

Sir Ratan Tata Trust

Final report of Impact Assessment

**IPM Cotton project for boosting
diversification process in Punjab**

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February 2011

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Executive summary

- 1. The economic impact of the project was approximated to Rs11823/ha and average farmers with 2.26 ha of area under cotton appeared to have gained Rs26700 per annum. The overall use of pesticides and fertilizers declined by 25% and 6.3% respectively compared to non-project farmers.*
- 2. Gain in Phase 1 villages is being diluted and need follow up approach and the farmers are being drifted towards the advice of private dealers.*
- 3. Appropriate seed variety is the base of IPM of cotton crop. Most of the problems stem from non-availability of authentic seed of desired variety. Existence of a large number of varieties of private companies is confusing to the farmers. The seed of desired varieties was available only in black market and even had genetic variability and mixtures and thus plant size and fruiting varied widely in the same field.*
- 4. In stead of one packet, 1½ to 3 packets of seed were used per acre with commitment to thin the crop but thinning is not done, resulting in uneven plant population in the field.*
- 5. Visit of agricultural specialists for addressing the problems of pest control in July to September may be geared up. In some areas camps were late but the information was, otherwise, quite useful. To the possible extent, the villages of earlier phases also should be covered.*
- 6. A number of small farmers and tenants tried cotton for the first time on the advice of SRTT IPM project staff and were very happy to have realized good income.*
- 7. Attack of Jassid, white fly, tobacco caterpillar and at the crop end mealy bug were problems. RCH134 faced leaf curl and higher attack of sucking pests. Prolonged rainy season added to the problem.*
- 8. Abohar area faced typical problem of severe attack of white fly and other pests, possibly due to large area under kinnow orchards, an alternative host for them. Kinnow fruit setting this year was stated to be less and many farmers planted cotton in the orchards.*
- 9. Refugia seed in many cases was kept unused due to improper knowledge. A continuous awareness among farmers is required to educate them about use of refuge for long term sustainability of Bt cotton which is an important component of IPM*
- 10. Need for picking technology is increasingly felt due to problems of non-availability of labour and rising wage rates.*
- 11. Market intelligence cell for compiling and providing information about the market forces is the need of time because price is determined by open market system. More stress on hints for proper marketing is needed.*

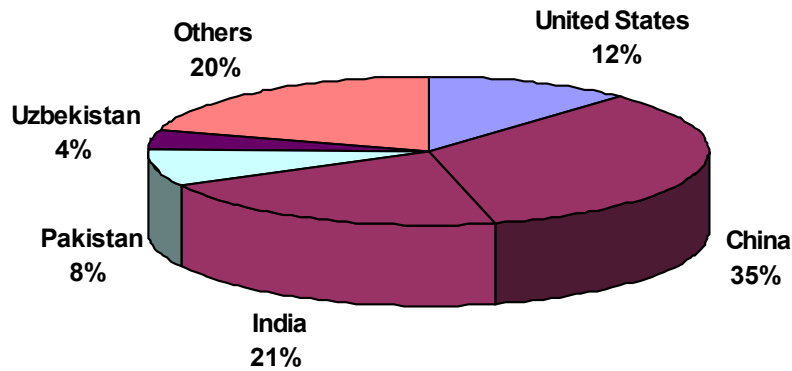
12. *Progressive cotton farmers, particularly in newer areas may be trained in PAU for better results. Best performing farmers and scouts should be encouraged.*
13. *New villages in the periphery which shifted over to paddy and invested in submersible tubewells are planning to shift back to cotton. More representation to such areas should be given for the next phase of IPM, so that diversification of Punjab agriculture can be hastened. To the possible extent, new villages should be nearby the left out ones so that proper follow up of those villages is also made.*

Impact Assessment Study of IPM Cotton project for boosting diversification process in Punjab

1. Introduction

Cotton is a crop of tropical region and its cultivation is concentrated mainly in Asia. The major countries known for its production in Asia are China, India, Pakistan and Uzbekistan which together account for more than 68% of the global production (Fig 1 & Appendix 1). Another 12% is produced by USA. India with 13200 million tonnes of production of seed cotton contributes 21% of world production. However, in terms of average yield of seed cotton as 1569 kg/ha, it lags much behind China where it was 3963 kg/ha and Uzbekistan and Pakistan having 2115 and 1959 kg/ha in 2008-09 respectively. One basic reason for this low productivity in India is that only 35% area under cotton is irrigated.

Fig 1: Production of cotton by major countries, 2008-09



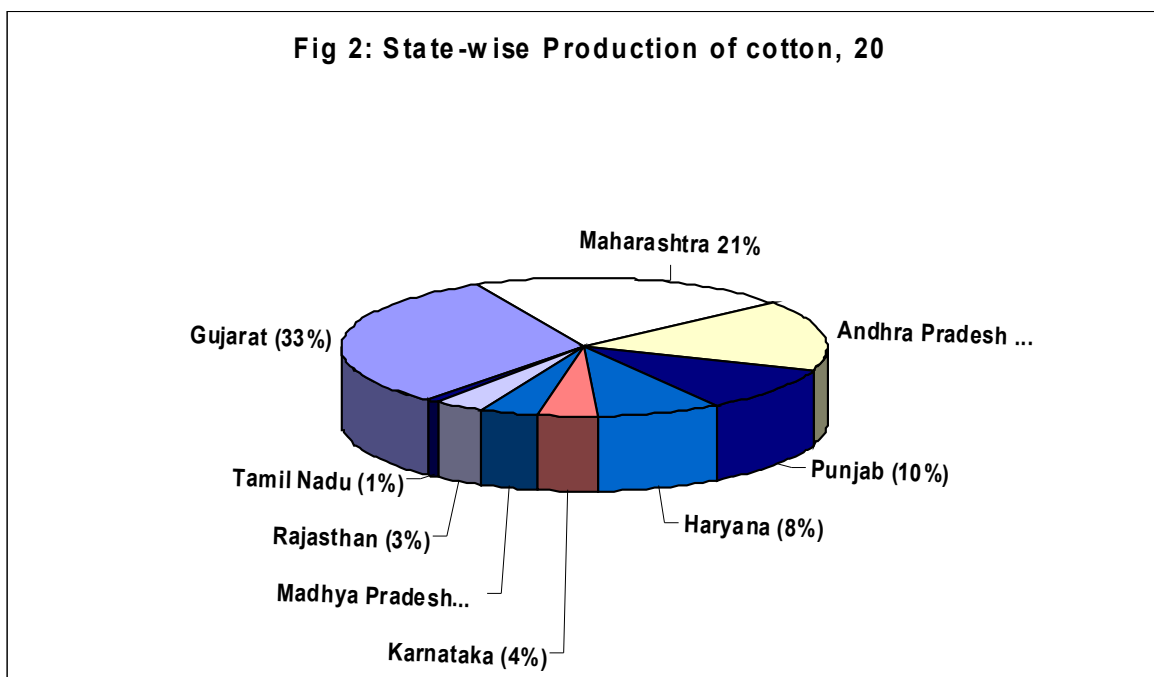
Cotton is a major cash crop of India, the area under which was 56 lakh hectares in 1950-51 but has shown consistent increase till the early eighties. During eighties, area again declined at annual Compound Growth Rate (CGR) of 1.25% in spite of rising productivity of the crop possibly due to faster increase in productivity and prices of food-grain crops. The pest problem on cotton crop became serious in nineties causing fast deceleration in average yield at CGR of minus 0.41% (Table 1). This was a period of serious economic turmoil for cotton growers pushing a number of them in heavy debt and even in suicide trap. However, revival of cotton crop due to introduction of Bt strains since 2002 has given a new lease of life to them and the annual CGR in yield during the past one decade worked out to as high as 11.21%. Amongst the major cotton growing states are Gujarat, Maharashtra, Andhra Pradesh, Punjab, Haryana, Karnataka, Madhya Pradesh and Rajasthan (Fig 2).

Table 1: Annual Compound Growth Rates in area, yield and production of Cotton crop (%)

Period	India	Punjab state
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	Area	Production	Yield	Area	Production	Yield
1980-81 to 1989-90	-1.25	2.80	4.10	0.48	9.54	9.00
1990-91 to 1999-2000	2.71	2.29	-0.41	-2.39	-11.36	-9.18
2000-01 to 2009-10	2.13	13.58	11.22	1.74	9.93	8.05

Fig 2: State-wise Production of cotton, 20

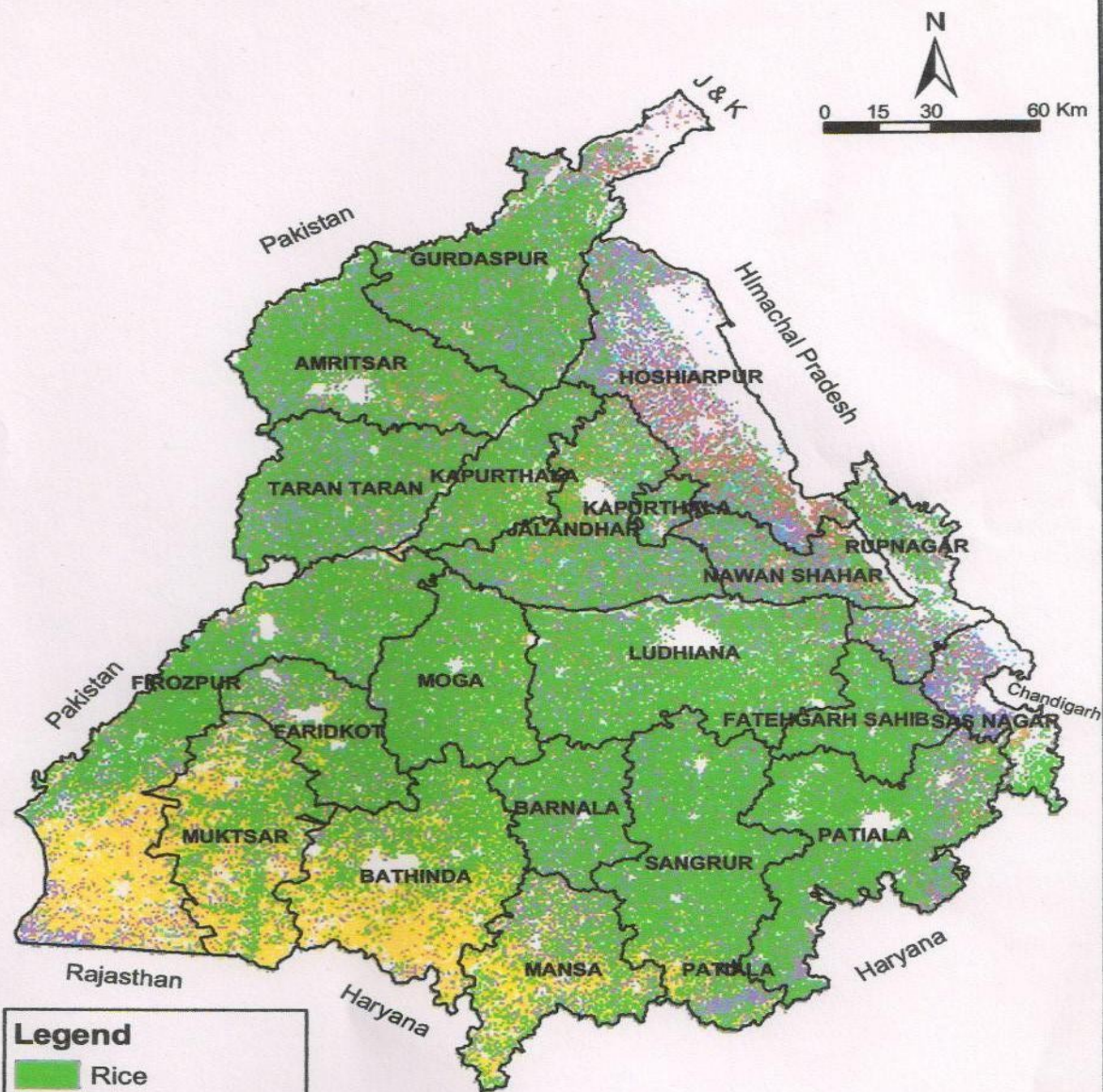


Punjab state contributes about 10% to the national output of cotton. Due to agro-climatic conditions, the south-western area of Punjab comprising Ferozpur, Faridkot, Muktsar, Moga, Bathinda, Mansa and Sangrur districts are most suited for growing this crop in *kharif* season (Appendix 5). Even within this belt, the crop is concentrated only in 24 blocks which account for 95% of area under cotton in the state (Ref Map showing Kharif crop pattern of Punjab). Therefore, economy of this part of the state is largely dependent upon the success of cotton crop. The productivity of cotton suffered most serious setback in Punjab where it dipped from 582kg/ha in terms of lint in 1991-92 to just 180 kg/ha in 1998-99. The crop yield was affected mainly by biotic stresses such as serious pest infestation particularly American boll worm. Therefore, the situation in

cotton belt of Punjab was in no way better than that of rest of India. The farmers suffered serious setback due to squeezing profit margin between fall in yield and increase in cost of plant protection accompanied by perpetuating indebtedness to non-institutional agencies and a consequent fall in prices of land, tractor and other assets.

The area under the crop has also been widely vibrating mainly to the tune of its productivity. To be more specific, there existed a safe potential margin of about 3 lakh ha to be shifted from rice crop back to cotton as evidenced from the fact that the crop covered 7.59 lakh ha in 1988-89 and dropped to 4.50 lakh ha 2002-03. During the failure of cotton crop in the state in nineties, sizable area got shifted from cotton to rice crop wherever deep groundwater of good quality could be exploited. The revival of cotton crop has therefore, special significance for the Punjab state which is heading towards rice-based ecological problems, particularly depletion of water resource. As a result of recent introduction of Bt strains of cotton, the crop has started picking up in the state. The last one decade has seen the CGR in average yield as 8.05% and consequently in cotton area as 1.74%. Yet lack of awareness of farmers about different agronomic practices of cotton production and marketing is the main area to be reckoned with for yield improvement and cost reduction for making it much more remunerative and thus relieve area from paddy for cotton to minimize ecological problems, generate more human labour employment and activate secondary and tertiary sectors.

KHARIF CROPPING PATTERN OF PUNJAB STATE (2004-05)



Legend

- Rice
- Cotton
- Maize
- S. Cane
- Vegetables
- Other crops
- Pulses
- Non-agriculture

~ District Boundary

Source: Remote Sensing Data

Prepared by: PRSC, Ludhiana and SAC, Ahmedabad

Map No. 1.2

Under such a situation Sir Ratan Tata Trust initiated the 'Project on Promotion and Validation of Cotton IPM Technology in Punjab' in March 2005 with Department of Agriculture Punjab as a nodal agency. Integrated Pest Management (IPM) was the main aspect to be taken care of. It takes holistic view of agricultural production and tries to minimize the use of chemicals by exploiting the trade off between chemical inputs and 'natural' inputs through careful monitoring of pest population, using mechanical and agronomic measures, encouragement of the natural predator population, checking the alternative hosts of pests etc. Subsequently, Reviving the Green Revolution (RGR) Cell was set up to take forward the success stories in 2008 which is roping in the State department of agriculture and Punjab Agricultural University to hasten the process of achieving the objectives. The impact assessment of the effort was made by the author, which revealed that a net addition of about Rs7000/ha in 2005-06 and Rs11188/ha in 2007-08 owing to yield improvement and cost saving apart from positive signals of social and ecological parameters. Based on the encouraging results, the Trust enhanced its efforts to improve the situation by educating the farmers of the area for increasing yield and lowering cost. Through RGR Cell, it funded the adoption IPM programme of 112 cotton villages while 112 villages were adopted by Department of Agriculture, Punjab. Viewing at the success of the programme, Govt. of Punjab have continued with sharing an equal number of 150 villages with the trust, thus covering 300 villages in 10 districts of cotton belt for three years (2009-11). It was expected that it would cover 90 thousand farmers as direct beneficiaries and 250 thousand as indirect beneficiaries of neighboring villages. Each beneficiary is expected to gain Rs21820/ farmer and generate large scale employment for rural families, particularly women in the area.

Information to the farmers is passed on through village scouts and directly by the Agriculture experts in training camps, field days, field visits organized for this purpose, distribution of pamphlets and conducting meetings at information centers set up for this purpose. This study with de-facto and post-facto analysis was carried out to bring out the socio-economic and environmental impacts of such interventions. Being mainly an educational programme, it is difficult to exactly quantify the impact. But the important ones taken include improvement in yield, reduction in cost of production, change in

employment of human labour, ecological parameters, educational aspects etc. on the target group of population and suggest ways to improve its effectiveness. This study has been planned to bring out the impact of the project on socio-economic parameters ultimately impacting the quality of life of rural masses in the cotton belt. The underlying specific objectives are spelled out as under.

2. Objectives

- a. To analyze the existing production practices with specific reference to IPM technology adoption by the farmers and reasons for deviation from recommended level.
- b. To study the inventions made by SRTT through various institutions and to assess the social, economic and environmental impacts of cotton IPM technology through its adoption by the farmers
- c. To highlight the constraints and problems in organizational set up and implementation process of the project and suggest ways to make it more effective in future.
- d. To illustrate the cotton market structure in the state and suggest ways to improve the same.

3. Sample Profile and Data

A sample of 30 villages was taken out of 300 villages where the current IPM is going on. As a baseline, sample of 10 villages not covered under the project were also selected. A random sample of 5 out of 56 villages covered under Phase 1 (2006-07) was also selected and 10 farmers from each such village representing different farm size categories were taken for comparison purposes. Thus in all, 302 farmers from current project villages, 106 farmers from non-project villages and 50 farmers from villages covered under Phase 1 (Appendix 7) formed the ultimate sample size. A detailed information regarding farm size, livestock, variety-wise area under cotton, cultivation and marketing practices followed, problems faced, type and quantum of interventions made, possible impact of such interventions, suggestions of farmers and scouts were collected

through personally interviewing the respondents with the help of questionnaire developed for this purpose (Appendix 6). The data were analyzed using various statistical techniques.

Out of villages taken for m-Krishi (Mobile based Agro-advisory) in the cotton belt 2 villages were also covered to assess the impact and problems realized and suggestions in the mind of stakeholders.

Table 3.1: Sample area and size selected for the study

S. No.	Village	District	Scouts paid by	Number of respondents
1	Gaga	Sangrur	DOA	13
2	Dharamgarh	Sangrur	DOA	11
3	Jakhpalwas	Sangrur	RGR	11
4	Chowas	Sangrur	RGR	8
5	Giderreani	Sangrur	RGR	8
6	Allamalla	Muktsar	RGR	9
7	Inakherra	Muktsar	RGR	10
8	Maur	Muktsar	DOA	11
9	Gobindnagar	Muktsar	RGR	10
10	Chak Midu Singh Wala	Muktsar	RGR	10
11	kandu khera	Mukatsar	DOA	10
12	Lohara	Moga	RGR	10
13	Kotla Raika	Moga	RGR	10
14	Demru Khurd	Moga	DOA	9
15	Samadh Bhai	Mansa	DOA	14
16	Makha	Mansa	RGR	9

17	Talwandi Akhlia	Mansa	RGR	10
18	Jhanduke	Firozpur	RGR	10
19	Killianwali	Firozpur	RGR	8
20	Chuhriwala	Firozpur	RGR	7
21	Dhani Mandla	Firozpur	DOA	10
22	Sehna	Barnala	RGR	11
23	Ishersinghwal	Barnala	RGR	11
24	khudi kalan	Barnala	RGR	10
25	Kaleke	Barnala	DOA	9
26	Kotbhara	Bathinda	DOA	9
27	Sukhasinghwal	Bathinda	RGR	10
28	Yatri	Bathinda	RGR	12
29	Mishriwala	Faridkot	RGR	11
30	Machakimal Singh	Faridkot	RGR	11
	Total			302

4. Respondents' background parameters

To understand the results in proper perspective, some relevant socio-economic parameters need to be kept in mind. Therefore, size of owned and operated farms, source of draft power, level of irrigation, livestock kept etc as effective parameters to direct the decisions of farmers are discussed in this section.

4.1 Farm size distribution

Distribution of respondents in terms of owned farm size and size of their operational holdings is presented in Table 4.1.1. It is interesting to note that 9.3% respondents were landless otherwise but had leased in land to improve their livelihood by

cultivation of cotton and wheat crops. Another 14% were marginal farmers each with less than 2.5 acres of land. About one-third of respondents owned land 5 to 10 acres. Only 8% farmers owned more than 20 acres of land.

In terms of operational holding the situation was relatively better. The average size of operational holding worked out to 12.7 acres of which about three-fourth of land was owned and the remaining one-fourth was leased in (Table 4.1.2). The farm size of sample farms of Phase 1 and non-project farms was quite comparable except that the land leasing practice in non-project villages was relatively less. Apart from leasing in land, some cultivators leased out a part of land on cash rent because management of distantly placed lands was cumbersome for them. Land lease market in Punjab thus seems to getting liberalized overtime as those leasing out have less and less fear of its redemption. Moreover, almost 75% farmers owning tractors and a 35 HP tractor can safely command 20 acres of land. Land rents are also rising overtime and varied from area to area with overall average of 30 thousand per acre in the cotton belt in 2010-11.

Table 4.1.1: Farm size distribution of respondents

Farm size	Owned holding		Operational holding	
	Number of respondents	% of respondents	Number of respondents	% of respondents
0	28	9.27		
Upto 2.5 acres	42	13.91	36	11.92
2.5 - 5 acres	62	20.53	63	20.86
5-10 acres	94	31.13	75	24.83
10-20 acres	52	17.22	79	26.16
20-30 acres	10	3.31	31	10.26
30-40 acres	9	2.98	8	2.65
>40 acres	5	1.65	10	3.31
Total	302	100.00	302	100.00

Table 4.1.2: Average Farm size (acres)

Category	Owned	Leased in	Leased out	Operational
Project farmers	9.30 (73.32)	3.72 (29.28)	0.31 (2.43)	12.69 (100.00)
Farmers of Phase 1	9.62 (73.38)	3.96 (30.22)	0.47 (3.60)	13.12 (100.00)
Non-project farmers	11.25 (84.02)	2.53 (18.90)	0.29 (2.14)	13.39 (100.00)

4.2 Source of power

As presented in Table 4.2, majority of farmers were having own tractors. Although fixed cost of a tractor in terms of depreciation and interest is unbearable for the small farmers but non-availability of it on hire during specific time of an operation costs the farmer very high. One bullock with cart was kept by about 50% of respondents to carry out light operations such as local transport of inputs, fodders etc. Yet one-third of farmers were solely dependent upon hired tractor for carrying out major farm operations such as land preparation, sowing, hoeing etc.

Table 4.2: Per cent farmers with sources of draft power

Category	Tractor owned	Bullock	Rented tractor
Project farmers	69.9	45.4	33.1
Farmers of Phase 1	80.9	58.4	21.3

Non-project farmers	82.4	47.1	19.1

4.3 Main source of irrigation

Canal was the major source of irrigation water on two-third number of farmers. But it was not a certain source and still more uncertain for farms located at the tail-end. Yet about 12% respondents were depending solely on this source (Table 4.3). The groundwater of first aquifer is invariably brackish, so this groundwater for irrigation is not advisable. Still though reluctantly, 41% farmers had to use such water. Another 31% had submersible electric tubewells of which water is of better quality. About 11.6% farmers had maintained diesel operated pumps or were using tractor for lifting water from the bores. Although electric power is cheaper but due to lack of its timely supply, they have to maintain diesel engine as standby source of power for uplifting water.

Table 4.3: Main source of irrigation of respondent farmers

Source of irrigation	Number of respondents	% of respondents
Only canal	38	12.58
Electric motor- Mono-block tubewells	124	41.06
Submersible tubewells	95	31.46
Only diesel motors/ with tractors	35	11.59
Hiring water	10	3.31

4.5 Supplementing livelihood with Livestock

Livestock is an integral component of farming. Almost every farmer keeps milch animals to meet their family requirements of milk. Buffaloes were commonly kept as milch animal in this area. An average farmer was keeping about one cow and three buffaloes to meet the family needs and selling surplus of about 5 lit of milk at an average price of Rs20/lit for meeting day to day requirements.

Table 4.4: Average size of livestock maintained by respondents

Category	Cows	Buffaloes	Bullock	Total
Project farmers	0.9	2.7	0.5	4.1
Farmers of Phase 1	0.4	2.6	0.6	3.6
Non-project farmers	0.8	2.8	0.5	4.1

Based on farmers' socio-economic and agro-climatic conditions of the area, cotton-wheat rotation is appropriately followed by them with some area put under paddy-wheat crop rotation. Kinnow orchards are also picking up in some areas showing promising returns. The farmers, in general and small farmers in particular, were satisfied with high return from cotton crop and are likely to increase area under the crop in the next year.

5. Agronomic practices of cotton crop

5.1 Land preparation and sowing

Invariably, all farmers reported that sowing of cotton was done from last week of April to first fortnight of May. Just after the harvest of wheat in mid April, land preparation work was started. Normally two to three ploughings (at least one with disc plough) and two plankings are given. After this, pre-sowing irrigation was given and seed was sown with machine designed for this purpose. A packet is stated to be enough for one acre. The seed rate varied from farm to farm with 1½ to three packets per acre. However, majority of farmers used 1½ packet of seed per acre with commitment to thin the crop but thinning is not done, resulting in uneven plant population in the field. Gap filling was done by 42.7% farmers and very few of them used plastic bags for raising nursery plants for this purpose. The main reason reported by the farmers was that there is degeneration of seed and the plant spread is much less what it was 3-4 years earlier. Some farmers said that they use higher seed-rate and plan thinning at later stage rather than using less seed and filling the gap due to poor germination. But actually thinning

was not done. This is an area where demonstration of proper seed rate for optimum plant population needs to be given.

Refugia seed was sown by only 37.75% respondents while the others did not use it. The farmers who had sown it, thought that they were wasting land by this and lacked clear cut guidance about the importance of sowing it and in stead of sowing on the periphery of Bt crop, they were raising it at some specific place nearby or at some common land.

Due to unusual prolonged rainy period during cotton crop season, the water requirement of the crop decreased significantly. The number of irrigations applied to cotton crop thus varied from 2 to 5 even though Bt cotton needs 4-6 irrigations depending upon the variety and type of soil.

It is essential to keep the crop free from weeds so that they do not compete with the main plants for water, soil nutrients, sunshine etc. Moreover, hoeing of crop is necessary to culturally control pests and for proper soil aeration. It was a common practice to do two weedings with tractor and tines followed by two weedings manually at later stage. The cost of this operation was estimated to be about Rs1200 per acre.

5.2 Variety-wise spread

The choice of varieties depended upon yield performance, availability of seed, suggestion of scout and canvassing by agents of seed agencies. It was typical that numerous varieties of cotton were reported to have tried by the respondents during 2010. Many of these were not recommended by Punjab Agricultural University. Non-availability of seed of certain varieties already experienced as better yielder was the sole reason for diversion. Much ahead of sowing time, seed agencies started booking by getting advanced payment from farmers. It was also reported that with seed they were forced to buy some pesticides and fertilizers. Under this cover, spurious seeds were also distributed. As presented in Table 5.2.1, the most dominant variety RCH134 raised by about 50% farmers on 27% of total area under cotton could not stand the test of time and yielded less owing to excessive rains and more susceptibility to white fly and other sucking pests. The other important varieties included MRC7017, 6488Bt and MRC6304

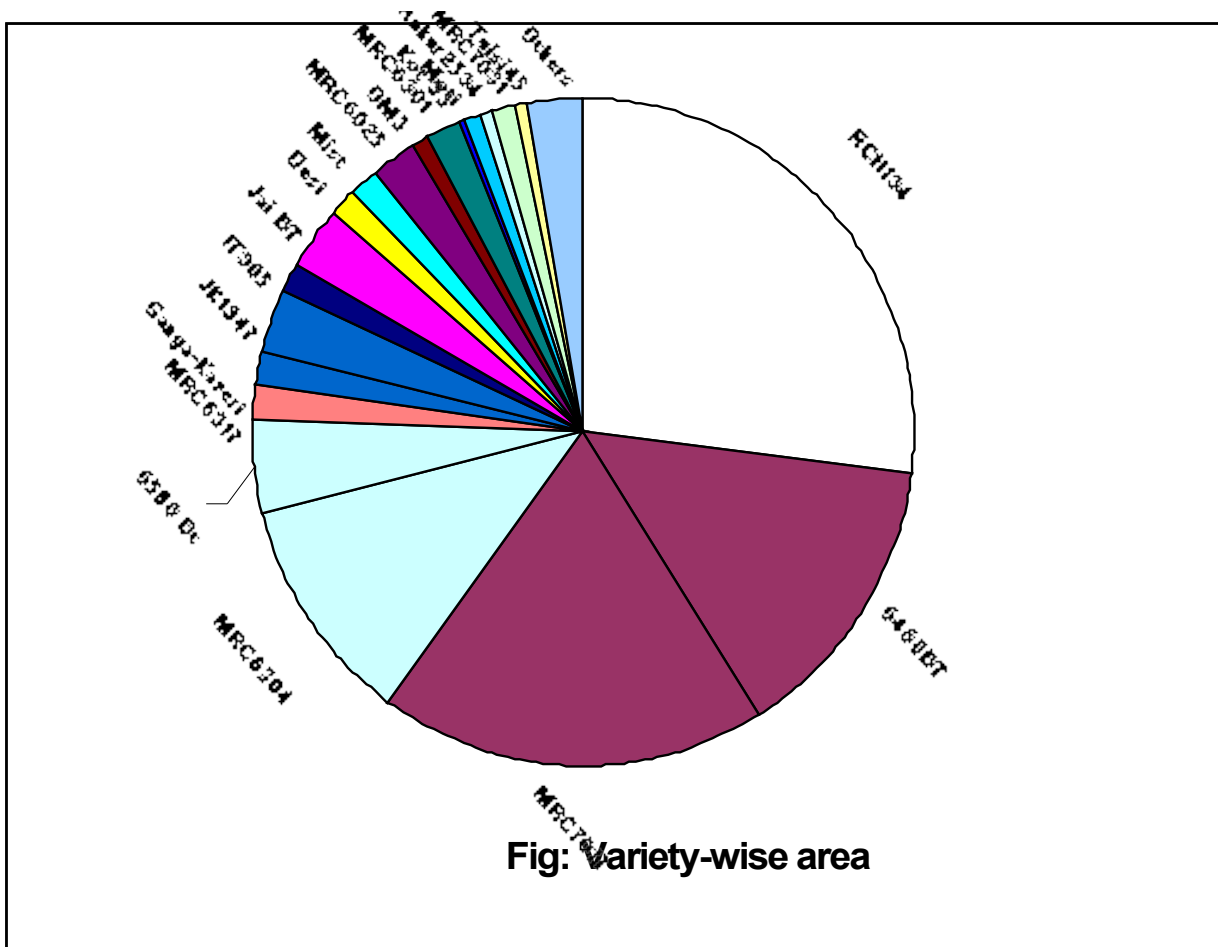
which covered 18.93%, 13.91% and 11.16% area and showed average yield performance of 24.5, 23.7 and 25.6 qt/ha. These four varieties thus covered 71% area under cotton. Another variety 6588Bt accounted for 4.44% area. It is important to note that 6488 Bt and 6588 Bt are not recommended by Punjab Agricultural University. The other varieties included MRC6317, Ganga-Kaveri, JK1947, IT905, Jai BT, Desi varieties, Mist, MRC6025, OM3, MRC6301, Kot33, Moti, Ankur2534, MRC7031, Tulsi45, Jyoti555, Mahi, Manak, Manat, Manjit, Mukesh, Namdhari.2, Raghav, Rashi, Super Ruby, Shakti, Sharbati, Shilpa, Vishal, and some other unspecified strains. As per experience of the farmers, the same field should not be put under one variety year after year as the yield falls. This needs to be verified.

No inference can be drawn from average yield of varieties covering negligible area. Moreover, due to heavy and prolonged rains during crop season, validity of yield data cannot be established and generalized. The normal price range during the crop harvest season was Rs4000 to Rs5200 with average of Rs4700 per quintal.

Table 5.2.1: Spread of different varieties among the respondents in Punjab, 2010-11

S. No	Variety	No. of farmers	% farmers	Av. area (acres)	% of cotton area	Average yield (Qt/ha)
1	RCH134	151	49.00	1.58	27.08	18.4
2	6488BT	75	24.83	0.81	13.91	23.7
3	MRC7017	93	30.79	1.11	18.93	24.5
4	MRC6304	71	23.51	0.65	11.16	25.6
5	6588 Bt	20	6.62	0.26	4.44	24.1
6	MRC6317	17	5.63	0.11	1.84	21.4
7	Ganga-Kaveri	14	4.64	0.10	1.67	20.8
8	JK1947	14	3.64	0.17	2.92	22.0
9	IT905	13	4.30	0.08	1.41	21.2

10	Jai BT	11	3.64	0.19	3.17	23.8
11	Desi	11	3.64	0.08	1.32	16.4
12	Mist	10	3.31	0.08	1.41	21.6
13	MRC6025	9	2.98	0.13	2.15	20.7
14	OM3	8	2.65	0.05	0.85	18.8
15	MRC6301	9	2.98	0.09	1.53	24.9
16	Kot 33	5	1.66	0.03	0.51	21.8
17	Moti	6	1.99	0.04	0.74	19.7
18	Ankur2534	5	1.66	0.04	0.64	19.6
19	MRC7031	4	1.32	0.06	1.05	23.9
20	Tulsi45	4	1.32	0.04	0.62	23.2
21	Others	21	6.95	0.16	2.66	19.4
	Overall	302	100.00	5.65	100.00	22.3



The main varieties raised in different districts of Punjab during 2010 are presented in Table 5.2.2. It is obvious from this that the farmers diversified their area under cotton with adoption of different varieties. RCH variety covered more area in Mansa and Bathinda districts, 6488Bt in Mukatsar and Ferozpur, MRC7017 in Mukatsar and Faridkot and MRC6304 in Bathinda district. The districts of Sangrur, Moga and Barnala had to go in for less important and more diversified varieties. The performance of RCH 134 was poorer as compared to most of other varieties due to higher attack of pests and leaf curl.

Table 5.2.2: Major Cotton varieties adopted by farmers in different districts, 2010

	RCH 134	6488 BT	MRC7017	MRC6304
District				

	% area	% farmers	Av. Yield*	% area	% farmers	Av. Yield*	% area	% farmers	Av. Yield*	% area	% farmers	Av. Yield*
Sangrur	8.7	40.0	29.0	6.2	24.0	27.6	1.2	10	28.7	5.0	22	27.0
Muktsar	11.1	47.1	17.7	10.5	50.0	23.6	18.8	71.4	24.6	5.0	27.1	22.7
Moga	9.9	39.4	10.7	1.2	3.0	25.0	7.4	36.4	24.1	3.7	21.2	22.4
Mansa	12.1	65.5	21.5	4.4	24.1	21.6	1.9	6.9	24.3	5.8	27.6	26.6
Firozpur	6.1	32	13.8	9.9	32.0	19.0	4.6	20.0	20.3	0.0	0.0	-
Barnala	8.2	56.1	24.7	0.7	4.9	29.9	3.0	19.5	25.5	6.7	41.9	24.1
Bathinda	16.5	45.2	20.4	5.5	22.6	23.9	2.8	9.7	9.6	17.9	45.5	21.9
Faridkot	4.5	27.3	17.7	3.4	22.7	24.7	11.2	59.1	24.5	1.1	13.6	23.2
Overall	10.2	45	18.4	6.3	25.5	23.7	8.7	32.5	24.5	4.8	23.4	25.6

*Average yield in qt/ha

5.3 Use of agro-chemicals

With increasing stress on organic farming, efforts are concentrated on making use of minimum and balanced fertilizers and pesticides.

5.3.1 Application of fertilizers

About 14.9% farmers used farm yard manure to cotton crop varying from 3 to 7 trolleys per acre depending upon its easy availability. Against the recommended level of 60 kg nitrogen per acre, about 36% farmers used 50-70kg/acre but most of them applied 31-50kg/acre (Table 5.3.1). Another 12.25% applied less than 30kg/acre. The major source of nitrogen was urea. Thus use of nitrogen was less than recommended level. The recommended level of phosphorus was 12kg/acre while as many as 11% applied more than 18kg/acre and 3% did not apply phosphorus to cotton crop. It was drilled at the time of sowing in the form of DAP (Diammonium phosphate). The average use of 5.6 kg of Zinc sulphate per acre was also used. Although soil application of potash was not

recommended yet the farmers continue to use it. An average number of 2.4 foliar applications of Potassium nitrate were also made to avoid the deficiency.

Table 5.3.1: Fertilizer use in nutrient form to cotton crop by respondents, 2010

Nitrogen		Phosphorus		Potash		Pot. nitrate		Zinc sulphate	
Use	% farmers	Use	% farmers	Sprays	% farmers	Use	% farmers	Use	% farmers
<30kg	12.25	Nil	3.31	0	6.62	Nil	33.11	0	43.05
31-50kg	49.01	1-10 kg	3.97	1	9.60	1-12 kg	32.45	5-10kg	50.0
51-70kg	36.42	10-20 kg	49.67	2	31.13	13-18 kg	23.18	15	4.64
>70kg	2.32	20-30 kg	37.09	3	32.45	19-30 kg	11.26	20	2.32
		>30 kg	5.96	4	20.20			4	20.20
Average	57.4 kg		13.3 kg		10.4 kg		2.4 sprays		5.6 kg

The data collected under the ‘Comprehensive scheme cost of cultivation in Punjab’ shows application of fertilizers overtime on cotton crop. The use of fertilizers (in nutrient form) has gone up from 17 kg/acre in 1974-75 to 58.4 kg/acre in 2006-07. This was due to various reasons such as increase in adoption of technology and replacement of desi cotton by American cotton and introduction of Bt varieties, requiring higher doses of fertilizers.

5.3.2 Plant protection

Cotton crop has to make massive use of pesticides. Still pests cause losses estimated around 15% of the world harvest. In Asia alone US\$ 32 Billion is spent on

chemical products and 20% of global insecticides and 30% of pesticides used in Asia are applied to cotton only. Pesticide poisoning has undermined human health. Every year 1million to 5 million cases of pesticide poisoning are reported in developing countries (WHO 1999).

As may be seen from cost of cultivation data presented in Table 5.3.2, the pesticides are increasingly used with the passage of time. For example, it was only Rs30/ha in 1974-75 which steeply increased to Rs6812 in 2001-02. This inflated bill was partly due to rise in prices of pesticides and mainly due to their higher use. However, owing to introduction of Bt cotton in 2002, it drastically slowed down to Rs1691/ha in 2006-07.

In general, serious attack of leaf curl, jassid, white fly and mealy bug was reported this year which could be attributed to various reasons such as;

- a) Weather conditions were abnormal. High humidity due to heavy rains in July-September, 2010 was most conducive for such pests. Even pesticides are less effective in such conditions.
- b) More plantations of orchards are in the process and the pests find alternative hosts. For example, sucking pests and drying of cotton plants are more serious problems reported in Abohar area.
- c) Against the recommendation, plantation of cotton in orchards was also done in many cases on the plea that fruit setting of kinnow was less.
- d) The number of cotton varieties are multiplying as discussed above. Pest problem also multiplies proportionally. For example, it was reported that some varieties such as RCH6304 & 6025 were more susceptible to leaf curl more in Firozpur.
- e) Higher use of nitrogenous fertilizers by some farmers was another causal factor for this menace.
- f) Sowing of non-Bt seed (refugia) on the crop periphery was neglected by farmers. This could also be an added reason. If this is not needed, it may be forbidden but if it is necessary, farmers be more educated about its importance.

- g) With some preferred varieties, the seed companies were forcing farmers to buy some pesticides and fertilizers which they used irrespective of the need.

About 58% respondents stated to have given 4-6 sprays of various pesticides to keep the pests under control and another 18% sprayed the crop 7-8 times (Table 5.3.2). Yet one-fourth of farmers carried out pesticide less than three sprays. The average number of sprays given to cotton crop in different districts is presented in Table 5.3.3. The average number sprays varied from 3.4 in Sangrur district to 6.3 in Ferozpur district with overall average of 4.8 sprays. In case of control farmers, the average number of sprays worked out to 6.4 which mean that there is reduction in pesticide use by about 25%. It was also observed that 57.2% of sprays were used mainly against sucking pests like white fly and jassid, 18.0% to control tobacco caterpillars, 6.9% to check mealy bug and 17.9% for controlling leaf curl.

In Phase-1 villages, the average number of sprays was 5.6, higher than project villages as they were getting under the higher influence of private dealers.

Table 5.3.2 Number of sprays of pesticides

Number of sprays	No. of respondents	% of respondents
0-3	72	23.84
4-6	177	57.95
7-8	55	18.21

Table 5.3.3: Number of sprays given to cotton crop in different districts

District	Average number of sprays
Sangrur	3.4
Muktsar	5.6
Moga	4.3
Mansa	5.6

Firozpur	6.3
Barnala	4.3
Bathinda	4.3
Faridkot	4.8
Overall	4.8

5.4 Picking

Generally three manual pickings were done with mainly hired labour. At the fag end of the crop, bolls were picked and kept for sprouting. This is necessary to avoid delay in sowing of wheat crop. Local labour is employed for this purpose. In some areas of cotton belt paddy crop has also shared the net area sown. The labour gets more employment due to non-overlapping farm operations of cotton and paddy. For picking generally contractual labour is employed at the normal wage rate of Rs3.00 to Rs3.50 per kg of cotton picked. However, small farmers stated to use family labour for this purpose. The farmers felt that some labour saving technology should be developed for carrying out picking operation more effectively and economically.

5.5 Utilization of cotton sticks

Weight of cotton sticks and other crop residue depends upon the variety, climatic conditions, spacing etc. On an average, the farmers reported to harvest about 25 qt of cotton sticks per acre. This could fetch about Rs2250 in the market after paying for harvest labour. Due to shift in area from cotton to paddy and orchards, the availability of cotton sticks is declining. The labour employed for uprooting sticks and for other operations also share cotton sticks to meet the need for their kitchen fuel. On the whole, only 7.7% of crop residue was used for brick kilns, 1.4% for energy generation and rest for kitchen fuel. The dry leaves and small twigs falling on the ground were ploughed back in the soil at the time of land preparation for sowing the oncoming crop.

Table 5.5: Use of cotton sticks for different purposes by percent respondents, 2010

District	Kitchen Fuel	Fuel for Brick kiln	For Power generation	Ploughed in the Soil
Sangrur	75.24	1.00	0.00	0.00
Muktsar	78.14	15.57	4.71	0.14
Moga	90.91	9.09	0.00	0.00
Mansa	92.76	3.79	3.45	0.00
Firozpur	94.00	5.20	0.00	0.00
Barnala	93.66	6.34	0.00	0.00
Bathinda	87.10	12.90	0.00	0.00
Faridkot	95.45	0.00	0.00	0.00
Overall	85.80	7.75	1.42	0.03

6. Interventions of SRTT and their impact

During phase-1 of the project in 2005-07, selected 10 farmers of the adopted villages were provided with some inputs apart from information of IPM cotton. This aroused some operational problems due to which the process of supplying physical inputs was abandoned. Now for providing strong information base an information centre was set up in each selected village. It is manned by the village scout who is educated for the job through short training courses. The information centres are used to display visuals for identification of pests, useful insects, measures to prevent and control pests and encouraging useful insects for biological control. Pheromone traps are put at appropriate place to monitor the pest attack. The meetings in the village itself are held at regular intervals during the crop season. Monitoring of pests is done by him taking daily round of cotton fields of selected farmers and through pheromone traps set up at appropriate places in the village. The experts from SRTT and State Department of Agriculture also remain on vigil in these villages from time to time. They provide spot guidance to the farmers and scouts and get feedback for flashing messages to other areas.

Some basic questions were framed to enquire from the farmers about their awareness regarding existence of information centre in the village, regularity of visit to information centre, usefulness of the displayed material, based only on displayed material if they could adopt the practices, being constantly in touch with the village scout and usefulness of attending meetings. All the respondents without exception provided positive and encouraging responses. Rather they proposed that apart from cotton, it may be extended to other crops in rotation with cotton, particularly wheat, kinnow orchards, chilli, tomato and other vegetables, livestock, other services such as soil and water testing, care of farm machinery and sometimes bigger field show be organized.

6.1 Economic aspect

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 (Table 6.1). Price was also improved by Rs33/qt due to guidance about care for marketing. Similarly, cost reduction due to balanced use of inputs, particularly agro-chemicals was estimated as Rs507/acre. Therefore, valuation of enhanced yield amounted to Rs3936/acre and that of higher price to Rs287/acre. Therefore, an overall annual economic average gain to a cotton farmer was assessed as Rs4729/acre or Rs11823/ha or Rs26719/farmer. Inter-district variation in economic impact was also estimated. It came out to Rs6867/acre in Sangrur and as low as Rs1824/acre in Mansa district. This is annual impact and is likely to continue for long period. It can be sustained through follow up by extension workers as well as by farmers. The impact of IPM technology on Phase 1 villages appeared to dampening with the passage of time, necessitating follow up approach.

The landless farmers (pure tenants) gained from the higher profitability of crop over rental value of land and self employment of family labour for various operations and expressed to increase area under cotton crop the next year.

Table 6.1: Economic impact of IPM cotton in Punjab, 2010-11

District	Yield increase (q/acre)	Price increase (Rs/qt)	Cost reduction (Rs/acre)	Value of enhanced yield (Rs/acre)	Value of enhanced price (Rs/acre)	Total economic gain (Rs/acre)
Sangrur	1.24	36	644	5817	406	6867
Muktsar	0.64	43	716	2995	394	4104
Moga	0.52	25	433	2450	134	3017
Mansa	0.31	24	155	1459	211	1824
Firozpur	0.99	42	182	4662	297	5142
Barnala	0.93	26	537	4379	261	5177
Bathinda	1.05	12	313	4912	92	5317
Faridkot	1.04	54	693	4871	498	6062
Overall	0.84	33	507	3936	287	4729

6.2 Income utilization

Impact of increase in income could have multiple effects to the extent the additional income is channelized in the production process. As may be viewed from Table 6.2, repayment of outstanding debts was a priority with about 15% farmers. The most important investment to be made by farmers was on purchase and repair of farm machinery, followed by purchase of livestock and purchase/ hiring in of land. However, consumption expenditure cannot be ignored as funds are to utilized for education of children, construction and repair of house and even for social ceremonies to be performed.

Table 6.2: Per cent respondents indicating purposes of enhanced income utilization

District	Productive purposes					Consumption purposes			
	Debts	Livestock	Machinery	Land	Others	Social purposes	Education	House	Other
Sangrur	12.0	2.0	48.0	54.0	0.0	56.0	48.0	60.0	0.0
Muktsar	28.6	38.6	57.1	27.1	0.0	45.7	81.4	52.9	1.4
Moga	3.0	30.3	72.7	0.0	3.0	63.6	66.7	39.4	0.0
Mansa	24.1	20.7	55.2	17.2	0.0	31.0	62.1	55.2	0.0
Ferozpur	8.0	20.0	68.0	8.0	0.0	36.0	64.0	56.0	0.0
Barnala	7.3	41.5	61.0	31.7	0.0	43.9	68.3	39.0	2.4
Bathinda	0.0	48.4	64.5	54.8	0.0	83.9	71.0	67.7	0.0
Faridkot	18.2	36.4	54.5	22.7	0.0	45.5	50.0	54.5	0.0
Overall	14.6	29.8	58.9	29.1	0.3	50.7	65.6	52.6	0.7

6.3 Environmental and social impacts

The environmental impact of any project has assumed greater significance as it is an important parameter of quality of human life and sustainability of livelihood. The cotton growers have perception of higher water requirements of Bt varieties as compared to non-Bt ones. Even in the last report it was mentioned that the farmers apply even more than 10 irrigations in certain cases against the recommended level of 4-5. However, this year more rains reduced the water usage. A perusal of Table 6.3 shows that the response of farmers in terms of water saving was 25.2% who were of the view that number of irrigations have decreased due to advice under the project. Similarly, improvement in soil health, lessening air pollution, improving human health was reported by 14.9, 15.2 and 12.6 per cent respondents. Effective check on pests and increase in population of useful insects was also stated by about one-fourth of respondents.

Table 6.3: Positive Environmental and social impacts of project

Parameter	% response
Water saving	25.2
Soil health	14.9
Less Air pollution	15.2
Human health	12.6
Pest control	22.8
Population of useful insects	27.8
Employment of male	17.5
Employment of female	34.1

6.4 m-Krishi scheme

A visit to m-Krishi villages, namely Gehributter (Bathinda district) and Jhanduke (Mansa district) revealed that selected farmers were supplied with mobile sets along with software at subsidized rates. Snaps are taken by the farmers and transmitted to experts for identification, intensity of problem and measures for rectification of the same. The selected farmers are benefited from this because of quick solution to the problems. This is also an educational process for them. Once they get used to this system of extension contact, early solution at cheaper rate would be available which would be of immense help. The cost of snap transmitting was stated to be two to three rupees due to which they hesitate to use in the initial stage. It appears to be more workable if this facility is further extended so that area specific problems are also addressed quickly.

6.5 Yield variability

The yield in every village varied widely from one field to another. In majority cases the range was 5 to 40 qt/ha. This question was framed to specifically enquire from farmers if they learn lessons from farmers of the village obtaining highest yield. The

reasons spelled out by them were; variation in soil type, water availability- quantity and quality, variety type and genuineness of seed and management practices typically timeliness in agronomic practices such as weeding, fertilizer use and plant protection. Low lying fields suffered more during heavy rains. Double Bt varieties in spite of less attack of pests was reported to have low yield potential than single Bt.

6.6 Response of Scouts

Regarding the ability of scouts to handle the project, the farmers invariably painted positive picture. To improve the effectiveness of project, some scouts reported that if some progressive farmers are also provided training just like them, it can have better demonstration effect on others. The main problem hindering the IPM cotton faced by them was the non-availability of recommended and desired seeds already experienced by farmers. The prolonged rainy season also reduced the effectiveness of agro-chemicals this time. They were mostly of the view that some other crops of area should also be covered under the system. The varieties most popular in the field but not recommended by PAU covering significant area should be tested and short-listed for specific area locations.

6.7 Some project operational issues

Opinion of respondents in terms of possibility of improvement of operation of project was also sought. A vast majority (94%) of them wanted to extend it for other crops such as kinnow, pulses, oilseeds, wheat etc so that farmers remain in contact with the extension system for improving their farming. Some services such as testing of micro-nutrients, water and soil testing, marketing guidance etc were also need of 81% farmers.

Almost all respondents reported that beneficiaries of project belonged to the village, while 48% had experience of some farmers of other neighbouring villages also benefited from the information (Table 6.7). No input except pheromone traps were supplied in the IPM villages. Fifty four per cent of sample farmers gave the opinion to

continue with having such traps even if the project is withdrawn. About 68.9% farmers stated that they would continue with the information system as and when project is withdrawn while the others were reluctant and wanted the flow of information system should continue for quite more number of years. Low positive response in Mansa was due to sample farmers fed up with confusion of varieties and they wanted some more time of guidance by SRTT set up. Thus two main information systems are running parallel in the villages. One is DOA accelerated by SRTT through RGR in selected villages and the other is private agencies through input dealers. More than two-third of farmers were firmly convinced by the former that they would continue to be linked with it. The others are equally influenced by private input dealers, particularly seed suppliers and wanted some solution to the problem of suitable seed variety and ensuring its supply for gaining reliability of IPM technology. Scouts were reported to be well trained for the job. It was suggested that even the progressive farmers should also be trained about cotton IPM technology to facilitate the work further. The performance of scouts and field officers be rated with objective criteria and best workers be encouraged.

Based on survey of phase 1 villages, it could be concluded that follow up advice in villages covered in earlier phases is required. To make it more practicable, the selection of villages in the oncoming phases be made such that to the possible extent, these are in line with each other.

Table 6.7: Type of beneficiaries and Future of information system (% respondents)

District	Project beneficiaries belong to			Would continue if	
	Farmers of the village	Farmers of neighbouring villages	Landless-Labour	Input (P. traps) is withdrawn	information system under project is discontinued
Sangrur	94.0	54.0	2.0	58.8	58.8
Muktsar	100.0	67.1	1.4	65.7	58.6
Moga	100.0	51.5	3.0	57.6	60.6

Mansa	100.0	27.6	0.0	65.5	48.3
Firozpur	76.0	8.0	0.0	84.0	96.0
Barnala	100.0	31.7	0.0	65.9	65.9
Bathinda	100.0	32.3	0.0	3.2	100.0
Faridkot	95.5	95.5	0.0	0.0	95.5
Overall	96.7	48.0	1.0	54.0	68.9

7. Crop economics and marketing aspect

7.1 Profitability of cotton crop

The cost-return analysis of cotton crop of project, non-project and Phase-1 farmers is shown in Table 7.1. In case of project farmers, total operational costs from land preparation up to marketing averaged to Rs10358 per acre. For phase-1 farmers, the cost was slightly less but in case of non-project farmers it was slightly higher. Cost comparison between project and non-project farmers shows that cost of picking labour was lower but cost of pesticides was higher (by 25%) and fertilizers (by 6.3%) in case of non-project farmers. The value of average yield of seed cotton was 8.92, 8.56 and 7.60 qt/acre which along with cotton sticks minus operational costs showed a net return of Rs33816, Rs32304 and Rs27455 in case of project, phase-1 and non-project farmers respectively. The impact of the project in Phase-1 is visible but still there is need for its revisit. The average price of seed cotton was taken as Rs4700/qt although the price initially was less and subsequently increased over the marketing period. The remunerative price of cotton witnessed during this year is likely to make its profitability higher than paddy crop and the farmers are for increasing area under cotton in the next year.

Table 7.1: Economics of cotton crop in Punjab, 2010 (per acre)

Operation	Project farmers		Phase 1 farmers		Non-project farmers	
	No.	Amount (Rs)	No.	Amount (Rs)	No.	Amount (Rs)
Ploughings & planking	3+2	1200	3+2	1200	3+2	1200
Sowing	1	400	1	400	1	400
Seed	1.5 packet	950	1.5 packet	950	1.5 packet	950
Weed control- Manual	2	600	2	600	2	600
With tractor	2	400	2	400	2	400
FYM	3.84 qt	96	1.70 qt	42	4.60 qt	115
13:0:45 and 19:0:19	3 sprays	600	2 sprays	400	2.5 sprays	500
Urea	110 kg	550	107 kg	535	123 kg	615
DAP	38 kg	380	30 kg	300	45 kg	450
MOP	17 kg	85	16 kg	80	25 kg	125
Zinc sulphate	6 kg	75	6 kg	75	8 kg	100
Plant protection	4.8 sprays	1200	5.6 sprays	1400	6.4 sprays	1600
Irrigations	3	200	4	300	4	300
Picking	4	3122	4	2996	4	2660
Marketing including transportation		500		500		500
Total operational cost		10358		10178		10515
Yield	8.92 qt	41924	8.56 qt	40232	7.60 qt	35720
By-product	25 qt	2250	25 qt	2250	25 qt	2250
Return over op. cost		33816		32304		27455

7. 2 Marketing

Cotton crop had MSP of Rs3000/qt in 2010-11 but the prevailing market price was far higher than that. Therefore, procurement agencies such as CCI did not enter the market and the purchase was made by private trade. The village sales also declined sharply and the farmers preferred to sell their produce in the open market through auction. The unauthorized deductions such as commission from farmers and overweighment of produce were also less due to continuously increasing demand and thus prices crossing Rs5000/qt during crop season and Rs6000/qt recently. However, quality cuts were imposed on the basis of foreign matter such as leaves, twigs, dust, moisture etc. Moreover, inter-market and inter-temporal variations were commonly observed. Under such a scenario, there is need for setting up a strong market intelligence cell for guiding the farmers regarding;

- a) Whether the farmers should store the produce or not and for how long? Analysis is needed about emerging global (main producing and consuming countries) and facilitating scientific storage, cost of storage etc.
- b) Information service about prices in the different markets in the area so that farmers make rational decision about the choice of market.
- c) Quality is an important parameter of price. Farmers should be guided about trade preference for choice of variety, care while picking so that moisture, is minimized and cleanliness of produce is ensured. Still 16% farmers were mixing the first picking with the other pickings and which lowers the price received. Guidance regarding keeping the produce properly covered while picking, transport, storage and displaying in the market yard, weighing it before entering the market, caring for the produce in the market, obtaining details of sold produce and charges in form-J and other rights of farmers in the market are essential.

In spite of the fact that the respondents stated yield this year to be lower than last year but the fact remains that arrivals have gone up in spite of possible storage at farm level in the wake of steeply rising prices. Table 7.2 indicates that up to January 2011, the

market arrivals in Punjab state were 51 lakh tonnes which were about 10.7% higher than that of last year.

Table 7.2: Arrivals of cotton in Punjab (000 qt)

District	2010-11	2009-10	% change
Bathinda	1452795	1211427	+19.9
Mansa	1266065	1106537	+14.4
Firozpur	1067620	1030295	+3.6
Mukatsar	880058	766291	+14.8
Sangrur	159480	148683	+7.3
Barnala	139605	148262	-5.8
Moga	20906	35127	-40.5
Faridkot	150965	186968	-19.3
Overall	5150684	4652726	+10.7

Source: HT Chandigarh, Feb 1, 2011

Price is the outcome of current year's supply, demand and stock balance for which national and international scenario also needs analysis. An assessment of the supply and demand forces done by some agencies is given below.

At national level, the Cotton Advisory Board had estimated an increase of about 3.25 per cent of area under cotton from 103.29 lakh hectares in 2009-10 to 106.12 lakh hectares in 2010-11. During the same period the cotton production is estimated to be increased from 295 to 325 lakh bales, an increase of about 10 per cent. The area under cotton in Punjab is expected to increase slightly as compared to last year. Due to rainfall at maturity stage the yield may be affected adversely. As a result the cotton production may remain the same as that of last year. The Indian government has fixed the target of cotton exports for year 2010-11 at 55 lakh bales as compared to total export of 83 lakh bales during 2009-10. This policy is expected to be reviewed from time to time depending upon the emerging cotton scenario which will affect the prices in domestic

market accordingly. However, these expected prices are sensitive to the changes in government export policy. There are indications in the media that the government may withdraw the export duty and increase the export target from 55 lakh bales to 75-80 lakh bales. In that case the cotton prices are likely to move upward.

The International Cotton Advisory Committee (ICAC) recently lowered its world cotton production forecast due to severe floods in Pakistan affecting its 20 per cent cotton area as well as slightly lower production expectation in China due to unfavourable weather in some tracts. This decline in production was partly expected to be offset by expected increases in USA, India, Australia and Uzbekistan. Accordingly, the world cotton production and consumption are expected to be roughly balanced at 25.1 million tonnes (mt) in 2010-11. The imports driven by china were expected to increase in 2010-11.

The current world production of 121.8 million bales in 2006-07 is dampening overtime touching the lowest ebb of 101.5 million bales in 2009-01. On the other hand, consumption figure is not relenting significantly. Therefore, with demand exceeding production by about 17 million bales in 2009-10 has depleted the world stock and pulled world supplies to their tightest in fifteen years. This has lowered the stock/use ratio from 55% in 2008-09 to only 37% in 2009-10. With supplies tight, there has been strong demand for exports. Rapid rates of commitment for exports have been reported for other major exporting countries. According to the International Cotton Advisory Committee (ICAC) estimates that only 10% of the world's total exportable supply remains uncommitted. In India, where the government limited exports to the equivalent of only 4.3 million bales this crop year, 100% percent of the exportable amount can be considered committed. The ICAC estimates 85% of the exportable supply from Central Asia, which includes Uzbekistan, the world's third largest exporter, has already been committed.

Export commitments represent mills securing supplies. As a result, the cotton that is currently committed could potentially be renegotiated for later shipment.

Nonetheless, demand for deliveries is strong. Arrivals to China, where the domestic production/consumption gap reached 17.0 million bales in 2010-11, were nearly 50% higher for the first four months of the crop year than they were during the same time period last year. To help meet mill demand during the 2011 calendar year, China's initial announcement regarding import quota is 34% higher than it was last year.

Given current tight supply conditions and high prices, expectations are that additional acreage will be devoted to cotton in the coming 2011-12 crop year. However, analysis by the USDA indicates that the seasonality of harvests relative to consumption causes world supplies to pull their tightest in October, just before harvests from the world's largest cotton producers become available in significant volumes. As a result, even though supplies are currently tight, it could be expected that the situation will draw tighter in coming months. October remains ten months away and only 10% of the world's exportable supply remains uncommitted. Due to such tight conditions, prices could be expected to remain strong and any developments affecting either supply or demand before the 2011-12 harvest could be expected to provoke a reaction in prices.

Table 7.3 World Cotton Balance Sheet (Millions of 480 lb. bales)

Demand-Supply	2006-07	2007-08	2008-09	2009-10	2010-11 January
Beginning Stocks	61.9	62.3	60.7	60.5	43.8
Production	121.8	119.7	107.1	101.5	115.5
Supply	183.7	181.9	167.8	162.1	159.3
Consumption	123.8	123.3	109.9	118.5	116.6
Ending Stocks	62.3	60.7	60.5	43.8	42.8
Stocks/Use	50.3%	49.2%	55.0%	37.0%	36.7%

Ratio					
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Source: USDA

8. Summary

In the wake of diversification requirement of Punjab agriculture, cotton crop provides an important avenue. Due to declining profitability of the crop as compared to paddy at the end of past century, a lot of area having potential for cotton growing was shifted to rice crop. Now, with the revival of economic return from cotton, its area is poised for increase. SRTT has made solemn efforts to boost up this process, the impact of which was assessed in this study. Based upon a sample of 302 farmers from project area, 106 farmers from non-project area and 50 farmers from Phase-1 area, the main inferences were derived as under.

The profit margin from cotton during 2010-11 has become at least comparable with rice crop. Further, in the project areas, returns have further been enhanced by yield improvement, cost reduction and fetching higher price. The economic impact of the project was approximated to Rs11823/ha and average farmers with 2.26 ha of area under cotton appeared to have gained Rs26700 per annum by way of cost reduction (11%), yield improvement (83%) and price increase (6%). The average use of pesticides has declined by 25% and that of fertilizers by 6.3% due to efforts of SRTT. Yet there is a lot of scope for further improvement. Due to lack of follow up in the villages of Phase 1, the farmers were being drifted towards the advice of private dealers due to which desired results could not be attained.

Seed variety is considered as the base of IPM of cotton crop. Most of the existing problems of cotton cultivation emerge from non-availability of authentic seed of desired variety. There were about 50 varieties reported to have raised by respondents, most of which are not recommended by research system. The number of varieties sold out by private companies is so large that farmers are getting confused. The non-availability of

seeds of preferred varieties, their availability only in black market and genetic variability or mixtures due to which plant size and fruiting varied widely in the same field are some other concerns requiring attention. Optimum plant population in the field could not be kept and seed rate used was higher than recommended level. In stead of one packet, 1½ to 3 packets of seed were used per acre with commitment to thin the crop but thinning is not done, resulting in uneven plant density. Refugia seed in many cases was kept unused due to improper knowledge. Need for economical picking technology is increasingly felt due to problems of non-availability of labour and rising wage rates. Attack of Jassid, white fly, tobacco caterpillar and at the crop end mealy bug were problems. Prolonged rainy season added to the problem. Abohar area faced typical problems due to severe attack of white fly and other pests, possibly due to large area under kinnow orchards, an alternative host for them. Kinnow fruit setting this year was stated to be less and many farmers planted cotton in the orchards.

Marketing aspect is an area where more stress is required for guidance to the farmers. Competitive market system of cotton is there. The price is determined by demand and supply forces at local level and ultimately at national and international level. Market intelligence cell for compiling and providing information about the market forces is the need of time.

Some other suggestions based on perceptions of respondents were that the visit of agricultural specialists for dressing the problems of pest control in July to September should be intensified, possibly, the villages of earlier phases should also be covered, progressive cotton farmers, particularly in newer areas may also be trained in PAU for better results and the best performing farmers and scouts should be encouraged. The villages which shifted over to paddy and invested in submersible tubewells are planning to shift back to cotton. More representation to such areas should be given for the next phase of IPM so that diversification of Punjab agriculture can be sped up. To the possible extent, new villages should be nearby the old ones so that proper follow up of those villages is also made.

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Appendix 1: Area, yield and production of cotton in major countries

Country	Area (million thousand ha)			Yield (Kg/ha)			Production (million 480 lb. bales)		
	2008-09	2009-10*	2010-11*	2008-09	2009-10*	2010-11*	2008-09	2009-10*	2010-11*
World	30.60	30.15	33.32	762	733	755	107.10	101.54	115.46
United States	3.06	3.05	4.33	911	871	920	12.82	12.19	18.32
China	6.05	5.30	5.10	1,321	1,315	1,281	36.70	32.00	30.00
India	9.41	10.26	11.00	523	492	515	22.60	23.20	26.00
Pakistan	2.90	3.00	2.90	653	697	661	8.70	9.60	8.80
Uzbekistan	1.42	1.30	1.30	705	653	804	4.60	3.90	4.80

*Preliminary estimates

Source: USDA

Appendix 2: Area, Production & Productivity of cotton in India

Year	Area (lakh ha)	Production (lakh bales of 170 kg each)	Average Yield Kg/ha)
1950-51	56.48	31	92
1960-61	76.78	56	124
1970-71	76.05	48	106
1980-81	78.24	79	170
1990-91	74.39	117	267
2000-01	85.76	140	278
2001-02	87.30	158	308
2002-03	76.67	136	302
2003-04	76.30	179	399
2004-05	87.86	243	470
2005-06	86.77	244	478
2006-07	91.44	280	521
2007-08	94.14	307	554

2008-09	94.06	290	524
2009-10	103.29	295	486

Appendix 3: Area, Yield and Production of Cotton in major states of India, 2008-09

State	Area	%	Production	%	Yield
Gujarat	2.35	25.02	7.01	31.49	507
Maharashtra	3.15	33.44	4.75	21.33	257
Andhra Pradesh	1.40	14.87	3.57	16.02	434
Punjab	0.53	5.60	2.29	10.26	737
Haryana	0.46	4.89	1.86	8.34	694
Karnataka	0.41	4.35	0.87	3.89	360
Madhya Pradesh	0.62	6.64	0.86	3.84	233
Rajasthan	0.30	3.22	0.73	3.26	408
Tamil Nadu	0.11	1.22	0.19	0.84	279
Others	0.07	0.75	0.16	0.73	@
All India	9.41	100.00	22.28	100.00	403

Appendix 4: Area, Production and Average yield of cotton in Punjab

Year	Area (000ha)	Production (000 bales)	Average Yield (Kg/ha)	Harvest Price of unginned Cotton (Rs /qt)	
				American	Desi
1980-81	649	1178	309	325.90	391.23
1990-91	701	1909	463	756.64	894.3
1991-92	701	2399	582	1030.30	1195.33
1992-93	701	2353	571	926.96	997.73
1993-94	577	1516	447	1064.01	1336.44
1994-95	598	1763	501	1771.19	2139.9
1995-96	742	1951	447	1578.75	1864.72
1996-97	717	1873	444	1260.00	1726.31
1997-98	724	937	220	1557.22	1992.31
1998-99	563	595	180	1897.88	2035.22
1999-00	476	951	340	1543.42	1731.51
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*	550	2310	714	2730.00	2600.00

Provisional

Appendix 5: Area, average yield & production of cotton in Punjab, 2008-09*

District	American cotton			<i>Desi</i> cotton		
	Area	Av. yield	Production	Area	Av. yield	Production
	000 ha	Kg/ha	000 bales	000 ha	Kg/ha	000 bales
Ferozpur	117	688	474	3	592	10
Faridkot	20	696	82	1	499	3
Mukatsar	105	758	468	2	648	8
Moga	5	1098	33	1	497	3
Bathinda	149	800	701	4	544	13
Mansa	88	697	361	2	445	5
Sangrur	12	629	45	2	431	5
Barnala	11	831	54	1	548	3
Patiala	1	743	4	0	0	0
Ludhiana	2	743	9	0	0	0
Total	511	743	2235	16	534	50

Source: Statistical Abstract of Punjab, 2009

* Provisional

**Appendix-6:Farmer's Questionnaire- Socio-economic Impact Assessment of Cotton IPM
Technology in Pb: SRTT Project**

Name of the farmer Village..... Block.....
District..... Education level.....

1. Farm size

Ownedacres Leased in.....acres Leased out.....acres
Operational.....acres Land rent Rs...../acre

2. Source of power

Own Tractor..... Bullock..... Custom hiring.....

3. Source of Irrigation

Source	Nos.	Area covered (acres)	HP	Depth of bore (ft)
Mono-bloc				
Submersible				
Diesel operated				
Canal	X		X	

4. Number of animals

Cows..... Buffaloes..... Bullock..... Other livestock:.....

Quantity of milk sold..... lit Rate Rs/lit

Area and average yield of cotton

Variety	2010			2009	
	Area (acres)	Total Production (mds)	Price (Rs/q)	Area (acres)	Total Production (mds)
Variety RCH134					
Variety					
Variety					
Variety.....					

Experience with each variety with respect to soil type, irrigations, sowing time, crop rotation etc

Change in varietal pattern over the past three years if any.....

5. Input used & practices followed in cotton crop

Information regarding	Details of practices followed	Cost
i. Land Preparation		X
ii. Seed rate/acre		
iii Source of seed		X
iv Seed treatment		
v Non-Bt refugia sown or not		X
vi Sowing time		X
vii Method of sowing		X
viii Gap filling done or not		
ix Manures & fertilizers		X
FYM (tones)		
DAP (Kg)		
Urea(Kg)		
S. Ph. (Kg)		
M.o. P. (Kg)		
Gypsum (Kg)		
Spray of potash such as 13:0:45		
x Micro-nutrients		

Zinc Sulfate(Kg)		
xi. Plant protection (against Insects which pests, name the pesticide, its quantity & no. of time used)		
a Bollworms		
b. Sucking pests; Jassid, thrip, white fly		
c. Foliage feeding pests: Tobacco caterpillar		
d. Soil pests: Termites		
e. Mealy bug		
f. Diseases; leaf curl, leaf spot, bacterial blight		
Total number of sprays		
xii Number of irrigations		X
xii Number of weedings		
xiii Pickings (no. & labour used)		
xiv Marketing aspect		
Sale in the market or village		
Aware about moisture content		
Keeping first picking separate		
xv. Any other, specify		

6. Problems of cotton crop

Relating to	Specify problem
i. Suitable varieties	
ii. Seed availability	
iii. Seed treatment	
iv. Planting time	
v. Planting techniques	
vi. Nutrient mgt.	
vii. Water mgt.	
viii. Weed mgt.	
ix. Pest management	
x. Picking	
xi. Grading	
xii. Marketing	
xiii Sticks removal	

7. Facilities availed under SRTT

- i. Seed ii. Seed treatment iii. Pesticides
- iv. Pheromone traps v. Bio-agent cards

Information about pest control

- i) Are you aware of information centre in the village? Yes/No

- ii) Do you visit the information centre regularly Yes/No
- iii) Do you feel the displayed material useful? Yes/No
- iv) Can you adopt the practices from the displayed material? Yes/No
- v) Are you in touch with village scout? Yes/No
- vi) Are you attending regular meetings? Yes/No
- vii) Were these meetings useful? Yes/No

Socio-economic Impact of the project

A. Economic Impact

Item	Impact
Yield improvement (q/acre)	
Price increase (Rs/qt)	
Cost reduction (Rs/ac)	
By-product use	

B. How would the increase in income be utilized?

- a. Repaying debts
- b. Investment in
 - i. Livestock ii Machinery
 - iii Land iv Others, specify
- c. Increase in consumption expenditure, please tick
 - i. Social ceremonies ii Education of children
 - iii House building iv Higher liquor use v Others, specify

C. Impact of project on environment

Parameter	Tick most appropriate	If yes, how?
i. Water saving	Yes/No	
ii. Water table in the area	Rising/Constant/Falling	
iii. Soil health	Positive/ No impact/Negative	
iv. Air pollution	Positive/ No impact/Negative	
v. Human health hazards	Positive/ No impact/Negative	
vi. Pest problem	Positive/ No impact/Negative	
vii. Population of useful insects	Increase/no change/decrease	

D. Employment of resources due to IPM project

- a. Use of human labour
 - i. Male Increased/No Change/ Decreased
How much /acre?
 - ii. Female Increased/No Change/ Decreased
How much /acre?
- b. Farm machinery Increased/No Change/ Decreased
How?
- c. Other resources: Increased/No Change/ Decreased How?

E. Specify the problems in the operation of the project

- i) Behaviour of staff
- ii) Knowledge of scout
- iii) Timeliness of input and guidance
- iv) Any other problem, please specify.....

F. Suggestions for improvement of the project

- i) May be extended to other crops as well
- ii) Other services such as soil testing be provided
- iii) Other farmers should also be covered
- iv) Special lectures on other crops as well
- v) Lectures on social evils, sanitation, human diet etc.
- vi)

G. Would you continue with the new adopted practices?

- i) If subsidy is withdrawn
- ii) If information system is discontinued

H. How were the other farmers benefited as a result of such information?

- a. Within the village
- b. Outside village
- c. Landless labour
- d. Women in general

I. Do you feel that there should be Self Help Group to improve marketing of cotton? If yes, specify.

10. Highest yield vs lowest yield in the village and factors associated

Highest yieldmd/acre Lowest yield.....md/acre
 Reasons for the difference

Market deductions Commission = Other charges=
 Use of by-product

S. No.	Use	% of sticks	Remarks
1	As fuel		
2	Sold to brick kiln		
3	Sold to power unit		
4	Ploughed back in soil		

Information from Scout

Name of scout.....

Village you belong to.....

Type of training received..... Place..... Duration.....

Problems faced in operation of project and Suggestions to improve

S. No.	Problems faced	Suggestions
1		
2		
3		
4		

Impact of project on your own farming.....

After this project how would you use this experience?

If this village is selected under M-krishi, experience of farmers and scout about that including its impact be highlighted

Appendix -7

List of Non-IPM and Phase 1 villages

S. No.	Non-IPM		Phase-1	
	Village	District	Village	District
1	Bhai Ka Khera	Mukatsar	Chauhanke Kalan	Sangrur
2	Nangal Khurd	Mansa	Vajeedke kalan	Sangrur
3	Amlasinghwala	Sangrur	Mashana	Bathinda
4	Pati Sekhwan	Sangrur	Kuti Kishanpura	Bathinda
5	Thraj	Moga	Patti Shekhan	Barnala
6	Karamgarh	Mukatsar		
7	Khaira Khurd	Mansa		
8	Pakkakhurd	Bathinda		
9	Bhagwangerh	Bathinda		
10	Doonewala	Bathinda		
11	Khaira Kalan	Mansa		