SIR RATAN TATA TRUST

Consolidated Impact Assessment of cotton IPM Programme in Punjab & Ways to Sustainability

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Executive Summary

Cotton is one of the most important crops of Punjab, covering about 5 lakh hectares area with an output of 20.06 lakh bales in 2009-10. It witnessed serious decline in productivity and shattering the economy of cotton belt at the end of past century. To arrest this trend, IPM cotton project was initiated by SRTT in collaboration with PAU and Department of Agriculture, Punjab. This project has been reviewed at a number of times which substantiated socio-economic and environmental gains reaped by farmers, landless labour, industry and trade. To assess the need for its continuation/ strengthening in the light of changing scenario of cotton crop in the state, this report was prepared by comprehensively reviewing the work already done. The salient findings are as under:

a) Major impact of the IPM technology

(i) As a result of popularisation of IPM technology jointly by stakeholders in cotton, the yield of cotton increased significantly and cost of production was reduced showing overall sizable economic gains to the extent of Rs. 11,210/- per hectare with annual additional economic gains to the extent of Rs. 750 crores by way of additional annual production of 10 lakh bales of lint.

(ii) Positive environmental impacts in terms of minimization of insecticide use to the extent of 25% that ultimately lowered the cost of production by about 60 percent.

(iii) The large scale demonstration of IPM has made it very popular throughout the cotton belt of the state as a result of which the total consumption of agrochemicals in the state has come down from 7400 tons in 1993 to 5800 tons by 2009.

(iv) The increased employment of rural labour, particularly women labour of about 3.05 million worth Rs. 75 crores man days for socially and economically weaker section of landless families.

(v) The safe environment through decreased use of pesticides provided additional opportunity for bee keepers to explore flora of cotton for honey production which increased from 5,500 tons in 2005 to 14,000 tons in 2010-11.

(vi) Revival of livestock enterprises can be viewed from large scale adoption of subsidiary occupations, improved environment, minimization of adverse effects on useful insects, birds, livestock and honey bees.

b) Project modifications and further technological interventions:

(i) Cotton based agro-ecosystem in totality should be covered rather than only cotton crop in isolation for better livelihood in the area.

(ii) Sustainability to the IPM Module in the IPM phased out villages is a matter of concern, where formation of IPM clubs of farmers can play effective role.

(iii) Some project modifications, additional interventions and researchable issues have also been suggested.

(iv) The success stories in IPM should be highlighted and practical aspects in field training programmes for stakeholders should be made an integral part of it.

c) Organisational structure and operational issues:

(i) A scout should cover a cluster of 3 villages continued for 3 years. A scout coordinator for every 3-4 clusters for more effective coordination with field officers is suggested.

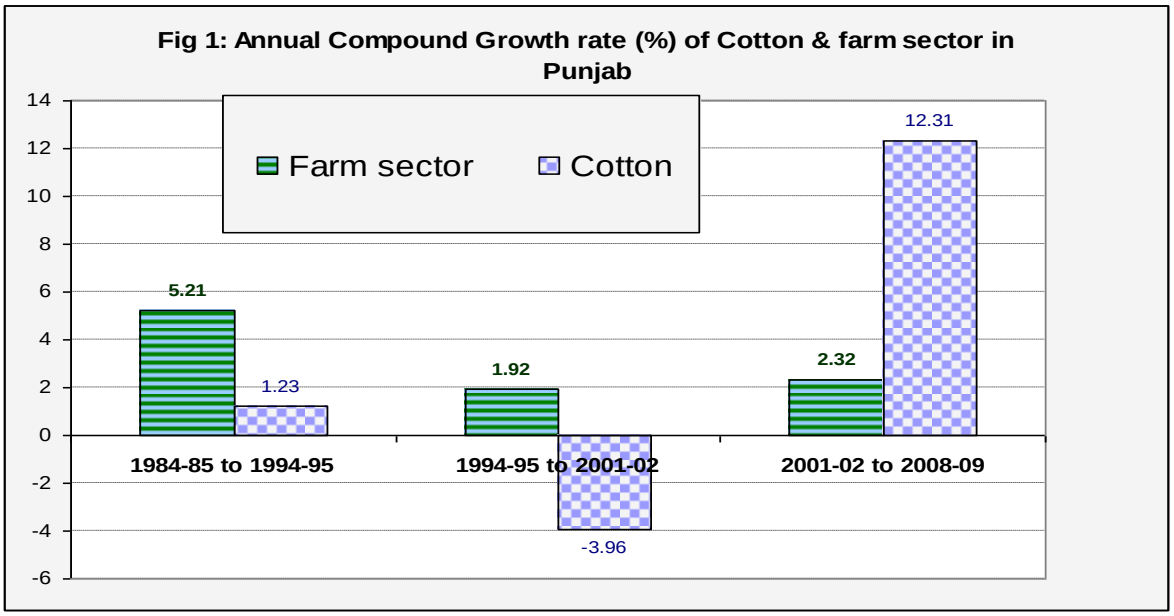
(ii) Better equipping the Village Information Centres for prevalent cropping system will be an added attraction for farmers.

The success story of cotton IPM has proved to be a role model for other such projects in the state and other states of the country.

Consolidated impact assessment of cotton IPM programme in Punjab & ways to sustainability

Background

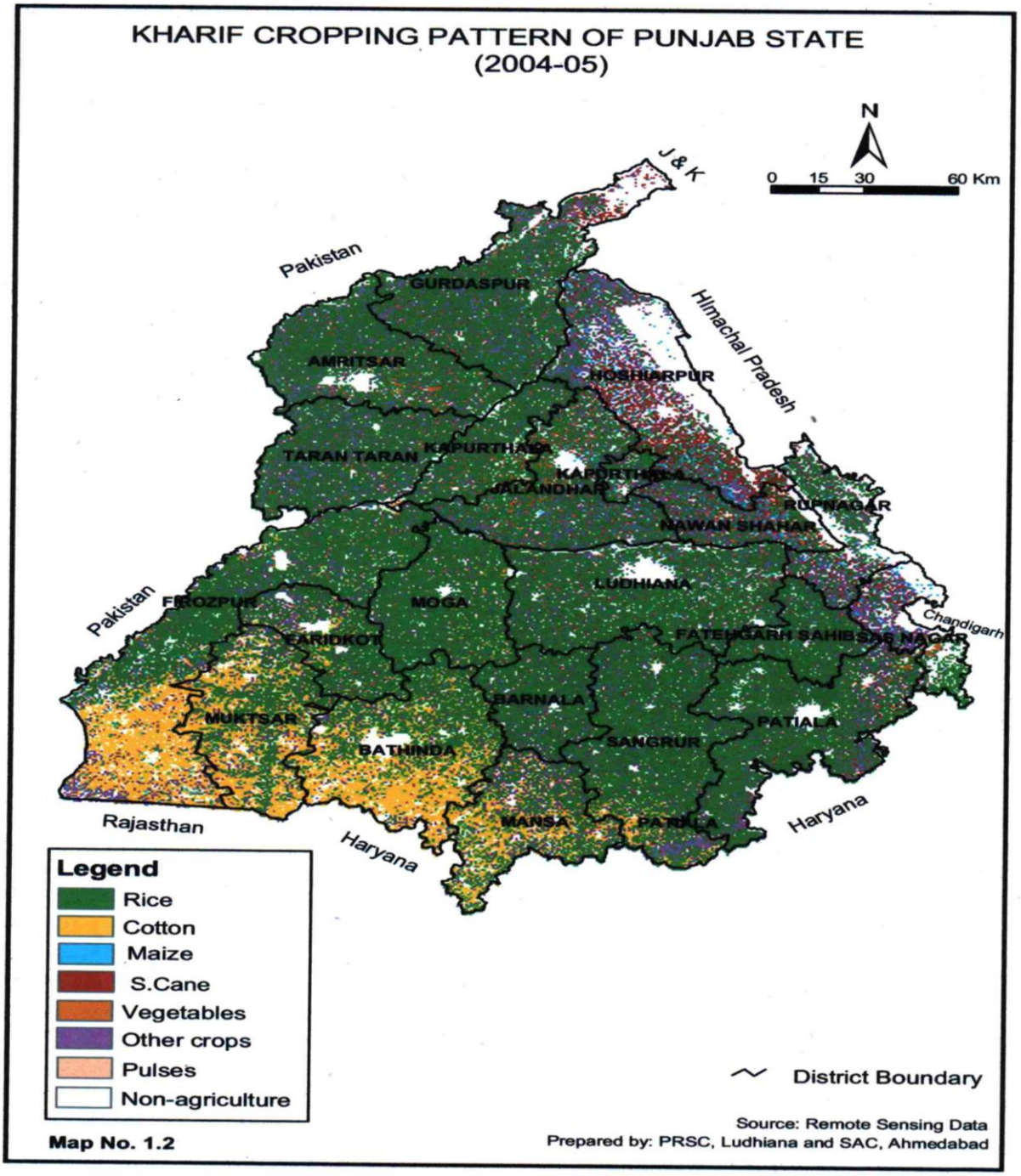
The 'Green Revolution' ushered in mid sixties in Punjab appeared to have faded away by early nineties, leaving agriculture sector to struggle for its mere sustainability. This is apparent from the fast sliding compound growth rate (CGR) in this sector from 5.21 percent in 1984-1994 to just 1.92 percent in 1994-2001 (Fig 1). The main reason for this is the stagnation due to almost complete exploitation of available improved technology and continuously depleting natural resource base in case of wheat and rice, the major crops of the state. Moreover, fall in production of cotton (the third most important crop) by 3.96% during 1994-2001 also played significant role for slow growth of agricultural sector. The cotton crop, which is area specific to south-western districts, got revived through introduction of Bt cotton varieties and IPM technology showing 12.31% increase in production during 2002-2009. This revival in cultivation of cotton more than compensated for deceleration of growth in wheat and rice as a result of which entire agriculture sector in Punjab showed an annual CGR of 2.32 percent during this period as compared to 1.93 percent in the earlier era.



The cotton crop is concentrated in the south-western area of the state comprising Ferozepur, Faridkot, Muktsar, Moga, Bathinda, Mansa and Sangrur districts which has comparative advantage of growing cotton in *kharif* season due to brackish underground water, low rainfall and lighter soils. Even within these districts, the cotton crop is concentrated in 24 blocks and accounts for 95% of the total area and 87% of production in the state. This area is earmarked in yellow in the map(Fig 2). Out of total 1600 villages in the cotton belt of the state, Trust has already adopted 900 villages. Thereby, Trust has contributed significantly to this growth process.

Since cotton is the most important crop of south-western districts of Punjab and there is no vice enterprise for this belt which has brackish groundwater and scarce canal water. Though paddy was grown in some area by exploiting groundwater but it further worsened the possibility of revival of cotton crop in the area on account of accumulation of salts through groundwater irrigation. The farmers suffered seriously from economic distress for more than a decade.

Fig. 2: Map of Indian Punjab showing Cotton belt (in yellow colour)



1.1 Cotton productivity and insect-pest scenario before Inception of IPM Project supported by Sir Ratan Tata Trust.

The productivity of cotton hovered around 300-400 kg of lint per hectare during the last decade of 20th century and beginning of present century. During this period, cotton farmers were incurring heavy losses due to reduced productivity even with heavy investment on pesticides. The crop was heavily attacked by bollworms out of which American Bollworm was the key pest. The sucking pests were jassid and whitefly which played havoc by causing heavy damage. Whitefly became more serious as a pest and a vector of Cotton Leaf Curl Virus (CLCV) which became a serious detrimental factor for cotton cultivation. The indiscriminate use of pesticides aggravated all these problems resulting in development of resistance in insects to insecticides (Appendix 4), elimination of natural enemies of pests, increase in cost of cultivation and decrease in yield. It was not only a matter of serious concern for economy of farmers in the cotton belt of the state but the cotton based industry and trade too received a serious setback which ended up with closure of several ginning factories.

1.2 Beginning of cotton IPM implementation in Punjab

Visualizing the gavity of the scenario of cotton production and further intensifying problems of farm economy, Sir Ratan Tata Trust entered the arena with interventions for crop revival by providing critical technical know-how to the farmers in collaboration with Punjab Agricultural University in 2002. The project was started in two villages in Ferozpur district where cotton IPM technology standardised by the Punjab Agricultural University was validated and promoted at farmers' fields. The technology was further demonstrated and disseminated to four more villages of Ferozpur and Mukatsar districts during 2003 and 2004 seasons to assess its worth for further extension to other areas.

1.3 Practices followed by the farmers before the start of project

The farmers were growing long duration, late maturing and CLCV susceptible varieties and a substantial part of the crop was not sown in time as a result of which late maturing crop faced relatively high incidence of pests. Over one hundred un-recommended varieties of Bt Cotton and conventional hybrids were being cultivated which further aggravated the pest scenario due to availability of fruiting bodies for survival and multiplication of pests over a long period. The farmers were applying 15-20 insecticidal sprays to the crop of which 50-60 per cent were of synthetic pyrethroids and tank mixtures which is not a recommended practice. The farmers usually adopted a fixed schedule of sprays after 8-10 days interval with least consideration of extent of pest incidence which ends in excessive use of pesticides.

1.4 The Cotton IPM module

The IPM technology in cotton was developed by PAU to provide an effective control of insect pests through proper and judicious use of pesticides. This technology is based on sound ecological principles to raise and sustain the crop productivity with the least destructive influence on crop ecology. It is achieved through integration of all available techniques of crop management in harmony with environment. It consisted of timely sowing of early maturing, rapid fruiting *hirsutum* cotton varieties/ hybrids, judicious use of fertilizers and irrigations, destruction of alternate weed hosts of cotton leaf curl virus, weekly monitoring of pest population, spraying of recommended insecticide by adopting proper technology. Though the main thrust of IPM technology is to provide an effective control of pests and diseases with minimum use of pesticides but IPM module also included all recommended crop management practices to ensure highest productivity of cotton with minimum cost of production.

1.5 Implementation of cotton IPM programme of the SRTT

The IPM module included all required inputs to keep the pest under control with minimum use of pesticides and maximisation of yields. The package includes the choice of ideal variety, sowing in time, balanced use of fertilizers and proper use of right type of pesticides. The farmers were also taught about the efficient spray technology. The benefits of IPM module were demonstrated through adoption of entire cotton area of the adopted village as demonstration units. The educated youth of the adopted village was contracted as Scout for round the clock technical input and feedback. The scientists regularly visited the farmers' fields at weekly intervals throughout the season to survey and monitor the crop and pest situation. The cotton IPM technology was demonstrated to the farmers at their own fields. They were educated about the identification of insect pests, their nature of damage and natural enemies. The farmers were also advised to use insecticidal sprays based on the economic threshold level (ETL). The farmers were educated through Field Days where Consultants and Field Officers delivered lectures and held demonstrations and training on identification of pests and choice of right type of pesticides.

1.6 Sequential activities of the IPM technology:

The contents of IPM project include the following activities:

a) Development of action plan for cotton IPM project prior to the start of the season

b) Selection of villages to be adopted for demonstration at village level

c) Selection of village scouts & their training at PAU about cultivation of cotton with special emphasis on IPM

d) Soil-testing of cotton farmers in adopted villages for judicious use of fertilizers

e) Establishment of 'Village Information Centres' in each village to educate farmers about management of pests and diseases and other cultural practices.

f) Entire village adoption with a target to include all farming families with small land holding and scheduled and backward classes

g) Regular survey of area under cotton in adopted villages to record the incidence of pests and determination of ETL for deciding the initiation of spray especially use of fertilizers and pesticides.

h) Emphasis on adoption of recommended agronomic practices

i) Adoption of plant protection measures based on pest surveillance and need based Economic Threshold Level (ETL) chemical control by adopting only recommended pesticides through right type of spray equipment.

2. Design of Review Exercise

The review exercise was undertaken by the team comprising of Dr N.S. Malhi, Plant Breeder & Former Director of Extension Education, Dr Joginder Singh, Former Head, Department of Entomology and Dr Joginder Singh, Former Head, Department of Economics & Sociology at Punjab Agricultural university, Ludhiana through interactions with Dr G.S. Chahal, Dr A.S. Dhatt and Mr B.S Saini of the RGR cell to know about the work done on IPM cotton since its inception. Various studies done / reports so far prepared on impact assessment, annual reports etc were reviewed. Various concerned officials from State Department of Agriculture at state and district level also provided some inputs on technical and operational problems. A significant input was provided by Dr A. S. Sohi, Dr A.L Sharma, Consultants SRTT on field observations, need for validation of innovations taken up by the farmers and difficulties encountered in operation of the project in IPM cotton. Dr Joginder Singh, Entomologist, Former Head, Department of Entomology, Punjab Agricultural University as a team member shared the impressions of the private seed companies and pesticide industry. Secondary data from various sources such as Statistical Abstracts of Punjab, Economic Surveys of Punjab, Data Book, IASRI were also taken for supporting information. Day to day account of work of the team is given in appendix 3.

3. Impact assessment of project

3.1 Phase 1 (2002-04)

The sole partner of the SRTT during this phase of the project was Punjab Agricultural University, Ludhiana where project was operated to demonstrate the potential impact of IPM module in the form of increase in adoption of each component of the module with consequent reduction in use of pesticides and increase in productivity of cotton and income of farmers. As may be seen from Table 1, the area under early maturing, rapid fruiting, CLCV resistant hybrids/varieties increased continuously to 63% in 2004 in comparison to about 39% in 2002. The area under timely sowing of crop also rose to 92% from about 81% during this period. IPM farmers gave on an average 5.4 sprays in 2004 as compared to 12.2 sprays in 2002. The insecticidal load was, therefore, reduced by about 33 and 56 per cent in 2003 and 2004 respectively. The positive demonstration impact on the neighbouring farmers was also observed which is evident from the fact that their number of sprays came down from 18 to 8 sprays. But still these non-IPM farmers used to make more sprays than the farmers being regularly advised about IPM technology. The IPM farmers reduced the use of synthetic pyrethroids and insecticide mixtures. The IPM farmers obtained 32.7% higher yield than the non-IPM farmers. Though this being a validation phase covered only few villages but on the whole, IPM technology improved the farm income by 45.6% which showed tremendous potential for impact on revival of cultivation of cotton and economy of the farmers through adoption of this approach of cultivation of cotton.

Table 1: Impact of IPM during first phase

Impacted parameters	Category	2002	2003	2004
Area under Hybrid cotton %	IPM farmers	38.6	49.8	63.4
Timely sown %	IPM farmers	81.4	91.1	92.4
No. of sprays	IPM farmers	12.2	8.2	5.4
	Non-IPM farmers	18.7	12.9	8.6
Synthetic prythroid sprays (% farmers)	IPM farmers	57.4	34.3	21.2
Insecide mixtures sprays (% farmers)	IPM farmers	61.5	38.7	19.6

3.2 Second (2005-2008) & third phase (2009-2011)

Subsequent operational details

In view of very encouraging response of IPM technology during Phase-I, the SRTT supported its upscaling in Phase-II through Department of Agriculture, Punjab by adopting 56 villages each in 2005 & 2006 and 112 in 2007. The Department of Agriculture also provided a Matching Grant as a result of which project covered 224 villages in 2008. The Phase-III was operated in 300 villages every year through a Matching Grant from Department of Agriculture, Punjab to cover 150 village each from grant of Trust and Punjab Government (table 2). The fact that Punjab Government started providing matching annual grant of Rs. 10.00 million to cover additional 150 villages itself speaks of the impressive impact of this project during second phase.

Table 2: Number of villages under IPM Cotton

Year	No of villages*	SRTT: Deptt of Agriculture**
2005	56	100:00
2006	56	100:00
2007	112	100:00
2008	224	50:50
2009	300	50:50
2010	300	50:50
2011	300	50:50

*In addition Punjab Agricultural University adopted 48 villages (2005-2010)
**Financed by SRTT and Department of Agriculture Punjab

All through during the third phase around 50,000 cotton growing families were covered every year under the project. The total area covered was 2.89 lakh hectares in 2008; 2.95 lakh hectare in 2009; 2.37 lakh hectares in 2010 and 2.69 lakh hectares in 2011. So every year about 50% of the total area benefitted from IPM project though farmers in adjoining areas of adopted villages also benefitted indirectly. In every year the impact analysis studies have been conducted through independent External Resource Person (Dr. Joginder Singh) as well as through contractual field staff engaged by RGR Cell under this project. The impact analysis brought out significant changes in both socio-economic and environmental parameters. The direct economic impact was realised in terms of yield improvement, reduction in pesticide use and cost of cultivation and improvement in quality reflected in market price. For the last 6 years, the average annual gain was estimated as Rs. 4,484/acre (Table 3) which ranged from Rs. 3,190/- to Rs. 6,790/- during these six years. This had impact on farmers, landless labour, women and public in general. Ensuring higher economic gain to farmers had positive effect on increase in area of the cotton crop, which has labour requirements much

more than alternative crops. Such an impact was experienced throughout all crop seasons under the project.

Year 2006-07:

The average yield of cotton across the categories of farmers provided a strong indication of positive economic impact of the project. The yield of seed cotton averaged to 23.2q/ha and 21.7q/ha in case of project and non-project respondents respectively. Thus a visible gap of 1.5q/ha has to be underlined here. Therefore, economic gain due to yield improvement and cost reduction accounted for income improvement by Rs. 3749/acre or Rs. 9373/ hectare.

Year 2007-08:

The farmers were enquired about the average yield of cotton obtained and the expenses incurred. Subsequently they were asked about the loss in yield and increase in costs if they were not provided the information under the project. The average yield improved by one quintal per acre and cost was reduced to the level of Rs. 690/acre, netting an average gain of Rs3190/acre or about Rs. 8000/ha to the selected farmers. In the long run such gains were expected to continue and even spread to more number of farmers.

Year 2008-09:

The overall economic gain was estimated as Rs. 4475/acre which could be attributed to improvement in yield by 1.34 qt/acre valued at Rs. 3629@ Rs. 2700/qt, higher price by Rs. 26/acre and cost reduction (through spraying, weeding, fertilizer use etc as per crop requirement) by Rs. 820/acre. The highest gain was reported by farmers of Faridkot amounting to Rs. 8258/acre.

Year 2009-10:

Net direct economic impact of IPM cotton project during the year worked out to Rs. 6,780/acre emerging mainly from yield improvement. The cost reduction was there but its impact on profitability was not so significant due to serious attack of mealy bug and other sucking pests which required additional sprays.

Year 2010-11:

Based on perceptions of respondents, yield, price and cost were simultaneously affected by way of SRTT interventions. But for information provided, cotton average yield could have been less by about 84kg/acre. Price was also improved by Rs. 33/qt due to guidance about care for marketing. Similarly, cost reduction due to balanced use of inputs, particularly agro-chemicals was estimated as Rs. 507/acre. Therefore, valuation of enhanced yield amounted to Rs. 3936/acre and that of higher price to Rs. 287/acre. Therefore, an overall annual economic average gain to a cotton farmer was assessed as Rs. 4729/acre or Rs. 11823/ha or Rs. 26719/farmer.

Table 3: Economic impact assessed by Impact assessment studies (Rs/acre)

Year	Cost reduction	Yield improvement	Price increase	Net benefit
2005-06	1465	2232	52	3749
2006-07	1247	2064	672	3983
2007-08	690	2500	0	3190
2008-09	820	3629	26	4475
2009-10	380	6400	0	6780
2010-11	507	3936	287	4729
Average	**851**	**3460**	**173**	**4484**

Sources:

a. Joginder Singh 'Socio-economic Impact Assessment of Promotion & Validation of Cotton IPM Technologies in Punjab' Sir Ratan Tata Trust, Mumbai, Feb, 2007

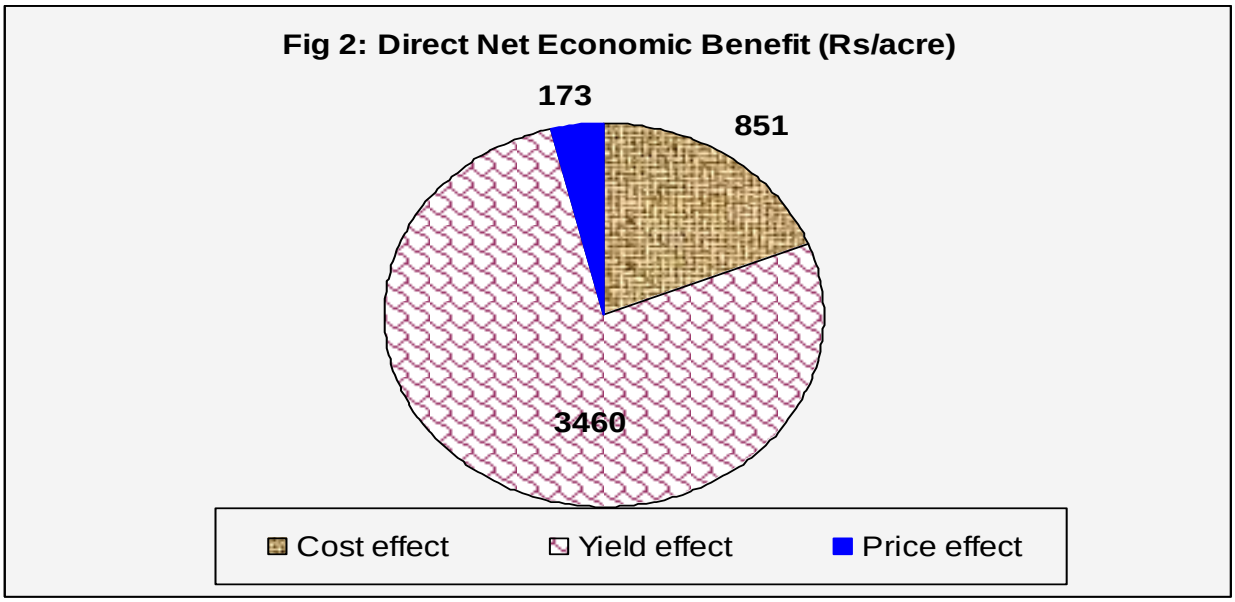
b. Joginder Singh 'Impact assessment report of cotton in Punjab' Sir Ratan Tata Trust, Mumbai, Jan 2008

c. Joginder Singh 'Impact assessment survey report of cotton in Punjab' Sir Ratan Tata Trust, Mumbai, Dec 2008

d. Joginder Singh 'Impact assessment study of groundnut, basmati & cotton as alternative to rice-wheat cropping system in Punjab' Sir Ratan Tata Trust, Mumbai, Jan 2009

e. Joginder Singh 'Impact assessment study of IPM cotton project for boosting diversification in Punjab' Sir Ratan Tata Trust, Mumbai, Jan 2010

f. Joginder Singh Report of 'Impact assessment: IPM cotton project for boosting diversification process in Punjab' Sir Ratan Tata Trust, Mumbai, Feb 2011



3.3 Impact on use of agro-chemicals and productivity

Initially efforts were made to lower the fertilizer cost by avoiding its excessive and imbalanced application. However, due to shift from non-Bt to Bt varieties, fertilizer requirements of cotton increased for which proper guidance of farmers was essential. So proper use of fertilisers increased with every successive phase of the project. Still more important was to make use of potash through its foliar application as soil potash availability was low and roots could not meet the demand of the plant especially after start of fruiting phase. As against 1.3 sprays of potassic supplement (13-0-45) by non-project farmers in 2006-07 two sprays were given by project farmers which further rose to 3 sprays during 2010-11 (Table 4). This practice was helpful in minimizing the boll shedding and has thus become a common practice in the entire cotton growing area. Since it was an entirely new practice in cotton cultivation so it could become popular only due to timely and regular advice to farmer in the project villages. The pesticide load with IPM farmers was lower than Non-IPM farmers. A significant (about 25% annually) decline in the number of insecticidal sprays and ultimately cost of plant protection was an obvious impact of the IPM project. Consequently, the cost on this operation declined by 60% i.e. from Rs. 3005/ha in 2006-07 to Rs. 1200/ha in 2010-11. It was made possible due to timely application of right quantity of appropriate pesticides of good quality based on ETL for sucking type of pests as well as borers for which pheromone traps were used to monitor the pest incidence. By way of various efforts regarding improvement in management practices, the average yield showed upward trend of selected farmers. As a cumulative effect of various efforts following improved management practices, the average yield of sample farmers increased by about 25% during the last 2 years (table 4).

Table 4: Impact on use of agro-chemicals and average yield

Parameter	NP 2006-07	Project 2006-07	% change	NP 2007-08	Project 2007-08	% change	NP 2009-10	Project 2009-10	% change	NP 2010-11	Project 2010-11	% change
Fertilizer cost (Rs/ha)	5145	4287	**-16.7**	5295	4460	**-15.8**	3500	4000	**14.3**	2700	3213	**19.0**
Number of Sprays of Pot. Nitrate	1.3	2.1	**61.5**	1.8	2.0	**11.1**	1.2	3.2	**166.7**	2.5	3.0	**20.0**
Plant protection cost (Rs/ha)	3005	1675	**-44.3**	3900	3505	**-10.1**	3150	1800	**-42.9**	1600	1200	**-25.0**
No. of insecticidal sprays	6.0	5.6	**-6.7**	6.3	4.9	**-22.2**	6.4	4.8	**-25.0**	6.4	4.8	**-25.0**
Average Yield (q/ha)	21.0	23.2	**10.5**	21.0	22.0	**4.8**	20.3	25.1	**23.7**	17.8	22.3	**25.3**

NP= Non-project

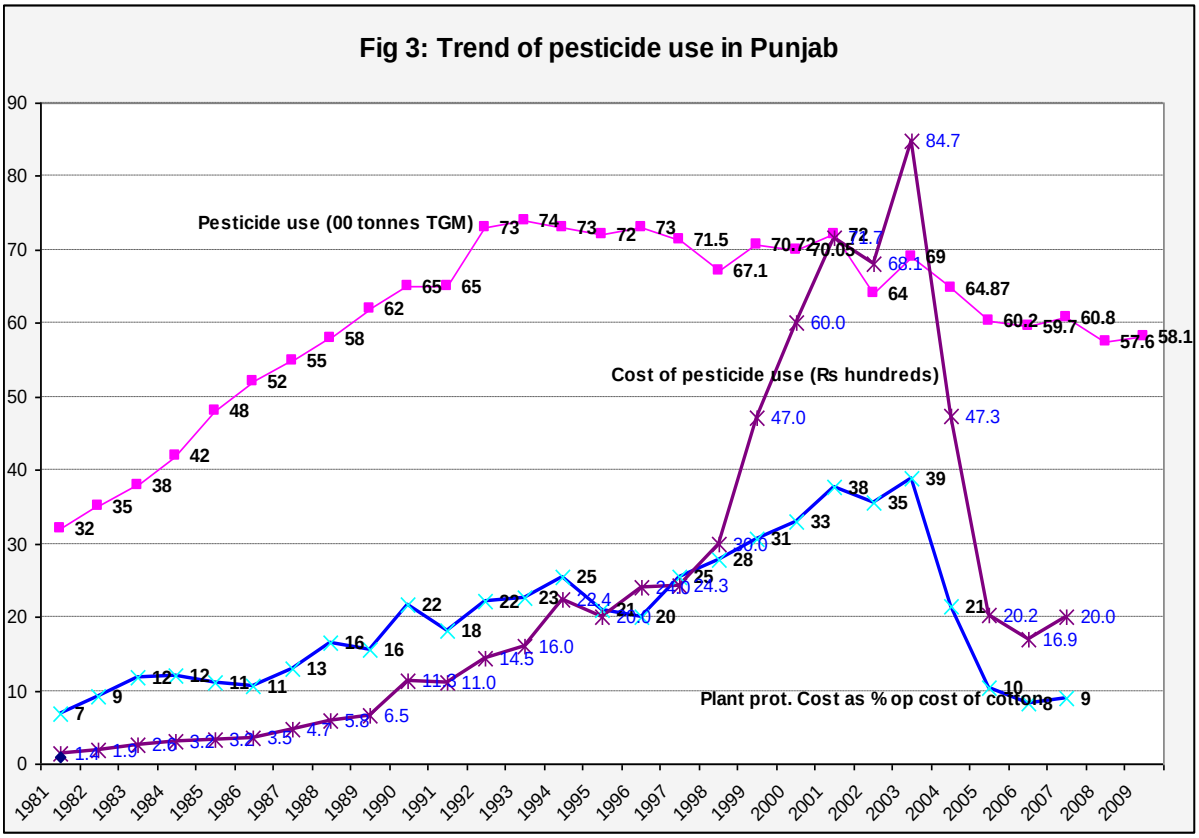
A similar analysis has also been made by RGR team and presented in its annual reports with full details especially during the current phase. The data from ten selected farmers of each adopted village on various production parameters is regularly recorded by village scouts and compiled by RGR team. The Cotton crop during 2008 received excessive rains during early phase that increased the incidence of sucking pests but even then the IPM farmers gave 4.4 sprays against 5.9 by Non-IPM farmers. The IPM farmers earned higher returns to the extent of Rs. 2,625/- acre. The IPM farmers during 2009-10, applied on an average 3.1 sprays as compared to an average of 4.8 sprays by Non-IPM farmers thereby reducing cost of spray by 35.4 percent. Furthermore over 90% farmers purchased branded quality pesticides though in general farmers usually apply spurious pesticides supplied by local pesticide dealers. On account of better control of pests, the IPM farmers obtained higher yield to the tune of 1.09qt/ acre which through saving on sprays per acre a net economic gain of Rs. 4052/ acre over Non-IPM farmers. In the subsequent crop season of 2010-11 the IPM farmers gained by Rs. 5,208/- per acre which was 21.1 percent higher income than that of Non-IPM farmers. These gains came through reduction in cost of sprays by 25.0 percent and enhancement of yield by 15.0 percent over the Non-IPM farmers.

These results were further authenticated from the secondary data as well. The use of pesticides in Punjab has been increasing especially from 1980s onward due to increase in pest problem, particularly in cotton crop. As presented in Fig 3 and Appendix 1, it touched highest level of 7400 tonnes of TGM in 1993 and almost maintained the plateau till 2003 (Source: Economic

Survey of Punjab). But during subsequent years there has been continuous decline in use of pesticides which came down to 5800 tons by 2009. Though the printed information for last two crops seasons is not yet available but the general trend of gradually increasing use of IPM technology is a strong pointer of still lower level of pesticides consumed in the state. Consequently, the plant protection cost of cotton as % of total operational cost on the crop touched a level of 39% in 2003 (Based on cost of Cultivation data, Punjab, Ministry of Agriculture & Cooperation, GOI). Thereafter, due to IPM efforts and introduction of Bt cotton, decline has started reaching the lowest ebb of 8% in 2006 and the state is heading towards minimum use of pesticides.

3.4. Economic gains and employment generation

A continuously decreasing cotton production touched its lowest level of only 10 lakh bales in 2002. The popularisation of IPM technology reversed this trend as a result of which cotton production crossed 20 lakh bales by 2004 and a record production of 26 lakh bales in 2006. The cotton crop being highly sensitive to environmental fluctuations suffers from instability of production levels but it is a matter of record that it never came below a level of 20 lakh bales after the adoption of IPM technology which amounts to an additional production of an annual average of 10 lakh bales. As per globally accepted norms fifty percent of any increase in overall production in any crop is attributed to enhanced inherent potential in the form of improved varieties of the crop with the remaining gains coming through matching crop production technology. The entire period of desperation to prosperity of cotton in Punjab is marked with introduction of new varieties in the form of Bt Cotton and production technology through adoption of IPM technology. It, therefore, is a legitimate estimate to state that at least about 5 lakhs bales of additional lint produced annually by now in Punjab is due to large scale adoption of IPM technology. Since one bale of lint comes on an average, from five quintals of raw cotton so additional annual production of 5 lakh bales of lint and 25 lakh quintals of cotton amounts to provide an additional annual financial gain of Rs. 750 crores with current rate of Rs. 3000/ quintal. Apart from such enormous economic benefit to cotton growers, it provided additional labour through picking of cotton. Entire cotton in Punjab is picked manually by landless labourers especially women of these families. Since the labour for picking is paid at the rate of one tenth of the cotton picked by a worker so the additional cotton of 5 lakh bales generated employment worth Rs. 75 crores per year. The landless families of cotton belt of Punjab and migratory labourers from Rajsthan are the most rejoicing beneficiaries to this gradually increasing use of IPM technology.



3.5 Environmental and social impact

The social capital in the form of a fleet of villages youth trained as scouts is an outstanding contribution of this project. One educated young farmer of each adopted village worked as a part of the project for the adoption of all recommended agronomic practices for profitable cultivation of cotton. On account of their all time availability in villages these scouts are serving as technical resource persons to the fellow cotton growers of these villages. A significant economic impact of IPM technology was accompanied by battery of social and environmental gains. As indicated in Table 5, the improvements in animal, human and soil health reduced environmental pollution were some advantages compared to alternative paddy crop. The response of respondents was 22% in water saving, 63% in soil health improvement, 49% in reducing air pollution, 52% in mitigating human health hazards and 54% in reduced pesticide use. The increased employment of human labour, particularly women labour for picking has been realised. It was authenticated by Cost of Cultivation data of Punjab that human labour use in case of cotton during 2006-07 and 2007-08 was 832 and 803 man-days per hectare of which cotton picking is the major manual operation. Only due to this operation and increase in area under cotton from 450 thousand hectares in 2002-03 to 511 thousand hectares in 2009-10 amounted to additional labour employment of 3.05 million man days every year. Other avenues of livelihood such as dairy, poultry, beekeeping etc which had gone out of the area due to high use of pesticides, were back in place.

The presence and intensity of honeybees in the cotton belt is an obvious index of environmental improvements. As presented in Table 6, the number of beekeepers and production of honey kinked up at 2005-06 which touched a level of 30000 beekeepers and 14000 tonnes of honey in 2010-11. Honey production increased 8 times during the past one decade. Increased population of insect predators, know -how of farmers and scouts, adoption of production technology of other crops as well and gain in credibility of agricultural extension agencies are the plus points of IPM technology.

Table 5: Positive Environmental and social impacts of project (% response)

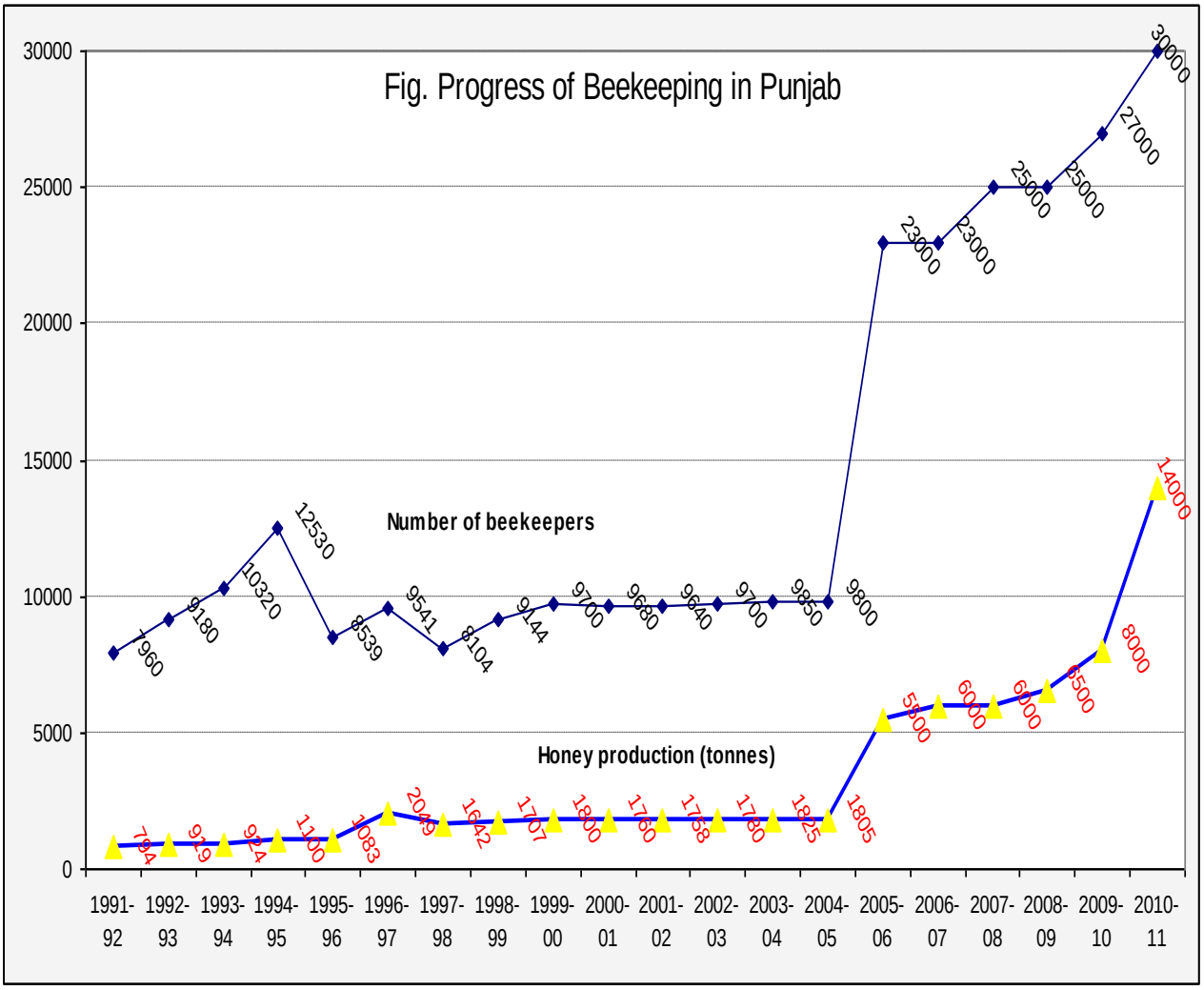
Parameter	**2006-07**	**2007-08**	**2009-10**	**2010-11**	**Average**
Water saving	45.1	6.1	11.4	25.2	**22**
Soil health	86.6	62.8	88.6	14.9	**63**
Reduced Air pollution	87.4	63.6	28.7	15.2	**49**
Human health	94.5	68.4	31.4	12.6	**52**
Reduced pesticide use	94.7	74.5	25.7	22.8	**54**
Population of useful insects			100.0	27.8	
Employment of male				17.5	
Employment of female				34.1	

Table 6: Progress of beekeeping in Punjab

Year	**Number of Beekeepers**	**Honey Production (t)**
1991-92	7960	794
1992-93	9180	919
1993-94	10320	924
1994-95	12530	1100
1995-96	8539	1083
1996-97	9541	2049
1997-98	8104	1642
1998-99	9144	1707
1999-00	9700	1800
2000-01	9680	1760
2001-02	9640	1758
2002-03	9700	1780
2003-04	9850	1825
2004-05	9800	1805
2005-06	23000*	5500*
2006-07	23000*	6000*
2007-08	25000*	6000*
2008-09	25000*	6500*
2009-10	27000*	8000*
2010-11	30000	14000

* approximated

Fig. 4: Progress of Beekeeping industry in Punjab



Improvement in economic status of the family has much more relevance if the quality of life is also enhanced. Response of farmers about utilization of increased income was obtained. The most urging need indicated by 54% farmers on an average, was repayment of outstanding debts (Table 7). Purchase and repair of machinery, land improvement and purchase of livestock were other major items of investment. Consumption needs were also prioritised on the basis of response. Education of children got the top priority by 63% farmers, followed by social functions and repair/renovation of house.

Table 7: Utilization of enhanced income (% response)

Purpose	2006-07	2007-08	2009-10	2010-11	Average
a. Productive purposes					
Debt servicing	63.2	49.8	90.0	14.6	**54**
Purchase of Livestock	19.8	2.8	16.7	29.8	**17**
Purchase & repair of Machinery	8.2	23.5	40.6	58.9	**33**
Improvement & leasing in Land	4.2	27.2	43.3	29.1	**26**
Others	3.8	0.5	3.5	0.3	**2**
b. Consumption purposes					
Social purposes	20.1	25.4	66.7	50.7	**41**
Education of children	43.1	74.6	69.0	65.6	**63**
House repair	12.1	18.3	30.0	52.6	**28**

4. Project modifications and further technological interventions- a way forward

Keeping in view benefits accrued to the farmers in cotton IPM project, the project needs to be up- scaled and sustained in Punjab due to certain reasons. The Cotton is highly suited for south-western districts of Punjab which is most productive cotton growing area of north India. It is the ideal alternative of paddy to arrest fast depleting water resources which otherwise are not most suited for paddy especially in main part of the cotton belt. Due to very limited chances of mechanisation in harvesting of cotton, it provides the single largest source of employment generation for picking of cotton especially for women of landless rural families. Moreover the fast increasing consumption of cotton in domestic and international market requires additional production of cotton which can ultimately impact the livelihood of rural families. SRTT must be complemented for the success in coordinating Department of Agriculture, Punjab; Punjab Agricultural University, Punjab government and farmers. For capturing such emerging issues, some modifications required in the IPM cotton project are as under.

4.1 Covering of cotton based agro-ecosystem in totality

The adoption of IPM in cotton crop during the past three phases has clearly indicated significant socio-economic and environmental gains accruing to the farmers, landless labour and other stakeholders. However, other crops in rotation, mainly wheat, mustard, barley remained untouched under the project. To make the technology more effective, it is essential to cover the entire crop sequence in the form of 'Habitat Management' which would

provide higher economic gains for livelihood and make the impact of interventions sustainable. Further, it would help other subsidiary farm enterprises such as beekeeping, dairy etc for still higher employment, economic gains and ecological balances. It would also be useful in recycling of bio-degradable waste into compost to improve the soil health and minimize air pollution caused by otherwise unavoidable burning. All such additional benefits could be realised by a meagre enhanced budget and without roping in extra agencies for this purpose.

4.2 Sustainability to the IPM Module in the IPM phased out villages

Cotton agro-ecosystem is witnessing rapid changes in different tools required for stress management and frequent availability of new genotypes/hybrids, emergence of new nutritional disorders and their management through nutritional formulations and development of new pesticide formulations against sucking pests, having varied levels of pesticide tolerance. For these, the farmers are left entirely to the mercy of pesticide dealers. For instance; unscientific and faulty use of such inputs may cause disruptions and adversely affect the self sustainability of the already existing IPM module which can be safeguarded through formation of IPM village clubs. Intelligent, sincere, trained young farmers may be motivated to form IPM village clubs, particularly in the phased out villages. IPM experts working in the currently adopted villages must develop at least cell-phone linkage with the club for spot guidance.

4.3 Validation of some new practices being favoured by farmers for cotton pest management through Punjab Agricultural University

i. It has been frequently expressed by the farmers that currently recommended pesticides are not providing a control of the sucking type of pests i.e whitefly and jassids. The farmers have thus started going for higher dose of recommended pesticides, mixtures of pesticides or some new chemicals. It all needs to be investigated to identify a satisfactory control of pests to check the adoption of old type of malpractices in use of pesticides.

ii. The private sector has come up with tractor mounted sprays using spray guns which are yet to be standardised. All such available types mechanical spray equipments may be got validated by the University.

iii. Spray of nutrients has become a standard practice especially during fruiting phase when pesticides are also required to be used. The farmers intend to save the cost of spray by mixing nutrients with pesticides which, if not complete, can lead to serious losses. So this aspect also needs to be investigated through field experimentation under the supervision of experts.

5 Organisational structure and operational issues

5.1 Organisational structure of IPM cotton

The existing organisational structure is functioning nicely but needs to be remodeled especially to cover larger areas during the next phase which may take into account the following suggestions:

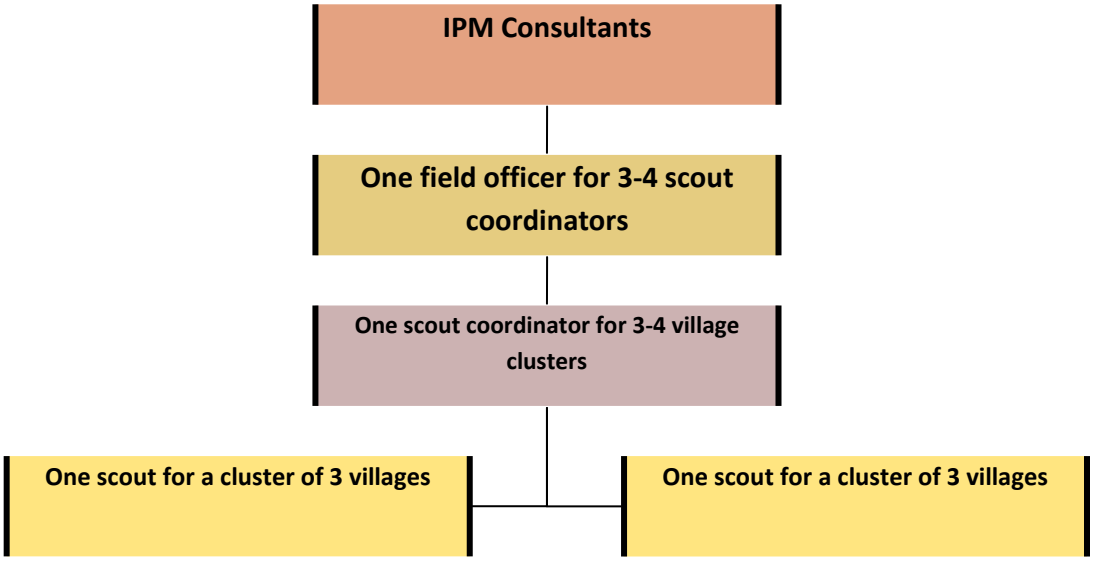
⇒ One senior scout at block level in coordinating position with salary of Rs7500/month should also be included in the hierarchy to create as an effective link (Fig 5).

⇒ Village scout is also considered as a person basically engaged in some occupation but also performs this activity part time. The payment of Rs3200 per month is made to him on this analogy. But it was realised that he should pay more attention to IPM job rather than treating it as casual and side activity. Therefore, it is proposed that he should look after the work of three villages in cluster and his salary be enhanced to Rs6000/month.

⇒ Salary of field officers should be revised to Rs24000/ month on a par with Research Fellows at PAU.

This structure would be more economical because on the whole, no additional burden would be created but effectiveness and efficiency would definitely be increased.

Fig 5: Proposed hierarchy of IPM cotton



a) 'Village Information Centre' should be equipped with

- Suitable specific visuals pertaining to nutritional deficiencies/ physiological disorders.

- An album of dry leaves/ infected plant parts showing symptoms of nutritional deficiencies, insects, diseases and other physiological disorders.
- Highlighting key action points about proper sowing, vegetative and fruiting phases in the form of do's and don'ts.
- Relevant literature including *Changi Kheti* should be added in information centre.

b) Best farmers, village scouts and field workers may be encouraged for excellent performance in IPM cotton.

5.2 Use of mass media

For technology dissemination, field days organised, success stories and impact analysis work carried out under the project since 2002 are quite encouraging and could be a guideline for other projects/ organisations. At present, the use of media in dissemination is limited. Although the mobile based dissemination of information (m-Krishi) was introduced but due to certain constraints, it could not attain the anticipated success and needs some rectifications. The farmers, policy makers, researchers, extension system, industrial concerns and public in general need exposure about exemplary operation of IPM project through press and other mass media. Some funds should be earmarked for such activities.

6. Summary

The first phase of IPM ending 2004 was assessed to have made a dent on livelihood of cotton growers in the adopted villages. The spread of area under the project in second phase thereafter further reduced the pesticide load by about 30% every year and presently only 3-5 sprays are given with balanced use of fertilizers. The overall direct net economic gain to the farmers was estimated as Rs. 4,484/acre or Rs. 11,210/hectare. The labour employment also enhanced by about 3.05 million man-days only for cotton picking. The additional production of cotton has created employment for women of rural landless families worth an annual Rs. 75.0 crores. There has been 25% reduction in sprays which has lowered the cost of production by 60 percent. The cost of plant protection which was 39 percent of total operation cost in cotton in the state has come down to 8.9 percent. The farmers not only in the villages covered under the project but even in rest of cotton growing areas have started making 2-3 sprays of potassium nitrate which has substantially increased fruit setting and ultimate yield of cotton. The safe environment by way of reduced use of pesticides has made cotton crop as best source of nector for honey bees as a result of which the quantity of honey rose from 5500 tons in 2005-06 to 14,000 tons in 2010-11. It is

encouraging to note that 54 percent cotton growers have been able to clear the debt through additional income generated through IPM technology. There is a strong felt need for strengthening of IPM cotton project for keeping the farmers abreast of the emerging problems and matching technology of cotton crop. It is suggested that cotton based agro-ecosystem in totality should be covered rather than only cotton crop in isolation. Sustainability to the IPM Module in the IPM phased out villages is needed. The success stories in IPM should be highlighted and practical field training programme for stakeholders should be chalked out. To improve the organisational structure, a scout should cover a cluster of 3 villages for continuously three years and a coordinator for 3-4 clusters can help in improving system efficiency.

References

- Joginder Singh, (2006-2011) 'Impact Assessment of Cotton IPM project, SRTT'
- Chahal, G.S et al., 'Annual Reports, RGR Cell'
- Punjab Govt., 'Statistical abstracts of Punjab'
- Punjab Govt. 'Economic Survey of Punjab'
- IASRI, ICAR 'Data Book'

Appendix 1: Use of pesticides in Punjab

Year	Pesticide use TGM (tonnes)	Cost of pesticides in cotton (Rs/ha)	% of total operational cost
1981	3200	144	6.84
1982	3500	186	9.12
1983	3800	255	11.70
1984	4200	315	11.91
1985	4800	319	11.19
1986	5200	352	10.58
1987	5500	466	12.85
1988	5800	583	16.47
1989	6200	652	15.52
1990	6500	1131	21.59
1991	6500	1096	18.08
1992	7300	1446	22.10
1993	7400	1597	22.67
1994	7300	2243	25.37
1995	7200	2000	21.08
1996	7300	2401	20.02
1997	7150	2429	25.34
1998	6710	2997	27.76
1999	7072	4702	30.73
2000	7005	NA	NA
2001	7200	7172	37.69
2002	6400	6812	35.49
2003	6900	8470	38.87
2004	6487	4725	21.46
2005	6020	2016	10.38
2006	5970	1691	8.17
2007	6080	2004	8.96
2008	5760		
2009	5810		

NA=Not available

Sources: Economic Survey of Punjab & Comprehensive Scheme on Cost of Cultivation, Punjab

Appendix 2: Area, Production and Average yield and market price of cotton in Punjab

Year	Area	Production	Average Yield	Harvest Price of unginned Cotton (Rs /qt)	
	(000ha)	(000 bales)	(Kg/ha)	American	Desi
1980-81	649	1178	309	325.90	391.23
1990-91	701	1909	463	756.64	894.3
2000-01	474	1200	430	1497.00	2047.00
2001-02	606	1305	366	1828.84	1827.91
2002-03	450	1085	410	1955.06	2004.56
2003-04	452	1478	556	1877.46	2381.94
2004-05	509	2088	697	1812.73	2053.90
2005-06	557	2393	730	2049.57	2049.57
2006-07	614	2678	741	2078.00	1817.50
2007-08	605	2359	663	2541.93	2127.73
2008-09	527	2285	737	2730.00	2582.91
2009-10*	511	2006	668	2730.00	2600.00
2010-11*	483	1822	641		

*Provisional

Sources; Statistical Abstracts of Punjab

Appendix 3: Day to day account of team

⇒ Day 1; 20.10.2011: Discussed with Dr G.S.Chahal and Mr B.S. Saini about the operation of the project and reports already compiled on IPM cotton. The plan for the field visits was also chalked out.

⇒ Day 2; 21.10.2011: Discussed some issues with Dr A.S.Dhatt, studied the reports and collected the secondary data on cotton crop in Punjab and shared the experiences by team members.

⇒ Day 3; 22.10.2011: Continued with sharing the information and compiled the results arrived at by the past studies.

⇒ Day 4; 24.10.2011: Visited the office of Director of agriculture, Punjab, Chandigarh. Discussed with Sh Jasbir Singh, Sh Tarsem Singh and Sh Gurvinder Singh about the current crop situation, problems in working of IPM project and need for its continuity and suggestions for improvement.

⇒ Day 5; 25.10.2011: Visited the office of Chief Agricultural Officer, Ferozepur and discussed with field staff of DOA and RGR cell the field operational problems and need for improving upon the IPM cotton project.

⇒ Day 6: 27.10.2011: Reviewed available literature relevant to the project mandate. Collected secondary data on pesticide use on cotton in Punjab.

⇒ Day 7; 28.10.2011: Started compilation of report and consequently discussed the emerging field problems in cotton cultivation and role of IPM in improving livelihood in the area.

⇒ Day 8; 29.10.2011: Collected some more facts to fill up the weak links in systematic presentation of facts.

⇒ Day 9; 31.10.2011: Visited the office of Chief Agricultural Officer, Bathinda and Mansa districts and discussed with field staff of DOA and RGR cell, field operational problems and need for improving upon the IPM cotton.

⇒ Day 10: 1.11.2011: Completed the draft write up of the report and submitted to the RGR cell.

Appendix 4

Insecticide Resistance to various insect pests of cotton in Punjab as reported by various workers

Insect pests	Common name	Insecticide to which resistant	Level of resistance	Reference
Bemisia tabaci	Whitefly	cyfluthrin, cypermethrin carbamates and organophosphates	to cypermethrin (5 - 60000 fold), fenvalrate(16 to 3200 fold), quinalphos2 to 59 fold, monocrotophos (0.4 to 3 fold)	Mehrotra and Phokela, 2000
Helicoverpa armigera	American bollworm	endosulfan, carbaryl, endrin, DDT+ toxaphene, organophosphates, synthetic pyrethroids		Mehrotra and Phokela, 2000
Spodoptera litura	Tobacco caterpillar	DDT, endosulfan, fenitrothion, HCH, lindane, malathion, methyl parathion, monocrotophos		Mehrotra and Phokela, 2000
Spodoptera litura	Tobacco caterpillar	Endosulfan, fenvalrate, chlorpyriphos, quinalphos and carbaryls		S. Sahoo and S K Kapoor(2007)
Helicoverpa armigera	American bollworm	20-40 % resistance to Quinalphos, 15-30 % to endosulfan , metomyl and also to pyrethroids in the population collected from different district of Punjab		Kapoor 1998
Bemisia tabaci	Whitefly	Dimethoate, oxydemeton methyl, acephate, chlorpyriphos		Darshan Singh (1998), Joginder Singh (1998)
Helicoverpa armigera	American bollworm	High resistance to pyrethroids (cypermethrin, deltamethrin, fenvalrate) and quinalphos, moderate to monocrotophos, endosulfan,		Dhawan et al (2005)

		chlorpyriphos, methomyl	
Helicoverpa armigera	American bollworm	5-6500 fold to pyrethroids in Punjab but lower than south India 1-14 fold to endosulfan 20-25 fold to quinalphos in the Punjab populations	Armes *et al* (1998)
Helicoverpa armigera	American bollworm	65 fold to monocrotophos, 82 fold to chlorpyriphos , 15 fold to quinalphos, 22 fold to methomyl, 4-37 fold to endosulfan	Kranthi *et al* (2001)
Helicoverpa armigera	American bollworm	**very high resistance** –cypermethrin, fenvalrate, deltamethrin **high resistance** –beta cyfluthrin **medium** ----quinalphos, chlorpyriphos, monocrotophos, endosulfan, thiodicarb **low level**--- methomyl	Kranthi *et al* (2005)

Appendix-5

ToR- Dr. N.S. Malhi, Convener, Assessment Committee

Consolidated Impact Assessment of Cotton IPM programme in Punjab and suggest Ways for its Sustainability

Background:

The "Green Revolution" symbolizes phenomenal increase in food grain production, especially that of wheat and rice, during 1960s and 1970s that transformed India from a food deficit to food surplus state. After independence of India in 1947, the efforts made to increase food grain production were not successful since these were largely concentrated on expanding the farming areas under traditional practices of agriculture. On account of fast increasing population that outpaced the rate of increase in food grain production, merely expansion of cultivable land did not meet the fast increasing demand of food grains. It was only the introduction of high yielding and input responsive dwarf varieties of wheat and rice, along with matching crop production and protection technologies that ushered in the Green Revolution with unprecedented increase in agricultural production. As a consequence of this phenomenon, a record grain output of 131 million tons in 1978-79 was produced to meet the domestic demand for food grains in the country. The yield per unit of farmland improved by more than 30 per cent and crop area under High Yielding Varieties (HYV) grew from 7% to 22% of the total cultivated area during the 10 years of the Green Revolution. More than 70% of the wheat crop area, 35% of the rice crop area and 20% of the millet and corn crop area used the HYV seeds. In North India, the positive impact of the 'revolution' was largely felt in the states of Punjab, Haryana, and Western Uttar Pradesh. But even in this region, the increase in agricultural production did not sustain for long as the incremental gains from agricultural productivity started to stagnate during late 1980s. The compulsions of national food security necessitated the formulation of the policy of minimum support price (MSP) and Government sponsored procurement for wheat and paddy which encouraged farmers to maximize area under these crops. But such a predominant paddy-wheat cropping system, evolved through green revolution technologies, turned out to be exhaustive in terms of requirement of underground water, soil fertility and use of expensive agrochemicals. The overexploitation of underground water and soil fertility, along with excessive use of pesticides, rendered the agriculture in this main seat of green revolution as unsustainable and economically unviable. The ensuing stagnation in agricultural production and degrading economy of farming sector became a serious threat to national food security. Consequently, in view of the gravity of the situation, the Government of Punjab set up an advisory committee in 1986, under the chairmanship of Dr. S. S. Johl, which strongly recommended adoption of "Diversification in Agriculture" by shifting of substantial area from wheat and rice to other crops. In the committee's opinion, meaningful shifts could be possible by encouraging farmers to put more area under maize, cotton, oilseeds, pulses, fruits and vegetables, fodder, agro-forestry and sugarcane. But notwithstanding several attempts by the Government and agricultural

scientists, the shift from paddy-wheat cropping system has met with limited success. The Trust's strategy in this regard aims to facilitate the implementation of the Johl Committee Report on "Diversification in Agriculture" to make agriculture sustainable and economically viable so that farmers may prosper while producing more to feed the burgeoning population of India.

Amidst this scenario, the Trust operationalised the 'Reviving the Green Revolution (RGR) Initiative in Punjab in 2002, to seek answers and solutions to arrest the stagnation in agriculture in Punjab that had set, due to the above said reasons. The Trusts key partners within the initiative have been the various departments at the Punjab Agricultural University (PAU), Ludhiana, which have been involved in development and demonstration of various innovative concepts for farmers and the Department of Agriculture (DoA), Government of Punjab (GoP), which has been instrumental in up scaling the dissemination of the technologies and package of practices developed by PAU.

The overall success within the initiative, coupled with a major expansion and coverage under the projects, encouraged the Trusts to upscale the level of funding individual projects to a centralized organization with a dedicated team through operationalizing the "Reviving Green Revolution (RGR) Cell" through a one year grant of Rs. 5.65 Million *(RLC/2007-08/TCM(8)/8)*. The Cell established in 2008 is now a registered body housed in PAU with formal institutional structure and is responsible for prioritization of thrust areas of funding in PAU, besides monitoring progress of ongoing projects. Moreover, the Cell also functions as an idea incubator for development and testing of potential agricultural technologies for benefit of farming community. The key objectives of the RGR Cell are to: (i) support researchable issues in agricultural universities to fill in the gaps of the developed agricultural technologies; (ii) support large scale activities of universities for adoption of technologies by the farmers in prime areas of concern in agriculture; (iii) support development departments of state governments and the private sector in demonstrating frontline extension activities for increasing agricultural productivity and augmenting economy of farmers; and (iv) support activities that build market linkages of farmers, growth of subsidiaries and encourage agro-based entrepreneurship.

The overall success story of IPM cotton programme warranted continuation of support from the Trust towards interventions of the IPM cotton project in Punjab. In view of success of this intervention and strong desire of farmers for continuation of the same, the RGR Cell approached the State Government of Punjab to provide matching financial support for programme to cover all major cotton growing villages in next three years (2009-12) in a phased manner. The Government of Punjab agreed to be part of the programme with coverage of 150 villages each by the Trusts and 150 villages by Government with an annual outlay of over Rs 10 Million/year for the next three years i.e. 2009-12.

Current status of the IPM Cotton project

Since the start of recruiting village youth as 'Scout' from 2002, it has now fairly progressed and become popular among farmers as it has helped them increasing cotton productivity significantly. In 2006, the IPM technology was disseminated in 56 villages which was further extended to 112 villages in 2007. In the 2008-09 *kharif*, the Trust has further funded cotton IPM project

covering 224 villages (112 each by Trust and Govt of Punjab) in ten districts of Punjab. This was the year which marked the funding contribution from State Government for the Cotton IPM project. The three year (2009-12) project "Further Upscaling the Dissemination of Cotton-IPM Technology across Cotton belt in Punjab" is being implemented by RGR Cell in collaboration with Department of Agriculture. The RGR Cell and DoA, through its extension wing, selected 300 villages every year (150 from financial support of Trust and 150 from State Government) and thus over the three years, 900 villages have been covered in 10 districts. The RGR Cell was able to convince the State Government to leverage funds for a matching grant of Rs. 35 million for this project. The immediate scope of this project was to cover 90,000 farmers as direct beneficiaries and over 250,000 indirect beneficiaries in neighboring villages. The project would come to an end in March 2012 and currently the Trust is planning to organize a consolidated impact assessment of its last eight years support to Cotton IPM project and plan the way forward to sustain the same.

Objectives of the Review:

The assignment would cover the assessment of detailed impact of the project "Further Upscaling the Dissemination of Cotton-IPM Technology across Cotton belt in Punjab" since its inception in 2002. The main objectives of the assignment would be:

- To assess and quantify the consolidated impact of Cotton IPM project in Punjab in terms of level of technology adoption by farmers for improved cotton production, gains in productivity and reduction in use of pesticides along with other additional gains especially for project area farmers and also over the entire state; impact towards livelihood promotion of rural communities and their perception of the same.
- To assess and analyze the sequential and cumulative impact over three phases during which the project has been operated since 2002 with special emphasis on current status vis-à-vis pre-project period scenario.

Scope of Services:

The review mission shall consist of:

1. Dr. N.S. Malhi (Convener), ex-Director of Extension Education, PAU, Ludhiana.
2. Dr. Joginder Singh, Ex-professor & Head-Department of Entomology, PAU, Ludhiana.
3. Dr. Joginder Singh, Ex-professor & Head-Department of Economics, PAU, Ludhiana.

The mission would assess the outcomes of IPM Cotton project implemented under the initiative 'Reviving the Green Revolution'. The mission would spend three days to assess Project Reports and Impact Assessment Reports of the project operated during previous years to assess the impact of the project on the status of agriculture and rural populations.

- Detailed information about each aspect of the project interventions including operational and technical issues with special emphasis on anticipated gains supported by relevant data would be obtained from

project. The panel in its preliminary meeting(s) with Trust/ RGR Cell may plan to seek additional information to attain the objectives of the impact assessment exercise. The information so supplied would be discussed with concerned project leaders by the team during its four days field visits.

- A comprehensive review of the various activities in terms of Scouts role as social entrepreneurs, (ii) community sensitization through various means such as training camps, village information centers, farmers meetings; iii) community mobilization for group actions such as weed removal; adoption of Package of Practices at farmer level etc should also be conducted. The Trust's efforts on introducing mKrishi (mobile based agro advisory service) technology should also be reviewed by knowing perception of cotton growing farmers.
- To identify key shortcomings/limitations/problems in the operation of the project along with recommendations for corrections for long term sustainability of IPM technology.
- Assess and analyze the production and marketing practices for cotton and identify the deviations from recommended practices having impact on socio-economic and environmental parameters in the study areas.

- The mission would spend four days to visit field areas for collection of relevant data as per schedule given below and for interaction with farmers, field staff from Department of Agriculture, Director of Agriculture, Director of Research of Punjab Agricultural University and other stakeholders such as Seed companies' representatives and agencies such as Markfed considered relevant. Thereafter, three days would be spent on report writing.

- The mission would conduct a detailed assessment of ongoing IPM programme and suggest ways and means for further sustainability of this intervention. The mission would also critically analyze the ground reality in terms of improving soil health, nutritional aspects and developing strategies for managing new pest problems. Thereafter inputs would be provided on the sequential and cumulative gains over the initiating years and further long term potential of the interventions on sustainability and profitability of Cotton IPM programme. The mission would provide suggestions about any change in the system and areas of research and extension for financial support especially for improving the economic status and livelihoods of rural populations.

- The mission would submit a detailed draft report to the Trust within seven days of completion of exercise. The report should have the following chapters in addition to others:
    1. An executive summary
    2. A background chapter
    3. A brief account of the design of review exercise
    4. A chapter on findings and recommendations.
    5. Any other annexure relevant to the exercise.

- On review of the draft report and receipt of Trust feedback on the document the mission would be requested to submit the final report.

Schedule for the visit

Schedule	Program
Day 1, 2 & 3 (October 17-19, 2011)	Desk Review of reports and discussion on key achievements of the projects.
Day 4, 5 , 6 & 7(October 20-23, 2011)	Field visits for interaction with farmers, field staff from Department of Agriculture, Director of Agriculture, Director of Research of Punjab Agricultural University and other stakeholders such as Seed companies' representatives and agencies such as Markfed considered relevant.
Day 8 & 9 (October 24-25, 2011)	Draft Report Writing
Day 10 (October 26, 2011)	Final Report

Final output that will be required of the Expert Review

Three copies of Final Report with a comprehensive chapter on findings and recommendations