Journal of Rural Development and Agriculture (2017) 2(1): 26-40

ORIGINAL PAPER

Working efficiency of extension field staff with regards to integrated pest management of cotton in district D. G. Khan, Punjab, Pakistan

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Key Message This study evaluates the working efficiency of extension field staff with special reference to integrated pest management (IPM) of cotton in agricultural development of country and D. G. Khan region especially.

ABSTRACT In the agriculture sector, the success of any program and project depends upon the working efficiency of extension field staff (EFS). EFS are key stake holders and play crucial roles in the extension services, particularly in agriculture and rural development. Therefore, the present study was conducted to evaluate the working efficiency of extension field staff with special reference to IPM of cotton growers in district D. G. Khan. The results reveal that most of the respondents (44.2%) were under 35 years of age and about 80.80% of them were educated. A majority of the respondents (85%) had small land holding up to 12.5 acres. Less than half of the respondents (42.5%) reported that EFS provided extension services fortnightly. More than half of the respondents (56.7%) reported that EFS provided excellent information regarding resistant varieties. About 69.2 to 84.2% of the respondents reported that microorganisms, beneficial insects, buying and releasing beneficial insect and protecting beneficial insects were poorly addressed. Insecticidal soap and horticultural oil were the activities that performed poorly by the EFS as reported by a vast majority (90%) of the respondents. More than half of the respondents (56.7%) were of the view that the time involved was a big problem in applying IPM. The entire respondents (99.2 -100%) were of the view that IPM had positive impact on their crops. So the concerted efforts such as launching of IPM program for cotton crop in other districts of Punjab, Pakistan should be made with the aim of adopting cultural and biological control rather than chemical control.

Keywords: Agriculture extension, Cotton growers, Extension field staff, Extension services, Integrated pest management

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To cite this article as: Adeel, M., Siddiqui, B. N., Tareen, W. H., Rayit, A., & Fahd, S. (2017). Working efficiency of extension field staff with regards to integrated pest management of cotton in district D. G. Khan, Punjab, Pakistan. *Journal of Rural Development and Agriculture 2*(1), 26-40.

INTRODUCTION

In Pakistan, agricultural extension acts as a catalyst in agriculture and rural development because it brings innovations to the farming community for the improvement of its living standards. It provides a channel through which the farmers can solve their problems of research as well as revision of agricultural policies for the maximization of profits of rural areas (FAO, 2002a). It is the prime responsibility of the Agricultural Extension Department to transfer the latest agriculture technology and technical assistance to the farming community for improving agricultural production. In a previous research study, Urooba (2001) reported that inefficiency of extension services was the major cause of failure of self-sufficiency in agricultural products. Generally, government bodies have been trying their best to fill the yield gap of various crops launching a number of agricultural extension programmes in Pakistan (FAO, 2002b). This situation demonstrates clearly that production of various crops depends upon education, research and extension of agricultural innovations and technologies (National Rural Support Programme [NRSP], 1999). Today, agriculture in Pakistan is totally

different from that of the past owing to the shift from conventional to modern technology. The rate and direction of agriculture development is determined by the farmers' capacities to adapt the changing technologies. At national level, unsuitable extension policies, inadequate community development funds, dearth of accountability and high rural poverty are the major causes that have provoked the developing world to re-constitute the relevant policies of agricultural extension for rural development (Shah, 1998).

In Pakistan, the contributions of major crops like sugarcane, rice, cotton and wheat to GDP are 1, 1.3, 2 and 3.4%, while their share in agriculture value addition are 4.2, 5.4, 8.2 and 13.8%, respectively. But the yield of these crops is lower as compared to other countries because a huge gap has been produced between the actual and potential yield of the major crops. Until 2000, IPM was not established in Pakistan. The misuse of pesticides and their negative effects on the society has become a key element of agriculture development policy for sustainable development of the country (Guinee, 2002). According to a report by Central Cotton Research Institute [CCRI], (2012), cotton has become a major cash crop that contributes about 62% of the total foreign exchange earned by the major field crops in Pakistan. It provides the labour force for its cultivation and employment to 40% of industrial labour in textile industries. Moreover, cotton seed oil accounts for 60% of total edible oil usage. Agricultural productivity depends upon the availability of improved technology and its active dissemination. But high dissatisfaction has been found among the farming communities regarding the efficiency of the present extension system (Malik & Prawl, 1993). Dearth of qualified staff, outdated syllabi for agricultural subjects, deficiency of trainings, no use of audio visual aids, lack of timely information about the latest technologies are the major problems of extension services. Therefore, the impact of these factors should be appraised to improve the capability of extension field staff so that the sustainable agricultural production may be improved.

In spite of much emphasis laid on agricultural extension services in the dissemination of improved agricultural practices, the farmers are still in search of satisfaction regarding the performance of extension field staff. The farmers demand that EFS should work like a bridge between the research stations and farmers. EFS provide the latest technologies to the farmers to improve their crop production. Small farmers also expect equal services and opportunities, so EFS should provide them equal services irrespective of the client's social status and landholdings because in our country, a majority of farmers have small land holding capacity. Working efficiency is the accomplishment of a job with a minimum expenditure of time and effort. In this project the working efficiency of EFS was checked at first stage whether the farmers were aware about IPM practices in the study area and then the adoption level of those IPM practices was explored among the farmers. Hence, this study was planned first time to explore the working efficiency of extension field staff (EFS) in relation to IPM of cotton crop in district D. G. Khan, Punjab, Pakistan and then to assess the impact of adoption of IPM recommendations in cotton crop. Adoption rate of IPM practices is directly related to the working efficiency of EFS. The formula of efficiency = output/input so, adoption rate is the output of our efforts and it directly relates with the efficiency. The study was also intended to evaluate the effectiveness of extension method applied to promote the IPM of cotton crop and to measure the satisfaction level of the farmers about the trainings of IPM for cotton under FFS strategy. Basically, all these objectives including effectiveness of extension methods applied to promote IPM and the satisfaction of farmers with the extension strategies were considered to analyze the working efficiency of EFS. It is hoped that the findings of the study will be helpful for probing into the level of expectations and satisfaction of farming community towards the working efficiency of EFS with reference to IPM of cotton growers.

METHODOLOGY

The study was conducted in sub district D. G. Khan. The district D. G. Khan comprises of three sub districts; D. G. Khan, Taunsa and Tribal Area. Sub district Tribal Area and Taunsa are not cotton cropped areas so these have not been included in the study. Sub district D. G. Khan was selected purposefully for the present study.

Sampling procedure

The study area comprises of more than 0.5 million farmers so it was difficult to collect data from all of these farmers. Therefore, random sampling was adopted to collect the data from the field. In this study, a simple random sampling technique was used. Out of total 41 union councils of sub district D. G. Khan, 6 union councils were randomly selected for the present study. Two villages from each nominated union council were selected using random sampling technique. From each village, 10 cotton growers working with IPM of cotton with the collaboration of EFS were then selected randomly hereby making a total 120 cotton growers as a sample for the study.

Study tool

Structured interview schedule was constructed keeping in view the objectives of the research and with the consultation of supervisor. The questionnaire was developed in English language but was asked from the respondents in their local languages like Saraiki and Urdu. Interview schedule consisted of open and close ended questions which were asked directly from the respondents to collect the accurate and relevant data. Random sampling was done on lottery system at every stage of random sampling technique. A list of farmers using IPM technique was generated and respondent's selection was done on lottery system that is each respondent may gain an equal chance of selection.

Pre-testing

During this study, a pre-testing was done on ten respondents to check the accuracy and efficiency of the interviewing plan. Subsequently, some essential modifications were made to make the plan more appropriate, efficient, understandable and reliable. The data was collected from those farmers who were participating in an IPM cotton programme in the study area. The data was collected from FFS, IPM cotton yield enhancement project sub district D. G. Khan.

Data analysis

After the collection of the data, results of the study were analyzed through Statistical Package for Social Sciences (SPSS) in which frequency distributions, tabulations, and graphs were made.

RESULTS

Socio-economic features of the respondents

During this study, the socio-economic features of the respondents including age, education level, size of land holding (acres), land ownership, cropping area of cotton (acres), cropping area of wheat (acres) and cropping area of fodder (acres) related to IPM were studied. Patterns of change in human behavior relate to age and younger farmers tend to be more open to agricultural innovations than that of their elders (Butt et al., 2011). The respondents were asked about their age and their perceptions were tabulated in table 1. The data in table 1 reveals that most of the respondents (44.2%) were young (under 35 years), while 41.7% of the respondents were between 36-50 years (middle aged). Only 14.2% of the respondents were over 50. Education relates to the formal years of schooling and it enhances the learning ability, knowledge and wisdom of the farmers (Mirza, 1994; Okunade, 2007). The education process develops knowledge and other desirable qualities by means of formal schooling years. In this study, respondents were asked about their educational status and their responses have been depicted in table 1. The results show that most of the people living in the research area were educated (80.8%), only 19.2% respondents were uneducated. Amongst educated respondents, more than half (57.5%) had primary to secondary education followed by primary (15%). During this study, it was noticed that in rural areas, most of the families were sending their children to schools and thus the education growth rate was increasing at a high speed. Size of land holding relates to the land area cultivated by a farmer and it affects the adoption behavior of the farmer for the latest techniques of cultivation (Nawaz, 1989; McCown, 2002). Keeping in view the importance of size of land holding, respondents were asked about the size of their land and their responses were recorded in table 1. A majority (85%) of the respondents had

small land holding (up to 12.5 acres), while 11.7% of the respondents had medium land holding (>12.6 to 25 acres) and 3.3% of the respondents had large land holding (more than 25 acres) (Table 1). Land ownership refers to the mode of cultivating land (Idrees, 2003). In this study, three types of land ownership namely owner, owner-cum tenant and tenant were considered. Owners were those types of farmers who cultivated their own land. Owner-cum tenants were those types of farmers who farmed their own land and rented others' land. The tenants were those types of farmers who cultivated others' land on rent. The data about type of tenure have been presented in table 1 that shows that a majority of the respondents (80.8%) had their own land, while only 17.5% of the respondents were tenants and only 1.7% of the respondents were appeared as owner-cum-tenant. The data in table 1 also shows that an overwhelming majority of the respondents (90.8%) had small land holding (up to 12.5 acre) and cultivated cotton and wheat crops. Large numbers of respondents (70%) grew fodders and they also had small land holding. The respondents had mainly two seasonal crops. It also shows that D. G. Khan area is diverse in agriculture.

Source of information regarding IPM

A new agricultural technology can be adopted by the efficient sources of information (Rogers, 1962). In this study, farmers were asked about the sources of information regarding IPM and the data about their sources were displayed in table 2. An overwhelming majority (80-100%) of the respondents reported that they got information about IPM from extension field staff, local people, radio and newspaper respectively. More than half (60%) of the respondents had learned about IPM via television and only 21.7% of respondents got information about IPM from internet.

Frequency of visits by Extension Field Staff

The extension field staff plays a significant role in rural development. Acquaintance of farmers with EFS is two dimensional i.e. it provides interest to the farmers for extension activities on one side and interest to EFS in educational programs for the farmers on other side. The respondents were therefore, asked whether they knew EFS of their area or not. The respondents were asked about the frequency of extension visits and their responses are depicted in table 3. Less than half of the respondents (42.5%) reported that EFS provided extension services fortnightly. About one-fourth of the respondents (29.2%) were of the view that EFS provided extension services on a weekly basis, while 26.7% of the respondents replied monthly, only a small fraction of the respondents (0.84%) replied that they got extension services once a year.

Cultural operations regarding IPM related activities provided by EFS

Various agricultural practices including crop rotation, cultivation of alternate host, trap crops and selection of planting sites to make the environment less suitable for insect pests. The crop rotation minimizes the incidence and severity of various plant diseases, and suitable planting site affects the severity of insect attack. Keeping in view the importance of cultural operations, the respondents were asked about their perceptions about the cultural operations with respect to IPM of cotton and their responses are represented in table 4. The table shows that the information was excellent for more than half of the respondents (56.7%) regarding resistant varieties, while it was excellent for 58.3% of the respondents for planting the right plants at the right place. Furthermore, the information relating to rotating annual plants and intercropping was poor as reported by 44.8 and 50.8% of the respondents, respectively (Table 4).

Physical operations regarding IPM related activities provided by EFS

The physical barriers including row covers and trenches limit the entry of insects into the crop. Row covers can prevent the cucumber beetles to save the damage of cucurbits, while plastic lined trenches are used to disperse the Colorado potato beetles. Likewise, cold storage is also considered as a physical control that stops the development of insects on the stored grains. Therefore, the respondents were asked about the physical operations regarding IPM related activities provided by EFS and their responses are displayed in table 5 which reflects that 55.8-97% of the respondents preserved information regarding pruning, mulching, handpicking, trapping and light trap as poor category, while 22.5% of the respondents had information about pruning, trapping, hand picking and mulching that fell in the category "fair".

Biological operations regarding IPM related activities provided by EFS

A biological control or bio-control agent of insect, disease, and weed pests is an important practice of IPM. Owing to the importance of biological control, the respondents were asked about this and their responses are presented in table 6. About 69.2 to 84.2% of the respondents reported that microorganisms, beneficial insects, buying and releasing beneficial insect and protecting beneficial insects were poorly addressed, while very few respondents rated all the activities as fair, satisfactory, good and excellent (Table 6).

Chemical operations regarding IPM related activities provided by EFS

The chemical control of insect pests creates health issues, kills non-target species, and creates problems of leaching and accumulation of residues on food crops. The chemical controls can only be used if other methods are not adequate to control insect pests, and they must be labeled for a specific intended use. The results in table 7 showed that EPS did not provide information about efficient and effective use of chemicals to the farmers; therefore a majority of the respondents (90%) were poorly using insecticidal soap and horticultural oils on crops". Similarly, 62.5% respondents were poorly using synthetic insecticides, fungicides and molluscicides.

Application of various IPM techniques in the field

Respondents were asked about to assess cultural activities and their responses are given in table 8. Resistant varieties were frequently used by most of the respondents (42.5%) as cultural activities of IPM regarding cotton. It was found that planting of right plant at right place and other activities were frequently adopted by the respondents (45.8%). However, about one-third of the respondents were often rotating annual plants and intercropping as cultural activities (Table 8). Respondents were investigated to assess the rating of physical activities related to IPM of cotton. It is clear from the table 9 that all the physical activities related to IPM of cotton were mostly applied as reported by 46.7, 54.2 and 65.8% of the respondents. However, most of the farmer often applied the recommended physical activities (Table 9). Respondents were asked about the application of IPM of biological activity and their responses given in table 10 that indicate that protecting beneficial insects, releasing of beneficial insect, buying and releasing of beneficial insects, microorganisms and parasitic nematodes were rarely applied by 59.2, 54.2, 52.5, 52.5, and 50% of the respondents, respectively. Respondents were asked to assess the effects of chemical activity they applied relating to IPM, and their responses are displayed in table 11. The data reflects that more than half of the respondents (54.2 and 55.0%) rarely applied horticultural oil and insecticidal soap as an IPM measure to their crop. Further, botanical insecticides, and inorganic fungicides and insecticides were often applied as reported by about one-third (37.5%) of the respondents. Very few (0.7-10.8%) respondents adopted the entire chemical regimen on occasional to frequent basis (Table 11).

Reasons for non-adoption of IPM measures

Respondents' responses regarding the non-adoption of IPM measures are presented in table 12. About one-fifth of the respondents (21.7-23.3%) were of the view that lack of equipment and skills were the reasons of non-adoption of IPM measures for some times, while about 20% frequently reported lack of finances as the non-adoption reason. However about one-third (29.2%) recorded others reasons for non- adoption (Table 12).

Table 1 Socio-economic characteristics of the respondents

Socio-economic characteristics	Frequency	Percentage
Age (years)		
Up to 34	53	44.2
35-50	50	41.7
More than 50	17	14.2
Education level (years of schooling)		
Uneducated	23	19.2
Primary	18	15
Primary to Secondary	69	57.5
F.A./F.Sc.	6	5
B.A./B.Sc.	3	2.5
M.A./M.Sc.	1	0.83
Size of land holding (acres)		
Small (Up to 12.5)	102	85
Medium (> 12.5 to 25)	14	11.7
Large (> 25)	4	3.3
Land ownership		
Owner	97	80.8
Owner-cum tenant	2	1.7
Tenant	21	17.5
Cropping area of cotton (acres)		
Small (Up to 12.5)	109	90.8
Medium (> 12.5 to 25)	10	8.3
Large (> 25)	1	0.8
Cropping area of wheat (acres)		
Small (Up to 12.5)	109	90.8
Medium (> 12.5 to 25)	10	8.3
Large (> 25)	1	0.8
Cropping area of fodder (acres)		
Small (Up to 12.5)	84	70
Medium (> 12.5 to 25)	1	0.8
Large (> 25)	-	-

Table 2 Source of information regarding IPM

Information source	Respondents saying "Yes"		Respondents saying "No"	
	Frequency	Percentage	Frequency	Percentage
Extension field staff	120	100	0	0.0
Newspaper	97	80.8	23	20
Local people	120	100	0	0.0
Radio	116	96.7	4	2.3
TV	72	60	48	40
Internet	26	21.7	94	78.3

❖ Respondents gave multiple response because of various sources of information

Table 3 Description of extension visits of the respondents

Provision of Extension Services	Frequency	Percentage
Weekly	35	29.2
Fortnightly	51	42.5
Monthly	32	26.7
Yearly	01	0.8

Table 4 Rating of various cultural operations regarding IPM related activities provided by EFS as perceived by the respondents

Cultural Activity	Poor		Fair		Satisfactory		Good		Excellent		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Resistant varieties	-	-	02	1.7	21	17.5	29	24.2	68	56.7	120	100
Rotating annual plants	-	-	53	44.2	19	15.8	19	15.8	01	0.8	120	100
Intercropping	28	23	61	50.8	19	15.8	12	10	0	0	120	100
Planting right plant at right place	09	7.5	20	16.7	11	9.2	10	8.3	70	58.3	120	100

Table 5 Rating of information regarding IPM physical operations related activities provided by EFS

Physical activity	Poor		Fair		Satisfactory		Good		Excellent		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Hand picking	77	64.2	26	21.7	12	10	03	2.5	02	1.7	120	100
Pruning	67	55.8	19	15.8	29	24.7	05	4.2	0	0	120	100
Mulching	66	55	27	22.5	10	8.3	17	14.2	0	0	120	100
Trapping	89	74.2	24	20	07	5.8	0	0	0	0	120	100
Light traps	116	97	02	1.7	02	1.7	0	0	0	0	120	100

Table 6 Rating of information regarding IPM biological activities provided by EFS

Biological Activity	Poor		Fair		Satisfactory		Good		Excellent		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Beneficial insects	92	76.7	17	14.2	07	5.8	03	2.5	01	0.8	120	100
Protecting beneficial insects	101	84.2	12	10	05	4.2	01	0.8	01	0.8	120	100
Buying and releasing beneficial insects	96	80	11	9.2	09	7.5	03	2.5	01	0.8	120	100
Microorganisms	83	69.2	21	17.5	13	10.8	03	2.5	0	0	100	120
Parasitic nematodes	91	75.8	20	16.7	07	5.8	02	1.7	0	0	120	100

Table 7 Rating of chemical activity relating to IPM of cotton as perceived by the respondents

Chemical operations	Poor		Fair		Satisfactory		Good		Excellent		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Insecticidal soap	109	90.8	09	7.5	02	1.7	-	-	-	-	120	100
Horticultural oils	108	90	08	6.7	04	3.3	-	-	-	-	120	100
Botanical insecticides	25	20.8	66	55	16	13.3	10	8.3	03	2.5	120	100
Inorganic fungicides and insecticides	22	18.3	66	55	16	13.3	12	10	04	3.3	120	100
Synthetic insecticides, fungicides and molluscicides	75	62.5	17	14.2	09	7.5	11	9.2	08	6.7	120	100

Table 8 Rating of cultural activities as adopted by the respondents

Cultural activity	Rarely		Often		Occasionally		Sometime		Frequently		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Resistant varieties	0	0	0	0	11	9.2	18	15	51	42.5	80	66.7
Rotating annual plants	20	16.7	42	35	13	10.8	04	3.3	01	0.8	80	66.7
Intercropping	22	18.3	43	35.8	13	10.8	02	1.7	0	0	80	66.7
Planting the right plant in the right place	12	10	03	2.5	04	3.3	06	05	55	45.8	80	66.7

Table 9 Rating of various physical activities applied by the respondents

Physical activity	Frequently		Often		Occasionally		Sometime		Rarely		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Hand picking	56	46.7	16	13.3	08	6.7	0	0	0	0	80	66.7
Pruning	48	40	13	10.8	14	11.7	05	4.2	0	0	80	66.7
Mulching	45	37.5	18	15	06	05	11	9.2	0	0	80	66.7
Trapping	65	54.2	12	10	03	2.5	0	0	0	0	80	66.7
Light traps	79	65.8	0	0	01	0.8	0	0	0	0	80	66.7

Table 10 Rating of various biological activities applied by the respondents

Biological activity	Rarely		Often		Occasionally		Sometime		Frequently		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Beneficial insects	65	54.2	10	8.3	05	4.2	0	0	0	0	80	66.7
Protecting beneficial insects	71	59.2	05	4.2	04	3.3	0	0	0	0	80	66.7
Buying and releasing beneficial insects	63	52.5	09	7.5	08	6.7	0	0	0	0	80	66.7
Microorganisms	63	52.5	10	8.3	04	3.3	03	2.5	0	0	80	66.7
Parasitic nematodes	60	50	14	11.7	05	4.2	01	0.8	0	0	80	66.7

Utilization of extension methods by EFS for IPM of cotton

The respondents were asked about the extension methods used for educating farmers regarding IPM of cotton and the responses are presented in table 13. Data depicts that result demonstration, farm and home visits and field tour were effectively used methods by EFS as reported by 55.8, 55.8 and 54.2% of the respondents, respectively. Whereas, method demonstration and group methods were also effectively used by EFS reported by less than half of the respondents (47.5 and 46.7%). About 45.8 and 49.8% respondents reported good use of demonstration (result and method). A majority of the respondents (79.2, 90.8, 91.7 and 93.3%) reported poor use of magazine multimedia, cassette and brochure by the EFS to educate the respondents regarding IPM of cotton (Table 13).

Effectiveness of extension methods

The responses regarding the effectiveness of various methods on the bases of their effectiveness are displayed in table 14. Slightly above half (54.2, 55.0 and 55.0%) and less than half (45.8and 41.7%) of the respondents reported field tour, farm and home visits, result demonstration, method demonstration and group meeting were the excellent methods on the bases of their effectiveness. About 45 and 53.3% rated result and method demonstration as good in their effectiveness (Table 14). Newspaper was rated fair for its effectiveness by most of the respondents (42.5%). Furthermore, a majority of the respondents (78.3, 90.0, 91.7 and 92.5%) disclosed that magazine, brushers, multimedia, and cassette were poor extension methods on the bases of their effectiveness (Table 14).

Problems faced by the respondents in applying IPM of cotton

The farmers were polled regarding the problems for practical application of IPM in the field and their responses are shown in table 15. More than half of the respondents (56.7%) were of the view that time is a big problem in applying IPM. Most of the respondents (40%) and one-third of the respondents (34.2-35%) rated practicability, approachability, adoptability and difficulty in management as a serious barrier to them applying IPM. Further, more than half of the respondents (52.5-60.8%) rated practicability, difficult to manage adoptability and approachability were high problems for them (Table 15).

Impact of IPM technology

The respondents were further asked about the impact of IPM technology on their crop and data in this regard is presented in table 16. It is clear from the data that almost the entire respondents (99.2 -100%) were of the view that IPM had positive impact on their crops.

Table 11 Rating of chemical activities relating to IPM of cotton by the respondents

Chemical activity	Rarely		Often		Occasionally		Sometime		Frequently		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Insecticidal soap	66	55	12	10	02	1.7	0	0	0	0	80	66.7
Horticultural oils	65	54.2	08	6.7	06	05	01	0.8	0	0	80	66.7
Botanical insecticides	17	14.2	44	36.7	13	10.8	04	3.3	02	1.7	80	66.7
Inorganic fungicides and insecticides	18	15	45	37.5	11	9.2	05	4.2	01	0.8	80	66.7
Synthetic insecticides, fungicides and molluscicides	45	37.5	18	15	10	8.3	06	05	01	0.8	80	66.7

Table 12 Reasons for non- adoption of IPM measures by the respondents

Reasons	Rarely		Often		Occasionally		Sometime		Frequently		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Lack of skill	1	.8	0	0	2	1.7	28	23.3	9	7.5	40	33.3
Lack of equipments	0	0	0	0	5	4.2	26	21.7	9	7.5	40	33.4
Lack of finances	0	0	1	0.8	0	0	16	13.3	23	19.2	40	33.3

Table 13 Rating of various extension methods used by EFS for IPM of cotton

Extension method	Poor		Fair		Satisfactory		Good		Excellent		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Farm and home visits	0	0	01	0.8	16	13.3	36	30.0	67	55.8	120	100
Result demonstration	0	0	0	0	0	0	55	45.8	65	54.2	120	100
Method demonstration	0	0	0	0	05	4.2	59	49.2	56	46.7	120	100
Group meeting	01	0.8	06	5.0	27	22.5	29	24.2	57	47.5	120	100
Field tour	03	2.5	8	6.7	28	23.3	15	12.5	66	55.0	120	100
Newspaper	42	35.0	60	50.0	07	5.8	6	5.0	05	4.2	120	100
Magazine	95	79.2	16	13.3	0	0	05	4.2	04	3.3	120	100
Brusher	112	93.3	08	6.7	0	0	0	0	0	0	120	100
Cassette	110	91.7	07	5.8	03	2.5	0	0	0	0	120	100
Radio	24	20.0	45	37.5	46	38.3	05	4.2	0	0	120	100
Television	34	28.3	42	35.0	39	32.5	05	4.2	0	0	120	100
Multimedia	109	90.8	02	1.7	05	4.2	0	0	04	3.3	120	100

Table 14 Rating of extension methods on the bases of their effectiveness for IPM of cotton

Extension Method	Poor		Fair		Satisfactory		Good		Excellent		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Farm and home visits	02	1.7	02	1.7	14	11.7	36	30.0	66	55.0	120	100
Result demonstration	0	0	0	0	0	0	54	45.0	66	55.0	120	100
Method demonstration	0	0	01	0.8	0	0	64	53.3	55	45.8	120	100
Group meeting	09	7.5	0	0	28	23.3	27	22.5	56	46.7	120	100
Field tour	02	1.7	11	9.2	27	22.5	15	12.5	65	54.2	120	100
Newspaper	57	47.5	51	42.5	09	7.5	01	0.8	02	1.7	120	100
Magazine	94	78.3	19	15.8	06	5.0	01	0.8	0	0	120	100
Brusher	108	90.0	10	8.3	02	1.7	0	0	0	0	120	100
Cassettes	111	92.5	09	7.5	0	0	0	0	0	0	120	100
Radio	23	19.2	41	34.2	50	41.7	06	5.0	0	0	120	100
Television	31	25.8	41	34.2	40	33.3	08	6.7	0	0	120	100
Multimedia	110	91.7	04	3.3	05	4.2	01	0.8	0	0	120	100

Table 15 Rating of various problems faced by the respondents in applying IPM of cotton

Problem	Very Low		Low		Medium		High		Very High		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Lack of resources	03	2.5	0	0	08	6.7	45	37.5	64	53.3	120	100
Difficult to manage	01	0.8	0	0	10	8.3	68	56.7	41	34.2	120	100
Adoptability	0	0	01	0.8	07	5.8	71	9.2	42	35.0	120	100
Approachable	0	0	01	0.8	05	4.2	73	60.8	41	34.2	120	100
Practicable	01	0.8	0	0	08	6.7	63	52.5	48	40.0	120	100
Time consuming	01	0.8	37	30.8	01	0.8	13	10.8	68	56.7	120	100
Other (please specify)	116	96.7	02	1.7	0	0	0	0	02	1.7	120	100

Table 16 Impact of IPM technology adopted as perceived respondents

Impact	Negative		No impact		Positive		Total	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Impact on production	0	0	0	0	199	99.2	120	100
Impact on skills	0	0	0	0	120	100	120	100
Impact on finance	0	0	1	0.8	119	99.2	120	100
Impact on management	0	0	0	0	120	100	120	100
Impact on health	0	0	0	0	120	100	120	100
Impact on environment	0	0	0	0	120	100	120	100

DISCUSSION

In the agriculture sector, the success of any program and project depends upon the efficiency of the extension field staff (EFS). EFS are key stake holders and play significant roles in providing services for agricultural extension, therefore they are crucial for rural as well as agricultural development. IPM is considered with eco-friendly strategy and one can use it to minimize the risks to people and the environment. It focuses on a combination of various methods for prevention of pests in the long term that cannot work better alone. Approaches for managing pests and insects include the use of resistant cultivars, cultural methods, biological methods and habitat manipulation. The pesticides are only used when they are needed and applied in a manner that minimizes risks to human health, beneficial and non-target organisms, and the environment. The IMP is also known as Integrated Pest Control (IPC) that controls pests with the aim of suppressing the pest population under the Economic Injury Level (EIL) for economic control through the integration of various methods (Perrings et al., 2001; FAO, 2012). The present study was conducted keeping in view the importance of IPM techniques for growing cotton in district D. G. Khan, Punjab, Pakistan. It has been reported that crop productivity for most of the crops in Pakistan is very low as compared with developed countries. This may be due to the limited access of farmers to the latest farming technology as well as poor services of agriculture extension departments.

Consistent to our findings, Mallah and Korejo (2007) evaluated cotton crop and farm level cotton production practices by surveying various parts of cotton growing districts of Sindh and observed that 50% of the farmers were able to identify the insect pests. Generally, the farmers sprayed their crop 3-4 times and in some cases 3-8 sprays were done mostly with hand sprayer. The main crop rotation; cotton-wheat-cotton was found in the study area. A study was conducted by Swinton and Day (2000) who reported that southern Punjab was a major cotton production region of Pakistan. The average yield of cotton was about 560 kg/ha. In this region, the demand for pesticides was continuously increasing. There was a dire need for alternate methods of pest management for sustainable and profitable cotton production. IPM was an appropriate method which can reduce or minimize the use of pesticides and cost of production as well. A similar study was conducted by Wilson and Tisdell (2001) who reported that the advancement of agricultural production processes increased the crop productivity and well-being of the rural areas. It also ensured self-sufficiency in food grains and fibre production. In southern Punjab, cotton has been known as white gold being a major fibre crop of the country. In cotton production, pesticides were intensively used to control the pests. The Public Health Officials were increasingly concerned about the adverse effects of the applications of pesticides by the farmers in cotton production. Pesticide applications not only generated negative externalities for health and environment, but also increased the economic cost of cotton producers.

Our study found that IPM is an economically sound and environmentally safe method that can significantly increase the production of cotton. These findings are in accordance with Anonymous (2002) who stated that the IPM system was economically viable. Sustainable agriculture involved the successful management of resources for agriculture to satisfy changing human needs maintaining the quality of the environment and conserving the natural resources. The world experience over the years has shown that the best way for the transfer of technology practice was through trainings of facilitators and Farmer Field School (FFS) activities, which formulated the core of cotton IPM programmes. Work (2002) reported that the extension department was equipped with some exogenously adopted tools of print media, field visits, audio-visual aids and the local needs had never been addressed. The socio-cultural environment of the province was not suitable for all of these tools for a variety of reasons. The print media was wrongly used as a technique in a farming community with more than 80% of the citizens being illiterate. The tribal culture was one of the major obstacles for making big gatherings from different villages and providing trainings at one time. It called upon huge funding and staff to provide farmers training in such cultural settings. Under such conditions, audio-visual aids had been reported as one of the most useful techniques and their best use in field conditions had shown improvement on the efficiency of EFS.

Our findings were in agreement with the previous research study by Feder and Savastano (2006) who found that if the opinion leaders were slightly superior to followers but not very superior in socio-economic status then they were also effective in disseminating the information and awareness about IPM technology among other farmers. The adoption of improved conservation practices increased the crop yield. During our study we found that the best way to accelerate the adoption of IPM technology was by means of education

and training of farmers about IPM. Coherent with our findings, Pilcher (2001) attempted to develop a standardized measurement tool to determine factors that contributed to IPM adoption for corn, soybean, and cotton production in Iowa and Texas but could be accessible to other commodities and regions. They developed a survey instrument from an IPM definition that represented the widest scope of strategies and determined 21 pest management tactics regarded by growers to be IPM oriented. From preliminary results, over 60 percent of participants identified three variables; scouting, economic threshold, and field records of pest population to be significant when implementing an IPM program. These three tactics were also found to be consistent with other literature regarding IPM measurement. Drost et al. (1996) surveyed over 900 growers in Utah and determined that for potato farmers, the adoption or rejection of an IPM program was determined based on time availability, market demand for commodities based on specific pest management approaches and real time IPM information. FAO (2006) also found that the FFS approach on IPM had the potential to provide farmers with the practical knowledge and skills to operate more effectively in a market oriented agricultural system and to enable optimum utilization of services offered by private providers.

In an earlier study Bartlett (2005) stated that the first FFS was introduced in Indonesia in 1989. It was a group based learning approach, which was used by NGO, government departments and some international agencies to promote IPM. At this time, millions of people participated in this type of learning. The author also discussed some organizational issues relating to leadership, human resources, policy making and competition among farmers. The calculation of cost and benefit ratio stressed the farmer to join the IPM FFS, the donors and government agencies also funded it because of its beneficial aspects. In conclusion, FFS was very beneficial for poor farmers living in rural areas. Guinee (2002) studied that FFS worked in reducing the use of pesticides and other chemical pest control measures by switching the farmers to IPM in the Netherlands. FFS also helped in controlling the environmental pollution and health problems caused by the pesticides. Through FFS, the technology transferred to farmers and they got a lot of knowledge about the biological pests control method and saved their pesticide expenses. The FFS approach on IPM had the potential to provide farmers with the practical knowledge and skills to operate more effectively in a market-oriented agricultural system and to enable optimum utilization of services offered by private providers (FAO, 2006).

CONCLUSION AND RECOMMENDATIONS

The study concluded that Extension Field Staff were making good progress in helping farmers in D. G. Khan, Punjab, Pakistan to better utilize Integrated Pest Management techniques in their cotton production operations. Extension field staff and local people were the major sources of information regarding IPM of cotton. More than half of the study respondents were under 35 years of age and more than half of this group had at least primary level education. A majority (85%) had small landholdings (up to 12.5 acres) and was owners of their land. The study found that education and age were both factors that guided respondents' appreciation of IPM methods and their ability to make use of training materials. The satisfaction level regarding chemical application was very low. Two-thirds of the respondents applied IPM techniques in the field, while one-third of the respondents were either not adopting the IPM technique in the field or were only partially adopting it. Demonstrations, farm and home visits and field tours were highly effective methods used by EFS as reported by 54.2 and 55.8% respondents, respectively. More than half of the respondents (56.7%) were of the view that IPM was very time-consuming and that this presented a barrier to its adoption. We recommend that Extension Field Staff focus their efforts helping farmers better understand the time constraints of IPM and how they can be more effective in using the method. Also they should focus on making sure cultural and biological controls are properly adopted so that the benefits of using IPM instead of chemical pest controls become well accepted. The extension field staff should utilize the extension method for the promotion of IPM technologies among the farmers. They should also consider launching the IPM program for cotton crops in other districts of the Punjab. The present study was conducted on a limited scale; therefore, future researchers may want to use it as a starting place for further research in other areas of the province. Areas such as the benefits of IPM on water quality and ways to better educate farmers in tribal areas are ripe for examination.

Author Contribution Statement Badar Naseem Siddiqui generated the idea, supervised the research. Muhammad Adeel conducted the research project. Waqar-Ul-Hassan Tareen wrote the manuscript. Adnan Rayit analyzed the data. Shah Fahd edited the manuscript. All the authors read and approved the manuscript to be published in Journal of Rural Development and Agriculture.

Conflict of Interest The authors declare that they have no conflict of interest.

Acknowledgements The authors are thankful to department of Agricultural Extension, PMAS-Arid Agriculture University, Rawalpindi for providing platform for this research.

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