J Agric. Res., 2017, Vol. 55(1):197-211
ISSN: Online: 2076-7897, Print:0368-1157
http://www.jar.com.pk

ANALYSIS OF SUSTAINABLE COTTON INITIATIVE IN THE PUNJAB; THE IMPACT ON INSECT/PEST RISK MANAGEMENT

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ABSTRACT

A study sustainable cotton initiative (SCI) has been started in major cotton producing areas of Pakistan for sustainable production of cotton with minimum use of chemicals against cotton pests. The present study was conducted at Institute of Agricultural Extension and Rural Development, University of Agriculture, Faisalabad, Pakistan during 2014-15 to analyze the impact of SCI on farmers' attitude regarding insect/pests risk management. In all 400 respondents (registered SCI cotton growers) were selected randomly from two cotton producing districts of the Punjab province (Toba Tek Singh and Bahawalpur). The results revealed significant impact of training regarding insect/pests risk management. Majority (70.5%) of respondents thought that skill about insect pest control had changed and only small number (18%, 17.75%) of the respondents perceived that knowledge about insect pest control and sustainable cotton production had changed to some extent because of SCI trainings. Famers were found better knowledgeable in recognition of insect/pests (harmful and beneficial) and were applying better strategies for pest control. Decrease in pesticide consumption is indeed a significant achievement providing security to crops and human health as well. On the basis of results of this study it is recommended that such training programs should be encouraged at national level.

KEYWORDS: Sustainable cotton; learning; pesticides; initiative; Pakistan.

INTRODUCTION

Cotton is one of most important cash crop of Pakistan. Pakistan's economy heavily depends upon this crop which significantly provides raw material to textile industry. Cotton being a cash crop and an essential source of raw material to the textile enables the textile industry to survive and expand its

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base (3). Production of cotton in Pakistan is lower than potential. Cultivated area of cotton is decreasing due to many factors like socio-economic, biological, managerial, and physical, in addition to lack of marketing, insect/pests attack less use of fertilizer and pure seed. One important factor is natural disasters like flood in 2010 in Pakistan. In 2014-15 cotton was cultivated on 2961 thousand hectares with total production of 13983 thousand bales documenting negative growth relative to previous year. Unfortunately, production in last year (2013-14) had also documented negative growth of -2.0 percent relative to previous year (2013-14). Average yield of cotton remained inconsistent in whole decade (3) which is insufficient to meet global challenges. The average yield of cotton in the country was 1.53 million tones during the year 2015-16 as against India (5.88 million tonnes), China (5.17 million tonnes) and Brazil (1.50 million tonnes). Despite immense lags, Pakistan remains fourth major producer of cotton followed by third largest consumer after China and India (3).

Domestic production of Pakistan is also expected to decline in future due to increasing risk in farming. These risks are persisting from the long period of time and have caused severe decline in past as well. Natural disasters and insect/pests and diseases infestation are the dominant obstacles in cotton production. Some studies (21, and 36) declared climate change as a most prominent threat of present. Climate change also tends to boost insects' pests and diseases infestation. Increasing cost of production and mounting insets pests' outbreak are also one of the hilarious factors affecting cotton production. (13) another survey (9) reported low cotton production due to shrinking area under cultivation, natural disasters, insects pest attack and dieses outbreaks. Better cotton initiative (2012) highlighted crop failure pertinent to increased insects pests infestation.

Better pest management practices are vital for increased production. Chemical pesticides are widely used to control infestation. Due to the complexities in cropping system and small holdings, ground spray has always been preferred. A large number of new insecticide active ingredients have developed the problem of evolved resistance which in time resulted in a financial impasse for growers (16).Several studies have shown that over- and misuse of pesticides has led to tremendous economic losses and hazards to human health (1, 12, 19, 33). The results of the pesticide policy analysis and the onset of FAO-EU IPM Programme for Cotton in Asia led to the establishment of a National IPM Programme of Pakistan in December 2000.

Realizing the fact that production of cotton by using pesticides extensively in Pakistan poses a serious threat to environment, WWF- Pakistan and IKEA

started a project "Pakistan Sustainable Cotton Initiative" (PSCI) in 2005 for the adoption of Better Management Practices (BMP) for farmers through Learning Groups (LGs) and FTOF (Farmers Training of Facilitators) (7). The main objective of learner groups (LGs) approach is to create a deeper understanding of the important interactions of agro-ecosystems as well as on sustainable farming and ultimately that leads to reduction of chemical pesticide use (15). Training is considered to be the most effective process for bringing a considerable change in the behavior of LGs farmers towards crop management practices. The purpose of precise training is to achieve a valuable upgradation in crop and pest management knowledge and promote best agricultural practices of the farmers for sustainable crop production (26).

Present study was designed to assess the impact of sustainable cotton initiative training program regarding the plant protection measures of cotton crop among the farming community. Study was based upon following research questions.

- What is the impact of training programs on farmer's awareness about insects and pests?
- Did farmers improve their knowledge about beneficial insect's pests of cotton?
- Are farmers more focused on botanical, cultural and mechanical control rather than chemical control?
- Has pesticide usage decreased and being applied in judicious way?
- Are farmers able to use judicious application of insecticides during different growth stages of crop?

MATERIALS AND METHODS

This study was conducted in the Institute of Agricultural Extension and Rural Development, University of Agriculture, Faisalabad during the year 2014-15, WWF-Pakistan launched Pakistan sustainable cotton initiative in five cotton growing districts of Punjab, namely Bahawalpur, Rahim Yar Khan, Toba Tek Singh, Lodharan, and Kahnewal during the year 2005. All learner groups (LGs) formed by WWF-Pakistan for PSCI in all districts mentioned above in the the Punjab were selected as study area.

Districts Toba Tek Singh and Bahwalpur, were purposively selected because these two districts have maximum concentration of LGs and registered farmers under Sustainable Cotton Initiative. Population of the present research consists of all LGs who are participating in the Sustainable Cotton Initiative in selected districts.

From each of selected district, one tehsil was selected randomly. From each selected tehsil, ten Learning Groups (LGs) were selected randomly. One LG usually contains about 30 farmers, from each LG, 20 farmers were selected randomly; thereby making a sample size of 400 respondents.

The research evolved combine quantitative and qualitative methods (triangulation) of data collection as advocated by livelihoods researchers (8, 17). Quantitative data were collected through structured interview schedule. Interview schedule was administered face to face with farmers. The instrument was pretested initially on 20 cotton growers other than sample. Final changes were incorporated after pretesting. Validity was checked through face validity with the help of experts from University of Agriculture Faisalabad, Pakistan.

Qualitative data were collected to elucidate the quantitative data and to obtain the holistic understanding of the problem. Key informants interviews were undertaken to gather direct quotations from key informants about their experiences, opinions, feelings and knowledge. The key informants in the study include trainers at LG, project staff, progressive farmers etc.

Impact assessment

Impact evaluation is an assessment of how the intervention being evaluated affects outcomes, whether these effects are intended or unintended. The proper analysis of impact requires a counterfactual of what those outcomes would have been in the absence of the intervention (10).The IFAD impact evaluation guidelines accordingly define impact as “the attainment of development goals of the project or program, or rather the contributions to their attainment.” The ADB guidelines state the same point as “project impact evaluation establishes whether the intervention had a welfare effect on individuals, households, and communities, and whether this effect can be attributed to the concerned intervention”. Impact evaluation serves both objectives of evaluation: lesson-learning and accountability (6). A properly designed impact evaluation can answer the question of whether the program is working or not and hence assist in decisions about scaling up. However, care must be taken about generalizing from a specific context (4).

Data analysis

Quantitative data were analyzed using statistical package for social sciences (SPSS) and qualitative data were analyzed through content analysis technique.

RESULTS AND DISCUSSION

Data (table 1) indicated that average age of registered growers was about 39 years and the time of SCI registered growers since their involvement varied but the average was about 2.33 years. Respondents were directly associated with farming and considering the significance of land, they were asked to depict their farm size that they possess.

Table 1. Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Age (years)	400	19.0	70.0	38.620	8.7643
Farm Size	400	2.0	100.0	13.087	11.9219
SCI-involvement	400	0	7	2.33	1.733
Valid N (leastwise)	400				

Table 2. Changes in awareness level regarding cotton insect/pests.

Harmful Insects	Mean		SD		Paired Differences	
	Before	After	Before	After	Mean#	SD
Whitefly	4.02	4.83	0.96	0.45	0.80	-0.87**
Jassid	3.84	4.83	1.07	0.46	0.99	-0.99**
Aphid	3.75	4.87	1.07	0.40	1.12	-1.02**
Thrips	3.81	4.77	1.05	0.51	0.96	-1.05**
Mites	3.84	4.81	1.02	0.45	0.97	-1.03**
American bollworm	3.86	4.83	1.10	0.48	0.97	-1.10**
Spotted bollworm	3.74	4.86	1.06	0.43	1.11	-1.05**
Pink bollworm	3.67	4.85	1.11	0.44	1.19	-1.12**
Army bollworm	3.72	4.86	1.10	0.42	1.14	-1.09**
Mealy bug	3.70	4.85	1.22	0.41	1.15	-1.16**
Cotton semi lopper	2.59	4.82	1.31	0.46	2.23	-1.35**

** 4 Highly significant (P<0.01); SD = Standard deviation Scale: 1. Not at all, 2. To some extent3. Moderate extent, 4.High extent, 5. Very high extent # Mean in paired difference is calculated by subtracting after – before

The respondents were asked on a scale of 1-5 with 1 as lowest level of awareness and 5 as highest level. The results in this regard are presented in Table 2. Growers were well aware to varied level before joining SCI about most of the insects' pests because of their extensive

experience of cotton cultivation. Awareness of cotton semi lopper was found least among all the other insects' pests before joining SCI with mean value of 2.59. Mean value implies that awareness was approaching towards moderate level. However, general outlook of data indicates increased awareness and knowledge among farmers after joining training and learning group. A previous study (37**)** revealed increased knowledge, skills and awareness about insect's pests among cotton growers. Another report (5) endorsed the positive set of trainings for instance, farmers had participated in FFS and were able to identify their obstacles and develop solution at their own at farm level. This positivity was entirely resulting of extensive awareness raised among the farmers.

Further the results were highly significant with P value of <0,01 which showed that participation of respondents in SCI training was helpful in increasing their knowledge and enhancing their awareness about the harmful insect pests. This result also showed that studying is conducted again under same conditions the results will be 90 percent same with a little difference.

Table 3. Changes in awareness level about beneficiaries' insects of cotton.

Beneficial insects	Mean		SD		Paired Differences	
	Before	After	Before	After	Mean#	SD
Predatory mites	2.46	4.45	1.20	0.84	1.98	-1.23**
Spider	3.39	4.58	1.28	0.66	1.20	-1.21**
Green lace wing	2.61	4.55	1.20	0.76	1.94	-1.21**
Damsel fly	2.47	4.42	1.14	0.93	1.95	-1.23**
Orious bug	2.50	4.47	1.12	0.88	1.97	-1.20**
Lady bird beetle	2.99	4.61	1.29	0.74	1.61	-1.22**
Wasps	4.83	4.98	0.37	0.16	0.14	-0.35**
Ants	4.86	4.98	0.35	0.16	0.12	-0.32**

**Highly significant (P<0.01); SD = Standard deviation Scale = 1. Not at all, 2. To some extent, 3. Moderate extent, 4. High extent, 5. Very high extent # Mean in paired difference is calculated by subtracting after - before

The data (Table 3) further showed that impact of SCI training on the awareness level of respondents about beneficiary insects was highly significant with P-value of <0.01 which showed that 90 percent same results with a slight difference could be obtained if the study would be conducted again in the same situation. Findings imply that prior joining SCI awareness level of farmers was not upto the mark. Farmers were having general

awareness rather than technical awareness about the mode of damage caused by insects' pests and how to control the insets pests' infestation. For instance, during informal discussion farmers reported their excessive application of pesticides to control insects' pests without having any consideration that this excessive usage is harming environment and human health. Moreover, excessive application developed insects pests resistance. Same scenario has already been reported (5) that farmers were not having enough awareness and were using different kinds of pesticide to eliminate insects which was endangering environment and human health. (34) also highlighted the rejection of time consuming and labor intensive strategies by the farmers and after trainings farmers were aware about the best fit technologies.

However, after trainings farmers were able to know about insects' pests and best way to control them because trainings imparted were according to the need of these farmers. These findings are similar to those of Ooi and Kenmore (32) also reported that after trainings farmers got 16.9 point scores regarding the awareness of insects' pests relative to farmers who didn't receive trainings link (28) highlighted that trainings imparted under the considerations' of local needs remain more fruitful which can be estimated from the above enhanced knowledge among farmers.

Data plotted in (Table 4) highlighted that all (100%) of the respondents always used pesticide before participating in SCI and LG training. However, after participating in SCI and LG training huge majority (84%) of respondents always used pesticides whereas small number (16%) of respondents sometimes used pesticide as a chemical control of insects and pests. Generally, it can be said that application of pesticide has decreased little bit after getting training. Various authors argue in reverse of these findings. For instance, LEC training regarding pesticide application had no impact on learning. With the passage of time erosion of knowledge had occurred. Non-availability of specific pesticides needed for the LEC method was the major reason behind reduction of knowledge (38, 41). It also can be reason of reduction that farmers were becoming more aware about judicious use of pesticides after training. However, these finding agree to those of earlier workers (18, 20, 22, 35).

Similarly majority (57.8%) of the respondents were not using weedicides before training and even after participating in training most (45.8%) of the respondents had not used weedicides followed by one-fifth (20%) of the respondents who always used weedicide/ herbicide before training while

most (38.8%) of the respondents always use weedicide/ herbicide after training. Information and awareness about the crop-ecosystem helps reduce the usage of pesticides and the same time production and economic profit increases particularly in cotton production system (20; 25). Similar kind of fashion is clear from the findings that farmers attitude is bit changed regarding usage of pesticides to control insect pests and diseases infestation. Therefore, farmers were heading towards other control like botanical and mechanical control.

Table 4. Strategies to control insect pest before and after participating in SCI and LG training.

Strategies	**Not at all**	**Some time**	**Always**	**Not at all**	**Some time**	**Always**
a) Use of chemical control	Before			After		
i) Pesticide (use of chemical control)	0.0	0.0	100.0	0.0	16.0	84.0
iii) Weedicide/ herbicide (use of chemical control)	57.8	22.3	20.0	45.8	15.5	38.8
b) Botanical control						
v) Extract of Neem (botanical control)	100.0	0.0	0.0	65.3	34.8	0.0
vi) Extract of Dhatora (botanical control)	100.0	0.0	0.0	85.8	14.3	0.0
vii) Use of Tobacco solution (botanical control)	100.0	0.0	0.0	86.3	13.8	0.0
c) Use of cultural control						
i) Weeding (use of cultural control)	3.0	20.8	76.3	1.8	6.3	92.0
ii) Hoeing (use of cultural control)	3.5	19.8	76.8	1.0	4.3	94.8
iii) Inter-tillage practices (use of cultural control)	6.0	12.5	81.5	2.3	10.3	87.5
d) Use of mechanical control						
i) Pheromone trap (use of mechanical control)	96.8	3.3	0.0	73.0	18.8	8.3
ii) Light trap (use of mechanical control)	100.0	0.0	0.0	79.3	18.0	2.8
iii) Hand picking of weeds (use of mechanical control)	83.8	8.5	7.8	97.5	2.0	0.5

Bold values are percentages

The data further revealed that regarding botanical control of the insect pest all (100%) of the respondents were not using *neem* extract but after training this percentage 65.3% decreased to (34.8%) of the respondents started using *neem* extract occasionally. These results are similar to those of Togbe et al. (41) reporting that control farmers were not using *neem* on their plots. Among participant farmers of trainings need oil adoption didn't exceeded and proportion of adopters also went down. Negligible percentage of farmers (4.6%) was using *neem* oil for cotton protection. Non-availability, complexity of effectiveness and cost of *neem* oil were major reasons behind poor adoption and similar types of reasons were found during discussion with farmers of present study.

In the same way ,all (100%) of the respondents were not using dhatora extract before training but after training small number (14.3%) of the respondents used it seldom followed by huge majority (85.8%) of the respondents to whom never used it. Correspondingly all (100%) of the respondents were not using tobacco solution before but after training small number (13.8%) of the respondents started using it rarely.

The data (Table 4) also showed fair majority (76.3%) of the respondents was practicing weeding before training and this tendency was increased to over whelming (92%) after training. Similarly, fair majority (76.8%) of the respondents were practicing hoeing before training but after training this trend was enhanced our whelming (94.8%). Likewise large majority (81.5%) of the respondents do inter tillage practices which increased to huge majority (87.5%) of the respondents after training.

The data (Table 4) further presented in table reveals that over whelming to fair majority (96.8%, 73%) of the respondents never used pheromones before or after training followed by small number (18.8%) of the respondents sometime used pheromones after training. Meager adoption of pheromone traps regularly was found subjected to availability. Vasantha and Buchreddy (42) endorsed limited access pheromone traps one of the key reasons behind stunted adoption and reduced impact. All (100%) of the respondents never used light traps before training but after participating in the training small to negligible number (18%, 2.8%) of the respondents started using light traps sometime and regularly, respectively. Likewise huge majority (83.8%) of the respondents was not practicing hand picking of weeds which was increased to over whelming majority (97.5%) of the respondents by who left hand picking practice of weeds followed by small number (7.8%) of the

respondents who always pick the weeds by hand which was decreased to negligible number (0.5%) after training.

Concluding the discussion, farmers were found inclined towards strategies to control insects' pests. However, an impact is seen narrowed after training because of several factors like cost. (41) Same view has been documented (42) that majority of farmers including small, medium and large farmers in India, adopted strategies sometime rather than regularly. Farmers claimed expensiveness of initial cost, meager net profit likelihood and irregular consistency in profits; labour intensive and dwindling financial positions were the reason behind meager impact. Similar kinds of problems are highlighted in present study.

Table 5. Change in number of pesticide sprays before and after training.

Crop growth stages		Mean	SD	SE	Paired Differences			t-value
					Mean	SD	SE	
Vegetative stage	Before	0.150	0.358	0.018	0.090	0.287	0.014	6.28**
	After							
		0.060	0.238	0.012				
Flowering stage	Before	1.265	0.926	0.046	0.768	0.954	0.048	16.08**
	After							
		0.498	0.838	0.042				
Boll stage	Before	1.298	1.520	0.076	0.828	1.367	0.068	12.11**
	After							
		0.470	0.906	0.045				

** Highly significant (P<0.01); SD = Standard deviation; SE = Standard error

The data (Table 5) highlights that effect of training on the awareness level of the respondents regarding pesticide application at various growth stages (vegetative stage, flowering stage and boll stage) was highly significant with P value of <0.01 which showed that awareness level had been enhanced and almost 90% same results could be obtained with a slight difference. Generally awareness has been increased among farmers to apply pesticides at different crop stages in appropriate way. For instance it has been reported (39) that farmers perceived reproductive stage most important to spray as bollworm attack was higher at this time. Other workers (24) also highlighted the meager increase of application at boll formation stage among farmers under farmers' field schools training. Similar kind of improvement has also been reported by Siddique *et al*. (37) indicating increased farmers' knowledge due to trainings. It can be stated that, prior joining training program farmers were moving on general concept to use maximum pesticides for maximum control. In fact, consequences are contrary, as due to excessive application, resistance of pesticides had been increased. Now, it has become mandatory to apply excessive chemical for the control. Training

impact is best for the farmers which changes their mindset. Now farmers are aware to apply pesticides according to need and at appropriate recommended rate of application Tanwar, *et al.* (40) were also of the view that number of pesticides sprays application was reduced to 2-3 from 6-7 sprays in field. It was all because of extended awareness raised after training. Farmers were also having sound awareness about applying chemicals on vegetative, productive of boll stage of cotton.

CONCLUSION

Information collected from data analysis showed supremacy of small farmer as greater than half of the respondents were small farmers owning land less than 12.5 acres. Majority of the farmers were owner of their land where they were practicing major as well as minor crops to support their livelihoods. Generally these are the farmers who need desperate care and efforts from the system. The results indicated improved awareness and knowledge about insect/pest of cotton among farmers after joining training and learning group. The study reveal that participation of the respondents in SCI training was helpful in increasing their knowledge and enhancing their awareness about the harmful insect pests of cotton. Farmers were heading towards other control like botanical and mechanical control. Farmers were also having sound awareness about applying chemicals on vegetative and productive of boll stage of cotton. For future direction, it is recommended that at national level such training programs should be encouraged and its recommendations may be used to formulate policies.

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Received: December 07, 2015 Accepted: August 09, 2016

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