by highly qualified staff of the research and educational system. It is also assumed that the scientist who has generated the technologies can demonstrate his technology better to the farmers in their fields. Since all scientists cannot be diverted for such work, FLES is operative only in selected pockets of the ICAR Research Institute and plays a limited but decisive role in TOT. Its main objectives are given below:

1. To demonstrate the farm technologies to the Farmers as well as the Extension workers of the states and NGOs.

2. To observe and analyze the factors, both technological & methodological, which act as the barriers to rapid change.

3. To assess the performance of the recommended technologies in the socio-economic conditions of the farmers and provide feed back to research institutions for improvement / refinement of their technologies.

4. To develop extension models or methodologies which can be profitably utilized by the extension agents / NGOs

5. To promote research in transfer of technology and identify constraints and suggest for improvement.

6. To organize training both professional and vocational to support the GES

7. To suggest policy issue to the higher ups and maintain linkage with the allied institutions and organizations.

3. General Extension System (GES):

The Ministry of Agriculture is the main GES in the country. The Department of Extension, Ministry of Agriculture, Government of India is directly responsible for the National Agriculture Extension System. It has its network at Regional, District and Block levels. The Extension system of the Ministry of Agriculture employs over 1.0 lakh extension workers at different levels. The most significant development was the introduction of Training and Visit Extension System started in the mid-seventies. The T & V extension was well suited to the rapid dissemination of broad based management practices for high yielding varieties of various crops. In 1990, the National Agricultural Research Projects (NARP) was launched to consolidate and review the earlier work and address specific system constraints, weaknesses and gaps that remained unaddressed by the previous research and extension (R-E) projects. The DOE deals with the NATPs (National Agricultural Technology Projects), 'Innovation of Technology Dissemination' Components through an Agricultural Technology Management Agency (ATMA). The ATMA is established in each pilot district to serve as focal point for de-centralizing day to day management of the public agriculture technology system. The R-E Unit in the project district includes KVKs and ZRSs or Sub-stations. The key line department includes Department of Agriculture (DOA), Animal Husbandry (DAH), Horticulture (DOH) and Fisheries (DOF). All these are constituents of ATMA. Besides, a few thrust extension programmes of the Department of Agriculture and Cooperation, Ministry of Agriculture are also promoting extension work. All extension work and activities are integrated at the field level (MANAGE, 1999).

4. Special Cotton Development Programme (SCDP):

The Crop Production Division of the Department of Agriculture and Cooperation, Ministry of Agriculture directly promotes extension work in cotton through Directorate of Cotton Development, Mumbai. Recently, Technology Mission on Cotton (TMC), Mini-Mission II has been launched which deals with Transfer of Technology by implementing Intensive Cotton Development Programme (ICDP) in nine major and two minor cotton growing states. Under the Mini-Mission II of TMC, Government of India has recently taken afresh initiatives to promote cotton crop in four non-traditional states, viz. West Bengal, Assam, Tripura and Jammu & Kashmir. This will help in expansion of cotton area in these states resulting in higher cotton production in the country. The Mini-Mission II will focus on the following aspects:

1. Production of Breeder and Certified seed
2. Setting up of seed delinting plants
3. Drip irrigation
4. Integrated pest management (IPM)-a) Surveillance, b) supply of Bioagents, c) Setting up of Bio-agents Laboratory
5. State level training
6. Electronic / print media support
7. Foreign training/ international farmers exchange programme (Hazara, 2000)

TOT Through NGO:

There are several Non-Government Organizations (Voluntary agencies, Seed companies, Business houses) in the country, of different shades, ideologies and commitment which are involved in technology transfer and assisting the cotton growers in technology adoption process.

5. Extension Programmes:

To study the impact of improved cotton production technology on productivity enhancement of cotton in the country, efforts were made to transfer economically viable technologies from Research Institutions to the farmers' field through the following popular extension programmes:

5.1 Lab To Land Programme (LLP):

The Lab to Land programme was first initiated by the Indian council of Agricultural Research (ICAR), New Delhi during its golden jubilee year in 1979. The main objective of this programme was to transfer latest proven and viable agricultural technology to 50,000 farm families belonging to small and marginal farmers, landless labourers and other people belonging to weaker sections to improve their economic condition. This programme was implemented in the entire country through ICAR Institutes, State Agricultural Universities, affiliated Agricultural Colleges and Voluntary organizations (Gautam, 1979).

The entire lab to land programme was coordinated, monitored and evaluated by eight zonal units which were established in eight agro-climatic zones of the country by the ICAR. The programme involved an estimated expenditure of Rs.3 crore (Rs.59, 000 per 100 farm families). The farm families for this programme were selected on the basis of following criteria:

i. They should have 1-2 hectares of land
ii. They should have willingness to participate in the programme
iii. They should provide necessary information as well as undertake training for improvement of skill etc.
iv. They should adopt new agriculture technology.

In selecting these, cluster or village approach was evolved under which the village having large numbers of families of small and marginal farmers, landless labourers and persons belonging to scheduled castes and scheduled tribes were selected.

The implementation agencies such as ICAR institute, State Agriculture Universities and Voluntary Agencies carried out initial economic benchmark survey of the participating farm families. At each of the participating Institutes an inter-disciplinary, task force was constituted for monitoring and implementation of lab to land programme. This team of scientists laid-out demonstrations of improved technologies at farmers field and organized Field Days, Exhibitions, Kisan Melas, etc. to display advantages of new proven technology. The team also helped farmers in getting loan from the Rural Development Department through Small Farmers Development Agency (SFDA), Medium Farmers Development Agency (MFDA), and Drought Prone Area Programme (DPAP) etc. The members of the team maintained regular contacts with the selected families and visited them frequently for providing necessary guidance and technical knowhow.

In 'Lab to land' programme, a provision was made to meet the costs of critical inputs like additional fertilizers, seeds, pesticides, insecticides, etc. For example, a subsidy in kind was given for crop demonstrations at the rate of Rs.500 per year to meet the critical requirements.

Central Institute for Cotton Research, Nagpur proposed to transfer cotton production technology on the following aspects of crop cultivation (ICAR, 1977).

i. Use of improved seed, trials on certified and treated seeds.
ii. Integrated pest and disease management
iii. Proper fertilizer application
iv. Yield maximization

Table 1: Details of Lab to Land Programme Conducted at Farmers Fields

Sr. No.	Year	No.Of villages	Crop/ Variety	No.Of farmers					Yield (Q/ha)		Highest yield (q/ha)	Yield Increase (%)
				SC	ST	OBC	Others	Total	Before Program	After Program		
1	1980-82	3	H4	14	5	17	2	38	4.49	4.99	5.9	11.1
2	1982-84	1	H4	10	6	85	-	101	2.62	10.99	22.5	319.4
3	1984-86	1	H4	19	20	65	23	127	15.0	17.65	23.75	17.7
			H6						14.50	16.08	21.25	10.9
4	1986-88	1	H4	19	3	78	-	100	4.60	7.05	16.25	53.2
			LRA-5166						4.00	5.00	14.25	25.0
5	1988-90	2	H4	8	18	-	28	54	4.47	6.77	9.50	43.7
			LRA-5166						4.66	6.68	9.00	43.4
6	1990-92	2	H4	7	5	45	-	57	4.0	7.0	7.0	75.0
			H6						7.5	16.5	25.0	120.0
			LRA-5166						5.7	11.50	15.0	73.7
7	1992-94	2	H4	8	10	12	30	60	9.25	11.37	-	22.9
			H6						8.06	9.31	-	15.5
			LRA-5166						6.96	8.17	-	17.4
			Anjali						9.75	(First year only)	-	-
8	1994-96	8	CNH-36	28	32	40	-	100	7.0	9.0	12.0	28.0

Source: Gupta et., al 1998.

For this purpose, 673, farmers in 20 villages of Nagpur (Maharashtra) were selected during the period 1980-1996, (Gupta, et al, 1998). Cotton crop was raised on their fields under the direct supervision of scientists with latest agro-technology available at the institute. The yield of cotton crop increased significantly due to implementation of the ' Lab to Land' programme (Table-1). The average productivity which was 2.62 q/ha in H-4 cotton before initiation of 'Lab to Land' programme increased to 10.99 q/ha with the increased of 319.4 per cent yield during the year 1982-84. Also in CNH-36, the variety released by CICR and also recommended for cultivation in shallow soils of Maharashtra, the maximum yield of 12 q/ha was recorded during the year 1994-96 at farmers field.

5.2 Krishi Vigyan Kendra (KVK)

The Krishi Vigyan Kendra's (Farm Science Centers) were started in 1974 as vocational training institutions for the farmers, farm women, rural youths, school drop-outs and field level

extension functionaries. There are 261 KVKs in the country established in 252 districts. In years ahead, the country may have over 540 Krishi Vigyan Kendra, indeed a very strong extension network for the technology transfer. Accordingly, the mandate of the KVK has been re-structured and refined since the KVKs have to take up the responsibilities of technology evaluation and impact assessment, front-line demonstration of technology on farmers field, in-service training for field extension functionaries to update their knowledge and skill, and training to farmers, farm women and rural youths (Das, 1999).

The Indian council of Agril. Research has sanctioned the Krishi Vigyan Kendra (KVK) at Central Institute for Cotton Research, (CICR), Nagpur in 1994. This is situated in the campus of CICR, in Panjari village and is helping the farmers and rural communities of the Nagpur district. The centre has provided training to more than 400 extension functionaries and 4000 farmers, rural youths and farm women since its inception on various topics such as plant protection, horticulture crops, animal science, home science and extension education (Gupta & Gajbhiye, 2000). This centre has also conducted number of front-line demonstrations on oilseed and pulses in the adopted villages and popularized the improvement varieties Vijay & ICCV-2 in Gram, PC-36, Kargil 187, Mahyco-Hybrid in Sunflower; JS-335 in Soybean; and Maroti & BSMR-736 in Pigeon pea. As a result, the farmers could harvest 30 to 50% more yield as compared to local varieties (Wasnik, 2000).

5.3 Cotton Front-Line Demonstrations (FLD):

The Front Line Demonstration was introduced by ICAR during 1991-92 under which the field demonstration on pulses, oilseeds, cereals, sugarcane, cotton and other crops are organized at farmers field under direct supervision of the scientists with a view to test the research result on farmers fields and to get direct feed back from the farmers. This helps scientist in re-orienting their research result on farmers fields and to get direct feed back from the farmers. This helps scientist in re-orienting their research, education and training programmes. To boost the productivity and overall production by using recent agricultural technologies the FLDs have played the great role in motivating the farmers for significant adoption of the technologies developed by the scientists.

The All India Coordinated Cotton Improvement Project (AICCIP), of the Indian Council of Agricultural Research, located at Central Institute for Cotton Research, Regional Station, Coimbatore as a nodal agency for conducting the Cotton Front-Line Demonstration implemented this programme with the help of various State Agricultural Universities, State Agricultural Department and ICAR Institutes with the following objectives:

- Direct involvement of scientists in the demonstration of production potential of recommended varieties / hybrids and technology packages.
- Effective linkage between scientists and lead farmers and also extension officials for an interaction and feedback.
- Village adoption for integrated efforts on seed production, pest management, efficient crop production and marketing.

The efforts were made to transfer and demonstrate cotton based cropping system and management of cotton technology throughout the country with the following cultivation practices:

i) High yielding varieties / hybrid
ii) Yield maximization through efficient crop production package

iii) Integrated Nutrient Management
iv) Integrated Pest Management
v) Drip Irrigation

Table 2: Comparison of Seed Cotton Yield with Improved & Farmers Practices Under Cotton FLD

Sr. No.	Technology Intervention		Seed cotton yield (q/ha)		Increase in yield (%)
			Improved Practice	Farmer Practice	
i	Improved Varieties / Hybrid:				
	North zone	LH1566	16.52	14.68	12.5
		F846	14.13	11.28	25.3
		LD327	12.94	11.09	16.9
		LHH144	17.47	15.96	9.5
		HD123	25.0	15.00	66.67
	Central Zone	LRK516	9.10	5.76	57.99
		CNH36	8.42	5.15	31.75
		NHH44	12.44	8.50	46.35
	South Zone	LAHH4	22.7	19.5	16.41
		TCHB213	17.1	13.9	23.0
		Surabhi Winter Demo SVPR-3	17.69	13.8	28.19
		Summer Demo SVPR-2	13.0	8.01	62.30
ii	Yield Maximization	H-1089	17.44	13.61	28.41
		HD-107	14.0	12.8	9.38
		HS-182 HS-6	16.88 16.40	14.35 13.73	17.68 19.45
iii	Intercropping	Cotton +	17.15		
		Ground – Nut	+7.85		
		Cotton +	9.52		
		Green-gram	+8.33		
		Cotton +	1.98		
		Soybean	+4.30		
iv	Integrated Nutrient Management (i) 6 t/A FYM+25kg DAP/A (Haryana)	HS-6	19.33	14.73	31.23
		H1098	18.25	16.70	9.28
		HS-182	19.25	14.91	33.22
	(ii) 50% N + Full P & K + 2 t FYM/ha + Azotobacter seed treatment (Nagpur)		10.23	8.23	24.30

	(iii)1% MgSO4 foliar spray (Raichur)		9.86	6.7	47.16
v (i)	Integrated Pest and Disease Management Seed treatment (Imadiclopride)	HS-6	19.45	12.59	33.31
		Anjali	15.0	11.5	3.043
(ii)	Seed treatment (Emison) + Foliar spray	HS-6	19.25	17.25	11.59
		HD-107	21.5	18.0	19.45
(iii)	HNPV+ Trichoderma +Endosulfan 1 spray		9.58	8.1	18.31
(iv)	Use of NPV		20.0	15.0	33.33
(v)	Chrysoperla cornia 2times + Trichoderma + spray NSKE		22.99	17.78	29.30
Vi	Drip Irrigation		27.19	21.86	24.38

Source: Venugopal, et., al 2000

Based on the data presented on various trial conducted at Sirsa, Hisar, Surat, Rahuri, Nagpur, Sirriguppa, etc. by All India Co-ordinated Cotton Improvement Project (Venugopal, et.al, 2000), it could be concluded that package I which included all the recommended cultural practices with high yielding varieties/ hybrids, produced more yield of 67% in HD-123 in north zone; 58% in LRK-516 & 46% in NHH-44 in Central Zone and 63% in summer demonstration of SVPR-2 in south zone over the farmers practices. In package II of yield maximization with efficient crop management practices where emphasis was on plant density of 49,500/ ha, spacing 67.5 x 30 cm, DAP application 25 kg after first application and deep ploughing yielded 9 to 29% more yield over local practice in Hisar and Sirsa. In package III of inter- cropping of cotton + Groudnut , Cotton+ Soybean and Cotton + green gram resulted into additional yields of 7.85, 4.30 & 8.33 q/ha of groundnut, soybean and green gram without affecting the main crop thereby improving the economic returns from same piece of land in MPKV, Rahuri. Apart from the nutritional fodder from these intercrops it also enhanced the soil fertility. Under package IV on integrated Nutrient Management i.e. 6t/A FYM + 25kg DAP/A, there was an increase in yield of 9 to 33% against the local practices in Sirsa, Haryana. While adoption of INM practice 50% N +full P & K + 2t FYM/ha + Azotobacter treatment at villages under co-coordinating center CICR, Nagpur realized yield 24% more over traditional practices. The package V of integrated pest & disease management – use of HNPV Trichoderma + one spray of Endosulplan gave cotton yield of 9.58 q/ha against 8.1 q/ha of farmers practice in CICR, Nagpur. In Nanded under jurisdiction of MAU, Parbhani, the IPM module consisting of bio-agent Tichoderma, spray of HaNPV @ 250 LE/ha, bio-pesticides spray 5% NSKE, manual collection of larvae and judicious use of chemical pesticides reported cotton yield of 22.99 q/ha as against non-IPM treatments (17.78 q/ha) at farmers field. In Package VI of drip irrigation the yield increase was 24% over the farmers practices.

5.4 Institute Village-Linkage Programme (IVLP):

The Institute village Linkage Programme (IVLP) was initiated by ICAR on a pilot basis through AP Cess Fund support in 1995. At present it is implemented in 42 centers of selected ICAR Institutes and SAUs. Keeping in view the initial success of the project, it was further strengthened and funds were provided by NATP (ICAR, 2000). The main objectives of IVLP as follows:

1. To generate technological options with emphasis on stability and sustainability along with productivity for complex diverse risk phone small production systems.

2. To generate technologies for maintaining high productivity and profitability with ecological sustainability of production systems.

3. To facilitate adoption of appropriate post harvest technology

4. To facilitate adoption of appropriate gender sensitive technology for removal of drudgery and to generate higher income.

5. To monitor socio-economic impact of technological interventions in different farming situations, and

6. To identify extrapolation domains for new technologies / technology modules based on environmental characterization to meso and mega levels.

Central Institute for cotton Research, Nagpur is implementing IVLP programme at its Regional Station, Coimbatore by addressing crop production problems through demonstrating integrated crop management technologies in one acre in each farmers field on Cotton, Tomato, Turmeric, Groundnut and Maize. A perceptible increase in yield and net profit was recorded in project farmers of IVLP (Ramamoorthy, 2001).

5.5 Agricultural Technology Information Centre (ATIC):

The Agricultural Technology Information Centre (ATIC) is being established as a “Single Window” support system linking the various units of a research institution with intermediary users and end users (Farmers) in decision-making & problem solving exercises. On the recommendations of the Technology Dissemination Management Committee (TDMC) of the NATP, the PMC approved a revised budget allocation of Rs. 124 million against the existing Rs. 36 million for 40 ATIC centers (ICAR, 1999-2000). The rationale for establishment of ATIC are as follows:

(i) To provide diagnostic services for soil and water testing, plant and livestock health.

(ii) To supply research products such as seeds and other planting materials, poultry strains, livestock breeds, fish seed, processed products, etc. emerging from the institution for testing and adaptation by various clientele.

(iii) To provide information through published literature and communication materials as well as audio-visual aids, and

(iv) To provide an opportunity to the Institutes/ SAUs to generate some resource through the sale of their technologies.

The project will also be supporting the district level project on Innovation in Technology Dissemination through Agricultural Technology Management Agency (ATMA) in 24 pilot districts.

The ATIC established at CICR in 2000 would serve as “Single window” system to provide farmers with latest technological information, products and services such as soil / water testing, plant clinic, veterinary clinic, equipment testing and testing of milk products. On farm Consultancy to farmers will also be provided and translate the reality of “Lab to Land” concept by facilitating

access of farmers to institutional resources which will cater to the needs of farmers from Nagpur district and neighboring areas (Anonymous, 2000).

6. Technology Mission On Cotton (TMC):

The Technology Mission on cotton (TMC) was launched on 21st Feb.2000 by Govt. of India with four Mini Missions as given below:

Mini Mission I: It deals with Cotton Research and Technology generation. The ICAR is the Nodal agency for this mission.

Mini Mission II: It deals with Transfer of Technology and Development. The Department of Agriculture and Cooperation, Government of India is nodal agency for this programme.

Mini Mission-III: It deals with improvement of marketing infrastructure. The Ministry of Textiles, Government of India is the nodal agency for this mission.

Mini Mission-IV: It deals with modernization of ginning and processing factories. The Ministry of Textiles, Government of India is executing this programme.

Mini Mission I is being carried out through 13 ICAR institutes and 13 State Agricultural Universities located in three cotton growing zones (ICAR, 2001). This deals mainly with research and development of new cotton technologies. The Extension Programme of CICR deals with demonstration and evaluation of selected technological interventions such as cultivation of cotton in ridges and furrows, integrated nutrient management, introduction of new cotton hybrids, introduction of new cotton varieties, supplementing nutrients with bio-fertilizer requirement, integrated pest management, management of bacterial blight and gray mildew, optimal plant density, intercropping, use of micro-nutrient and DAP spray, Plano fix application for reducing boll shedding, etc. All the 15 cooperating centres are actively engaged in evaluation of above tehnologies through farmers participation.

7. Other Extension Activities:

7.1 Rashtriya Kapas Mela:

Every year, Rashtriya Kapas Mela is organized by CICR at Nagpur, where large number of farmers, extension workers and local leaders from various parts of the country participate and are benefied by the technologies evolved by the Institute. In the RKM, an exhibition is arranged in which latest cotton production, protection technologies, farm implements, cotton varieties, hybrids, bio-fertilizers and bio pesticides are displayed by different organizations.

7.2 Cotton Day:

Every year, Cotton Day is being organized by CICR in CICR and its Regional Stations, Sirsa and Coimbatore in adopted villages for popularizing latest cotton technologies in the respective states. Large number of cotton growers from neighbouring villages also participate in Farmers' Fair.

7.3 State Exhibitions:

Scientist of the Institute regularly participate in the ICAR Exhibition and other National level and State level Exhibitions and display transferable technologies developed by the Institute. In such exhibitions, large number of farmers, extension workers, local leaders get acquainted with CICR technologies.

7.4 National Training for SMS: The Institute organizes every year a National Training course on "Integrated Cotton Production Technology" for the Subject Matter Specialists. This is sponsored by the Directorate of Extension, Ministry of Agril.Govt.of India. The training is practical oriented and is imparted by the scientist of ICAR Institutes and Agricultural Universities. The latest knowledge gained by SMS is passed on to farmers through field level workers. So far, more than 15 training courses have been organized and more than 200 senior level cotton development officers have been trained.

7.5 Use of Mass Media: : Quite often, the scientists of the institute disseminate cotton based technologies through mass media viz. Television, Radio and Newspapers. From such programmes, large number of cotton growers are benefited.

7.6 Extension Literature: For diffusing the knowledge and skill on specific topics the extension teaching materials like leaflets, pamphlet, bulletins and folders are being prepared in Hindi, English, Marathi, Tamil etc. and distributed to farmers, extension workers, etc. during their visits to the institute. Such literature is also distributed during Farmer's Fairs, Kisan Mela and National / State level Exhibitions.

8. Suggested Further Readings

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