Int. J. Agr. Ext. 12 (02) 2024. 183-194 DOI:10.33687/ijae.012.002.5259

Available Online at EScience Press

International Journal of Agricultural Extension

ISSN: 2311-6110 (Online), 2311-8547 (Print)

https://esciencepress.net/journals/IJAE

ASSESSING AWARENESS AMONG COTTON GROWERS ABOUT THE IPM IN PUNJAB, PAKISTAN: EXPLORING THE ROLE OF PEST WARNING AND QUALITY CONTROL OF PESTICIDES (PW&QCP) DEPARTMENT

[a]Ahsan Ali, [a]Shoukat Ali*, [a]Ijaz Ashraf, [b]Muhammad T. Siddiqui

[a] *Institute of Agricultural Extension, Education and Rural Development, University of Agriculture Faisalabad, Pakistan.*

[b] *Department of Agricultural and Resource Economics, University of Arizona, Tucson, Arizona, USA.*

[c] *Department of Forestry & Range Management, University of Agriculture Faisalabad, Pakistan.*

ARTICLE INFO

Article History

Received: March 19,2024

Revised: June 07,2024

Accepted: June 21,2024

Keywords

IPM

Pesticides

Attitude

Pest warning

Usefulness

Awareness

Biological control

ABSTRACT

Integrated Pest Management (IPM) is deemed a practical approach to controlling insect pest infestation in cotton crop. This study explored the cotton grower's awareness of the IPM activities with particular reference to the role of field staff from the Pest Warning and Quality Control of Pesticides (PW&QCP) department, Punjab. A total of 192 purposively chosen cotton growers from two districts, Multan and Dera Ghazi Khan, were interviewed face-to-face using a structured interview schedule. Using Statistical Package for Social Sciences (SPSS), frequency, percentages, mean, standard deviation, and range were calculated along with correlation and regression to explore the relationship between variables. Results revealed that the mean age of respondents was 43.86 years, education was 4.34 years, land was 9.90 acres, and farming experience was 27.23 years. Around 66% were landowners, and for 73.4%, crop farming was the key income source. The majority (87.5%) had awareness about pest scouting, 69.3% about intercropping, whereas 35.9% were aware of biological control agents, referring to poor understanding of biological control. The grand mean of farmers' attitudes and perceived usefulness of provided services were 3.47 and 3.43, respectively, implying that both were rated moderately. An attitude was statistically significantly correlated with the awareness of IPM activities ($P<0.05$) and the usefulness of services ($P<0.05$). Binary regression showed that attitude and perceived usefulness had a statistically significant ($P<0.05$) impact on the farmers' awareness. The study concludes that the attitude of farmers was key in the context of the usefulness of IPM activities. The field staff of PW&QCP can organise trainings and workshops for the farmers to shape their positive attitude towards biological control.

Corresponding Author: Shoukat Ali

Email: shoukat78pk@yahoo.com

INTRODUCTION

Cotton is regarded as a cash crop in Pakistan for its enormous potential and support for farmers and industry. Cotton contributes 0.7% to the national GDP and 2.9% in value addition to agriculture (Government of Pakistan, 2024). During 2023-24, cotton was cultivated in an area of 2.4 million hectares, and production remained at 10.2 million bales. Both area and production increased, especially the production, which showed an escalated growth of 13.1% compared to the

previous growing season (Government of Pakistan, 2024).

Cotton accounts for over 60% of Pakistan's total export earnings. The cotton-based textile industry is the backbone of Pakistan's manufacturing sector, making up around 60% of the country's total exports (Dahri et al., 2023; Baig et al., 2023). Cotton cultivation provides income and employment for millions of small-scale farmers in Pakistan, contributing significantly to their livelihoods. Two-thirds of Pakistan's export earnings come from cotton-made products and textiles. Cotton is considered Pakistan's "white gold, " contributing 23.6% of its value-added and 4.45% of its total GDP. The cotton crop is crucial for the country's economy and economic growth.

Over the last two decades, cotton area and production in Pakistan have declined, raising concerns. Policies to enhance cotton production, especially for small and medium-sized growers, have been suggested to improve the crop's competitiveness and the country's overall cotton production Baig et al., 2023). Cotton yield in Pakistan has declined significantly from 12 million bales (2010-11) to 7.06 million bales (2020-21), mainly due to poor pest management and other factors (Ali and Ahmed, 2021). Over time, the cost of cotton production in Pakistan has increased, with land rent (28.536%) and seed (21.336%) having the highest and lowest shares, respectively (Ali et al., 2012).

Factors contributing to the decline in cotton production in Pakistan include inefficient use of fertilizer, irrigation, electricity, and machinery and a lack of strategic policies for synthetic fertilizers and irrigation (Arshad et al., 2022). Climate change and biotic stresses are contributing to Pakistan's cotton production decline (Razzaq et al., 2021). Major constraints causing the decline in cotton production in Pakistan include environmental constraints, climate change, water-related constraints, agronomic constraints, and socio-economic-related constraints (Ch et al., 2021). According to Shahzad (2021), factors contributing to the decline in cotton production in Pakistan included the high cost of certified cotton seed and fertilizers, adulteration of pesticides, unavailability of accredited seed, poor quality of water and extreme heat waves, market fluctuation and middleman monopoly, and expansion of sugar industry.

Pesticide use in Pakistan mainly focuses on cotton crop, accounting for 70-85% of total pesticide use (Shahid et al., 2016). Farmers in the cotton belt of Punjab, Pakistan, apply an average of 10 or 11 pesticide applications per growing season, with better-educated farmers spraying less (Khan et al., 2015). Heavy pesticide dependence for pest control among cotton farmers in Punjab, Pakistan, leads to high exposure risk and health problems (Khan and Damalas, 2015). Khan and Damalas (2015) found that 49% of cotton farmers in Pakistan tend to overuse pesticides by spraying higher quantities than required despite significant health concerns. Apart from health concerns, this extensive use of pesticides escalated the production cost and decreased the farmers' profitability.

IPM technologies can reduce the use of pesticides to a great extent without causing harm to the yield in vegetable farming in Bangladesh (Kabir and Rainis, 2015). IPM adoption significantly lowers pesticide use and saves production costs for adopters (Yaguana et al., 2016). Training vegetable farmers in integrated pest management (IPM) reduces the frequency of spraying and mixing different pesticides, and leads to higher crop yield and gross margin (Gautam et al., 2017).

Integrated Pest Management (IPM) is crucial for sustainable agriculture, particularly in regions like Punjab, Pakistan, where cotton farming is economically significant. However, the effectiveness of IPM practices depends heavily on farmers' awareness and adoption. The Pest Warning and Quality Control Department (PWQCD) plays a pivotal role in disseminating information and supporting IPM initiatives.

This study aims to assess the current level of awareness among cotton growers regarding IPM practices in Punjab, Pakistan. By exploring the role of the PWQCD, the research seeks to understand how effectively information about IPM is communicated to farmers, the challenges faced in implementation, and the potential improvements needed.

The findings from this research are expected to contribute valuable insights into enhancing the adoption of IPM among cotton growers in Punjab. This, in turn, could lead to more sustainable agricultural practices, reduced reliance on pesticides, improved crop yields, and ultimately, better economic outcomes for farmers and environmental sustainability in the region. Therefore, assessing awareness and understanding the role of the PWQCD in promoting IPM is not only academically relevant but also holds practical implications for agricultural policy and extension services in Pakistan.

METHODOLOGY

Study area

The southern zone of Punjab is known as a cotton-producing region, including top cotton-growing districts such as (i) Muzaffargarh (ii) Multan (iii) Bahawalnagar (iv) Bahawalpur (v) Vehari (vi) Rahim Yar Khan (vii) Dera Ghazi Khan (viii) Layyah (ix) Sahiwal and (x) Rajan Pur. Of the mentioned districts of Punjab province, two districts (i) Multan and (ii) Dera Ghazi Khan were chosen at random to serve as a study area.

Population, sample and sampling procedure

Two tehsils (sub-districts) were randomly selected from each selected district. From district Multan, two tehsils (i) Jalal Pur Pirwala (ii) Shujabad and from Dera Ghazi Khan, two tehsils, (i) Taunsa Sharif (ii) Kot Chutta were chosen purposively, considering the extensive cultivation of cotton crop in these areas. Four villages were chosen purposively from each selected tehsil, thereby making a total of 16 villages from two districts. From each village, 12 cotton growers were chosen purposively, thereby making 48 farmers from one tehsil, 96 from one district and a total sample of 192 farmers from the two districts (Figure 1).

Data Collection

The interview schedule was used as a research instrument for the data collection from the respondents. The interview schedule was quantitative, with binary and Likert scale questions. Sources such as scholarly articles, books, literature and periodicals were consulted to prepare an interview schedule. The prepared interview schedule was validated by two experts, one from the Institute of Agricultural Extension, Education and Rural Development and the second from the Department of Entomology, University of Agriculture Faisalabad. Based on the suggestions, minor corrections were made to the final interview schedule. Before the start of final data collection, the interview schedule was pre-tested on twenty farmers who were not part of the actual sample size. Based on pre-testing, the reliability of the instrument was checked. Cronbach alpha was calculated to examine the reliability. The alpha value emerged at 0.746, ensuring that the interview schedule was reliable enough to collect data.

Data were collected using a face-to-face interview technique. Respondents were interviewed at their farms and homes. The researcher personally interviewed the respondents. Formal verbal informed consent was obtained from the respondents before the start of the interview. Respondents were also informed that their personal information would be kept anonymous, and the information collected would only be used for research.

Data Analysis

Statistical Package for Social Sciences (SPSS) was used to analyze the collected data. Descriptive statistics such as frequency, percentages, mean, standard deviation, and ranges were calculated. Correlation and regression analysis were used to determine the relationship between the dependent and independent variables.

Computation of variables

Dependent and independent variables were computed to run a binary regression analysis. The model kept awareness about the IPM practices as the dependent variable. In contrast, the attitude of farmers and the usefulness of provided services were the independent variables in the model. Dependent and independent variables were measured on five five-point Likert scales and computed to run a binary regression model.

Awareness: There was a total of ten statements in the awareness section. The score ranged between 11-18. The score ranges from 11-15 was recorded as 1, referring to awareness and the score ranged from 16-18, recoded as 2 referred to “otherwise.”

Attitude: There were 16 statements in the attitude of farmers’ section. The score ranged between 46-63 after the computation of 16 statements. The score ranges from 46-54 was recorded as 1, referring to a favorable attitude, and the score ranged from 55-63, recoded as 2 referring to “otherwise.”

Usefulness: There were 8 statements in the usefulness of services section. The score ranged between 22-32 after the computation of 8 statements. The score ranges from 22-26 was recoded as 1, referring to useful, and the score ranged from 27-32, recoded into 2, referred to as “otherwise”.

RESULTS

The results section of the research articles is the most important, where the readers can find the research question's answers. We divided this section into sub-sections including (i) demographic attributes of the respondents (ii) awareness regarding IPM practices (iii)

effectiveness of PWQC, and (iv) perceived benefits as a result of contact with field staff.

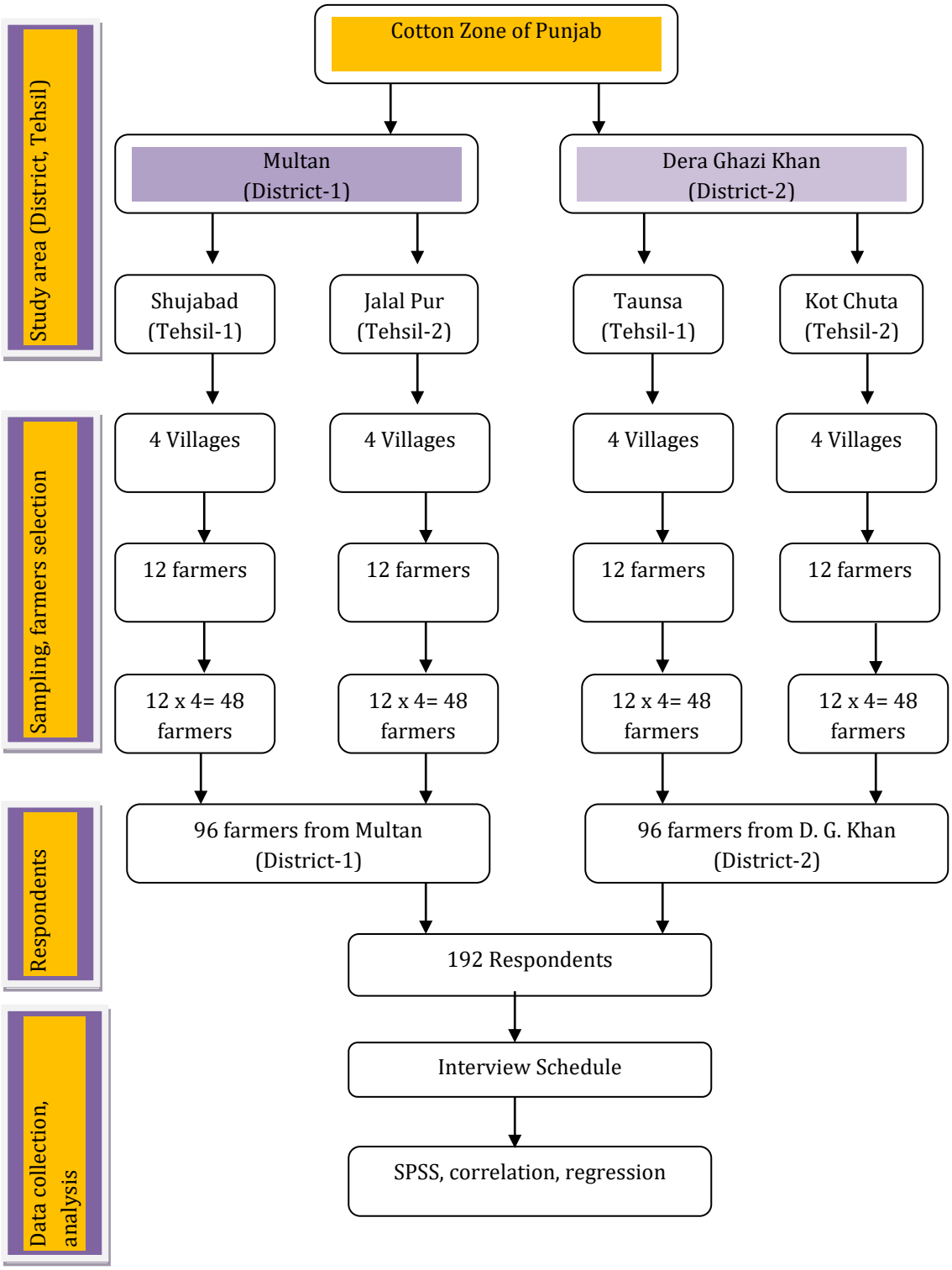

Figure 1. The methodological framework of the study.

Demographic profile of respondents

Demographic attributes are essential for inclusion, advancing diversity, and accurately describing samples for clarity, impacting the generalization and replication of findings (Hughes et al., 2016). Demographic attributes, such as age, gender identity, sex assigned at

birth, ethnicity and race, and socioeconomic status, are essential for gathering accurate information about survey participants' identities and demonstrating inclusion and diversity (Hughes et al., 2022). The importance of demographic attributes, age, education, land size, farming experience, tenancy status and income sources of the study participants were explored. Data in this regard are given in Table 1.

Table 1. Demographic attributes of the respondents.

	Frequency	%	Minimum	Maximum	Mean	Std. Deviation
Age			18	75	43.86	12.99
Education			.00	16	4.34	4.68
Land			1	52	9.90	8.94
Tenancy			1	3	1.51	0.77
Owner	127	66.1				
Tenant	31	16.1				
Owner-cum-tenant	34	17.7				
Experience			2	50	27.23	13.10
Income source						
Crop farming	141	73.4				
Crop + Livestock farming	12	6.3				
Multiple sources	39	20.4				

Table 1 shows that the average age of the survey participants was 43.86 years, with a minimum age of 18 and a maximum of 75 years. This indicates that the survey sample had respondents of diverse age groups. However, current findings contradict those of Khan et al. (20122) as they reported that the overall mean age of farmers in Pakistan was 31.18± 12.79 years (range: 21-30 years). Regarding education, 4.34 years was the average years of schooling of survey participants, which was considerably lower and perhaps inadequate to cope with the increasing complexities of agriculture. This is also a notion that agriculture is managed by the less educated people in the study area. Lack of education is a key factor restricting farmers' access to agricultural advisory and financial services in Pakistan (Elahi et al., 2018). The average land of the respondents was 9.90 acres in the study area. The minimum land size was 1 acre, and the maximum land size held by farmers was 52 acres. Average land endorses that the majority of the farmers were small landholders. In addition, the majority (66.1%) of respondents were owners of their lands, followed by 16.1% tenants and 17.7% owner-cum-tenants in the study area. Concerning farming experience, farmers had 27.2% of the average years they were involved in farming. This experience of farmers shows they had diverse experiences of cultivating cotton crops, facing different challenges and delving into solutions. Crop farming was the income source of 73.4% of respondents. However, one-fifth of respondents (20.4%) generated income from multiple sources. Of the total respondents, 6.3% relied on crop and livestock farming revenue.

Awareness of respondents

In this section, farmers' awareness of the different IPM practices was explored, seeking binary responses from the respondents. There were 10 practices in the list, and respondents were asked to respond 1 (Yes) in case of awareness and 2 (No) for otherwise. The data in this regard are portrayed in Figure 2.

Figure 2 shows varying levels of awareness of different Integrated Pest Management (IPM) practices among cotton growers. While pest scouting had high awareness at 87.5%, indicating a widespread understanding of its importance, using specific tools like pheromone traps and yellow sticky traps appears less prevalent, with only 44.8% and 43.8% awareness, respectively. Similarly, the release of beneficial insects such as Trichogramma and Chrysoperla, though recognized by around a third to half of the respondents, indicates room for improvement in

creating awareness among farmers. The use of botanical extracts like Neem and tobacco shows moderate awareness, with 41.7% and 28.6%, respectively, while using bio-control agents and resistant crop varieties is acknowledged by 35.9% and 55.2% of respondents. Interestingly, intercropping emerges as a more recognized practice, with 69.3% awareness, potentially highlighting its perceived effectiveness or existing cultural practices in agricultural communities. These results synthesize the need for further education and promotion of various IPM strategies to enhance agricultural sustainability and productivity.

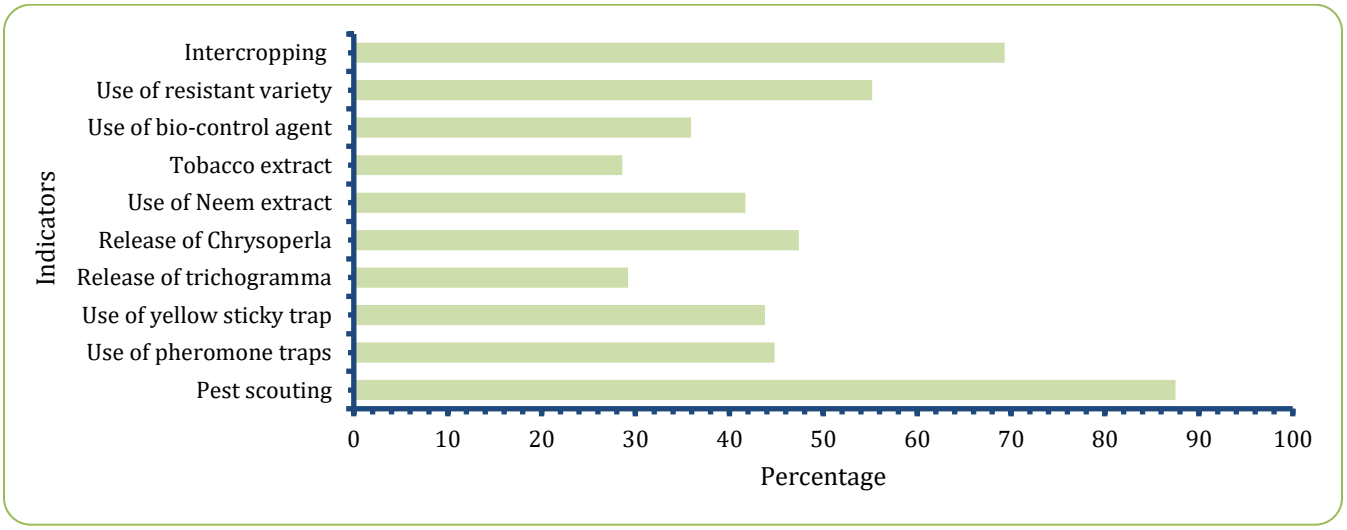

Figure 2. Awareness of respondents about different IPM practices.

The attitude of farmers towards PWQC staff

In this section, the attitude of cotton growers towards the services provided by the Pest Warning and Quality Control of Pesticides (PW&QCP) department. Responses from the respondents were collected on a five-point Likert scale. The information is presented in Table 2.

Table 2. An attitude of farmers towards services provides by PW&QCP department.

Attitude	Range	Mean	Std. Deviation
Playing key role in ensuring the quality of pesticides in the local market	2.00	4.45	0.653
Recommended quality pesticides/chemicals	2.00	4.41	0.657
Advisory from PWQC officials is always free of cost	2.00	4.29	0.558
Awareness about the newest methods of pest control	3.00	4.15	0.599
Officials have sufficient technical knowledge	4.00	4.01	0.897
Advisory from PWQC officials is always effective	3.00	3.96	0.625
Services provided by PWQC are adequate and timely	3.00	3.92	0.771
Establish demo plots in different areas	3.00	3.90	0.556
Recommended IPM practices work effectively	3.00	3.82	0.655
Information regarding delisted/banned pesticides	3.00	3.44	0.908
Staff is easily accessible	3.00	2.73	0.750
The behavior of PWQC officials is friendly	3.00	2.65	0.924
Pesticide use was reduced after using PWQC services	3.00	2.61	0.895
Frequently contact with farmers	4.00	2.57	0.962
PWQC officials provide useful information.	2.00	2.28	0.644
Promote non-chemical methods	4.00	2.26	0.750
Grand Mean		3.47	0.738

1: Strongly disagree 2. Disagree 3. Undecided 4. Agree 5. Strongly Agree

Table 2 shows that the grand mean of indicators of farmers' attitudes towards services from the Pest Warning and Quality Control Department appeared at 3.47. This indicates that the attitude of farmers was on an undecided level although tending towards agree on a five-point Likert scale. Farmers' attitudes towards various services provided by the Pest Warning and Quality Control (PWQC) department, as measured on a scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). Notably, farmers generally highly value the role of the PWQC department in ensuring the quality of pesticides in the local market, as evidenced by the high mean score of 4.45. Similarly, the provision of recommended quality pesticides/chemicals and the free-of-cost advisory from PWQC officials are also highly regarded, with mean scores above 4. The awareness about the newest pest control methods is also perceived positively, although slightly lower, with a mean score of 4.15. However, perceptions regarding the accessibility of staff and the friendliness of PWQC officials appear to be lower, as indicated by mean scores below 3. On the other hand, services such as promoting non-chemical methods and reducing pesticide use after utilizing PWQC services receive comparatively lower mean scores, suggesting areas where improvements or increased emphasis may be necessary to better meet farmers' needs and expectations.

Perceived usefulness

In this section, the perceived usefulness of different services provided by the Pest Warning and Pesticides Quality Control Department was assessed as perceived by the respondents. There was a total of eight statements, which were asked from the respondents using a five-point Likert scale. The data in this regard are given in Table 3.

Table 3. Perceived usefulness of services provided by PW&QCP department.

Perceived Usefulness	Range	Mean	Std. Deviation
Better control of Insect/pests	3.00	3.9010	.60157
Better control of plant diseases	3.00	3.7240	.54326
Identification of ETL level of the specific crop	1.00	3.6146	.48797
Chemical pesticides use is decreased as a result of PWQC services	2.00	3.5469	.54905
Better identification of insect pest	4.00	3.5208	.99716
Better understanding regarding pesticide application for insect pest and diseases	3.00	3.5156	.67859
Better identification of useful insects	2.00	3.1562	.49770
Better identification of plant disease	2.00	2.4792	.79236
Grand Mean		3.4322	0.6434

Scale- 1. Very low 2. Low 3. moderate 4. High 5. Very High

Table 3 presents data on the perceived usefulness of various aspects related to pest and disease control in agriculture, with respondents providing scores ranging from 1 to 4. The aggregate mean 3.432 shows the moderate level of usefulness of services. The aspect deemed most useful is better control of Insect/pests" with a mean score of 3.9010, followed closely by better control of plant diseases" at 3.7240. Identification of ETL level of the specific crop also scored high at 3.6146, indicating its importance. Moderately useful aspects include decreased Chemical pesticide use as a result of PWQC services, better identification of insect pest," and "Better understanding regarding pesticide application for insect pests and diseases," all scoring around 3.5. "Better identification of useful insects" garnered a slightly lower score of 3.1562, while better identification of plant disease received the lowest mean score of 2.4792, suggesting it's considered the least useful aspect among those listed. Overall, the data strongly emphasize controlling insect pests and reducing chemical pesticide use, with less emphasis on identifying and managing plant diseases.

Multivariate analysis

Correlation analysis

Correlation coefficients quantify the strength and direction of the relationship between two variables. By testing correlation, we can determine if there is a significant association between variables. This helps understand how changes in one variable correspond to

changes in another. The model tested awareness, attitude and perceived usefulness for the correlation.

Table 4 shows that the attitude of farmers was statically significantly correlated with their awareness (P<0.05), and usefulness was insignificantly but positively correlated with awareness (P>0.05). Attitude was statistically significantly correlated (P<0.05) with the usefulness of the services.

Table 4. Correlation between awareness, attitude and perceived usefulness.

	Awareness	Attitude	Usefulness
Awareness	1		
Attitude	0.252**	1	
Usefulness	0.011	0.215**	1

**. Correlation is significant at the 0.01 level (2-tailed).

Binary Logistics Regression

Binary logistic regression is a statistical method used to model the relationship between a binary dependent variable (a variable with two possible outcomes, typically coded as 0 and 1) and one or more independent variables. In this study, awareness among respondents about the different IPM practices was the dependent variable (1: aware 0: otherwise), whereas the attitude of the farmers towards services (1: positive 0: otherwise) and perceived usefulness of services (1: useful 0: otherwise) were the independent variables. The hypotheses of the study are as under:

H1: Attitude had a significant impact on awareness among respondents about IPM practices

H0: Attitude had an insignificant impact on awareness among respondents about IPM practices

H1: Usefulness had a significant impact on awareness among respondents about IPM practices

H0: Usefulness had an insignificant impact on awareness among respondents about IPM practices

Table 5. Relationship of attitude and usefulness of services with the level of awareness among farmers.

	B	S.E.	Wald	df	Sig.	Odds ratio
Attitude	-.172	.064	7.249	1	.007	0.842
Usefulness	.159	.099	2.585	1	.108	1.172
Constant	3.980	3.891	1.047	1	.306	53.520
	-2 Log likelihood	200.58				
	Cox & Snell R^2	0.47				
	agelkerke R^2	0.71				

Table 5 shows that the overall model of regression was statistically significant (P<0.05). Whereas, the model showed 47% of the variance. As far as independent variables were concerned, the attitude had a statistically significant impact on the farmers' awareness (P< 0.05), implying that with the increasingly positive attitude of farmers towards the services, there were growing chances of more awareness among farmers about the IPM-related indicators. Perceived usefulness of services was statistically significant with farmers' awareness of IPM services (P<0.05). This indicated that with the increase in the usefulness of the services among farmers, farmers would have more urge to get more information and increase their awareness about the different IPM-related activities.

DISCUSSION

This study was mainly concerned with exploring the demographic attributes of respondents first, awareness about different IPM activities, the attitude of farmers towards the services provided by the Pest Warning & Quality Control Pesticides department, and the perceived usefulness of provided services. Demographic attributes of the respondents showed that the average schooling of respondents was considerably lower (4.34 years). A low level of education among farmers can have adverse consequences, becoming poor awareness and inadequate capabilities to cope with the increasing challenges of modern crop farming. Disadvantages of farmers' low level of education include singleness, backward educational means, and backward levels

affecting farming expertise, scientific and technological awareness, and labor skills (Peng and Tang, 2022). Farmer field schools were launched to educate the farmers. Davis et al. (2012) reported that farmer field schools increased income by 61% and improved agricultural income and crop productivity overall in East Africa. This shows that education is one of the significant factors in ensuring high production and profitability.

Research studies have consistently shown a positive correlation between education and awareness. Higher levels of education are associated with increased awareness of sustainable practices (Hasan et al., 2015). Our study indicated that farmers had the highest awareness of pest scouting (87.5%). In contrast, there was less awareness of the bio-control agents and biological control of pests in cotton. Biological control is perceived as important in cotton crops, especially in curtailion of the use of pesticides, conservation of the ecosystem, and increase in production. Biological control is essential in integrated pest management (IPM) strategies for cotton pests, preventing outbreaks of other pests like cotton aphids (Luo et al., 2014). In another study, Neharkar et al. (2014) stated that biological control, including natural enemies and biological control agents, is important for maintaining insect pests below economic injury levels in cotton crops. Improved awareness, understanding of organic and IPM histories and benefits, and increased education and extension can help overcome barriers to greater adoption of biological control (Baker et al., 2020). Farmers' intentions to use biological control are affected by perceived self-efficacy, facilitating conditions, compatibility, and perceived usefulness (Sharifzadeh et al., 2017). Barriers to adopting biopesticides include a competitive market, risk-averse customers, a complex selling channel, a perceived lack of efficacy, and lack of awareness (Marrone, 2007). In our study, the farmers' awareness of biological control was ordinary. Farmers in Pakistan rely mainly on chemical pest control methods, but their knowledge of pesticide safety issues is below average (Khan and Damalas, 2015).

Another key objective of the study was to explore the attitude of farmers towards services provided by pest warning and quality control of pesticides. It was found that the overall attitude was undecided. However, the attitude was more positive towards the department's role in ensuring the quality of pesticides, and the attitude was least inclined towards the department's role in promoting non-chemical methods. Farmers still rely heavily on chemicals to control pests in Bt cotton as they are easily persuaded by the advertisements of pesticide companies (Arshad et al., 2009). In another study, Khan and Damalas (2015) identified that farmers rely on chemical methods for pest control, but their knowledge of pesticide safety issues is below average. On the other hand, Farmer Field School (FFS) farmers in Khairpur District of Sindh, Pakistan, reduced pesticide application by 44% and maintained a higher level of technical efficiency, indicating a shift towards non-chemical methods of crop protection (Khan and Iqbal, 2005). In a study, Kadam (2016) reported that most cotton growers (56%) had developed a 'favourable' attitude towards integrated pest management technology programs on cotton. However, high levels of education and training are main determinants of environmentally sound behaviour in pest control among Pakistani cotton farmers (Khan and Damalas, 2015).

Factors influencing the adoption of non-chemical crop protection methods by cotton farmers in Pakistan include easy access to credit, provision of extension services, awareness regarding CSA, availability of good quality groundwater, and right of ownership of tubewell (Imran et al., 2019). Pertinent to the different challenges, the usefulness of the provided services was also reported to be moderate by the study participants. Farmers were poor in the identification of beneficial insect pests in particular. In a study, Ali et al. (2019) reported that only 11% of farmers correctly identified bees, and 58% showed a willingness to conserve bees on their farms after learning about their importance in pollination services. Of the total respondents, 46.67% had a low level of adoption towards recommended plant protection practices, with 35.83% having medium and 17.5% having high levels of adoption. This indicates room for improvement in plant protection services in the study area. Effective plant disease management, including integrated pest and disease management, can minimize economic losses, improve crop productivity, and promote environmental sustainability and human health in Pakistan (Afzal et al., 2023). The effective role of institutions such as Pest Warning and Quality Control of Pesticides can shape the farmers' attitude towards adopting biological control and IPM activities, which could not only conserve the environment but also curtail the cost of production. Our study complimented that the attitude of farmers had a statistically significant

relationship with farmers' awareness and usefulness of IPM-led activities. The results from a survey conducted by Rezai et al. (2019) confirmed that attitude significantly influenced farmers' intention to use integrated pest management practices (Rezaei et al., 2019). In another study, Rezaei et al. (2020) reported that attitude explained 41.3% of the variance in farmers' ecological conservation behaviour regarding using IPM practices (Rezaei et al., 2020). However, farmers' familiarity with IPM is positively related to their choice of pest control information sources and higher levels of adoption when they seek information from impartial sources (Creissen et al., 2021). Therefore, this study highlights the great potential for the Pest Warning and Quality Control of Pesticides department to be a significant information source for farmers.

CONCLUSION

This study focused on assessing cotton growers' awareness of IPM practices, particularly the role of field staff from the Pest Warning and Quality Control of Pesticides (PW&QCP) department in Punjab. Farmers had varying levels of awareness regarding IPM components such as pest scouting, intercropping, and biological control agents, with notably low awareness concerning biological control methods for cotton crops. However, farmers' attitudes significantly influenced their overall understanding of IPM activities and perception of IPM usefulness. It is suggested that PW&QCP field staff should conduct targeted training and workshops to enhance farmers' positive attitudes towards biological control methods. There should be some efforts to educate farmers on the benefits and application of IPM practices, emphasizing ecological sustainability. Fostering partnerships with agricultural extension services and local universities to broaden access to IPM knowledge and resources could be very effective. Ultimate there is a need to monitor and evaluate IPM adoption rates to refine outreach strategies and tailor interventions to farmers' needs and preferences.

REFERENCES

Afzal, A., Ahmad, A., Hassaan, M., Mushtaq, S. and Abbas, A. 2023. Enhancing Agricultural Sustainability in Pakistan: Addressing Challenges and Seizing Opportunities through Effective Plant Disease Management. Plant Protection, 7(2): 341-350.

Ali, A. and Ahmed, Z. 2021. Revival of Cotton Pest Management Strategies in Pakistan. Outlooks on Pest Management, 32(4): 144-148.

Ali, H., Aslam, M. and Ali, H. 2012. Economic Analysis of Input Trend in Cotton Production Process in Pakistan. Asian Economic and Financial Review, 2: 553-561.

Ali, M., Sajjad, A., Farooqi, M., Bashir, M., Aslam, M., Nafees, M., Aslam, M., Adnan, M. and Khan, K. 2019. Assessing indigenous and local knowledge of farmers about pollination services in the cucurbit agro-ecosystem of Punjab, Pakistan. Saudi Journal of Biological Sciences, 27: 189-194.

Arshad, M., Suhail, A., Gogi, M., Yaseen, M., Asghar, M., Tayyib, M., Karar, H., Hafeez, F. and Ullah, U. 2009. Farmers' perceptions of insect pests and pest management practices in Bt cotton in the Punjab, Pakistan. International Journal of Pest Management, 55: 1-10.

Arshad, M., Zhao, Y., Hanif, O. and Fatima, F. 2022. Evolution of Overall Cotton Production and Its Determinants: Implications for Developing Countries Using Pakistan Case. Sustainability, 14(2): 840.

Baig, I. A., Ullah, S. and Nasir, S. 2023. Policy Impacts on Comparative Advantage and Production Protection to Cotton and Its Competing Crops in Pakistan. The Pakistan Development Review, 62(4): 539-552.

Baker, B., Green, T. and Loker, A. 2020. Biological control and integrated pest management in organic and conventional systems. Biological Control, 140: 10495.

Ch, K., Ashraf, S. and Ashraf, I. 2021. Cotton production trends in Pakistan: An integrative review. Journal of Plant and Environment, 3(2): 149-159.

Creissen, H., Jones, P., Tranter, R., Girling, R., Jess, S., Burnett, F., Gaffney, M., Thorne, F. and Kildea, S. 2021. Identifying the drivers and constraints to the adoption of IPM amongst arable farmers in the UK and Ireland. Pest Management, 77: 4148-4158.

Dahri, G. N., Wang, J., Khanzadab, B., Soomro, A. S., Hingorjo, W. B., Mari, M. A. and Tabassum, S. 2023. Impact of Training Approaches to Reduce Knowledge and Skills Gap in Cotton Crop: A Case

Study Taluka Sinjhoro District Sanghar, Sindh. Journal of Applied Research in Plant Sciences, 4(01): 502-511.

Davis, K., Nkonya, E., Kato, E., Mekonnen, D., Odendo, M., Miiro, R. and Nkuba, J. 2012. Impact of Farmer Field Schools on Agricultural Productivity and Poverty in East Africa. World Development, 40: 402-413.

Elahi, E., Abid, M., Zhang, L., Haq, S. and Sahito, J. 2018. Agricultural advisory and financial services; farm level access, outreach and impact in a mixed cropping district of Punjab, Pakistan. Land Use Policy, 71: 249-260.

Gautam, S., Schreinemachers, P., Uddin, M. and Srinivasan, R. 2017. Impact of training vegetable farmers in Bangladesh in integrated pest management (IPM). Crop Protection, 102: 161-169.

Hasan, M. S., Rahman, R. A., Abdillah, S. F. H. B. T. and Omar, N. 2015. Perception and awareness of young internet users towards cybercrime: Evidence from Malaysia. Journal of Social Sciences, 11(4): 395.

Hughes, J., Camden, A. and Yangchen, T. 2016. Rethinking and updating demographic questions: Guidance to improve descriptions of research samples. Psi Chi Journal of Psychological Research, 21: 138.

Hughes, J., Camden, A., Yangchen, T., Smith, G., Rodríguez, M., Rouse, S., McDonald, C. and Lopez, S. 2022. Invited Editorial: Guidance for Researchers When Using Inclusive Demographic Questions for Surveys: Improved and Updated Questions. Psi Chi Journal of Psychological Research, 27(4):232-255.

Imran, M., Ali, A., Ashfaq, M., Hassan, S., Culas, R., & Ma, C. (2019). Impact of climate smart agriculture (CSA) through sustainable irrigation management on Resource use efficiency: A sustainable production alternative for cotton. Land Use Policy, 88:104113.

Kabir, M. and Rainis, R. 2015. Adoption and intensity of integrated pest management (IPM) vegetable farming in Bangladesh: an approach to Sustainable Agricultural Development. Environment, Development and Sustainability, 17: 1413-1429.

Kadam, P. 2016. Attitude of the Farmers towards Integrated Pest Management Technology Programme on Cotton. International Journal of Agricultural Sciences, 12: 294-297.

Khan, A., Jaffar, N. and Murad, F. 2022. Practice and effect of pesticide use on farmers' health in Sindh, Pakistan. *JPMA.* The Journal of the Pakistan Medical Association, 72: 587-592.

Khan, M. and Damalas, C. 2015. Farmers' knowledge about common pests and pesticide safety in conventional cotton production in Pakistan. Crop Protection, 77: 45-51.

Khan, M. and Damalas, C. 2015. Occupational exposure to pesticides and resultant health problems among cotton farmers of Punjab, Pakistan. *International* Journal of Environmental Health Research, 25: 508 - 521.

Khan, M. and Iqbal, M. 2005. Sustainable Cotton Production Through Skill Development among Farmers: Evidence from Khairpur District of Sindh, Pakistan. The Pakistan Development Review, 44: 695-716.

Khan, M., Mahmood, H. and Damalas, C. 2015. Pesticide use and risk perceptions among farmers in the cotton belt of Punjab, Pakistan. Crop Protection, 67: 184-190.

Luo, S., Naranjo, S. and Wu, K. 2014. Biological control of cotton pests in China. Biological Control, 68: 6-14.

Marrone, P. 2007. Barriers to adoption of biological control agents and biological pesticides. Cab Reviews: Perspectives in Agriculture, Veterinary Science, Nutrition and Natural Resources, 2: 51.

Neharkar, P., Kamdi, S., Kadu, P., Bramhankar, S., & Bhagat, G. 2014. Effect of some insecticides and botanicals on predatory ladybird beetles (*Coleoptera: Coccinellidae*) in cotton. International Journal of Plant Sciences, 9: 394-396.

Peng, W. and Tang, Z. 2022. Construction and Application of Farmers' Practical Teaching System in Vocational Education Based on Big Data Mining Technology. Computational Intelligence and Neuroscience, 19: 1-9.

Razzaq, A., Zafar, M., Ali, A., Hafeez, A., Batool, W., Shi, Y., Gŏng, W. and Yuan, Y. 2021. Cotton germplasm improvement and progress in Pakistan. Journal of Cotton Research, 4: 1-14.

Rezaei, R., Safa, L. and Ganjkhanloo, M. 2020. Understanding farmers' ecological conservation

behaviour regarding the use of integrated pest management- an application of the technology acceptance model. Global Ecology and Conservation, 22: e00941

Rezaei, R., Safa, L., Damalas, C. and Ganjkhanloo, M. 2019. Drivers of farmers' intention to use integrated pest management: Integrating the theory of planned behaviour and norm activation model. Journal of Environmental Management, 236: 328-339.

Shahid, M., Ahmad, A., Khalid, S., Siddique, H., Saeed, M., Ashraf, M., Sabir, M., Niazi, N., Bilal, M., Naqvi, S., Bibi, I. and Pinelli, E. 2016. Pesticides Pollution in Agricultural Soils of Pakistan. In: Hakeem, K., Akhtar, J., Sabir, M. (eds) Soil Science: Agricultural and Environmental Prospectives. Springer, Cham. p199-229.

Shahzad, M., Iftikhar, M., and Wajid, S. A. 2021. An investigative insight of factors responsible for cotton paradigm shifting in the Punjab, Pakistan. Pakistan Journal of Agricultural Sciences, 58(6),1953-1958.

Sharifzadeh, M., Damalas, C., Abdollahzadeh, G. and Ahmadi-Gorgi, H. 2017. Predicting adoption of biological control among Iranian rice farmers: An application of the extended technology acceptance model (TAM2). Crop Protection, 96: 88-96.

Yaguana, V., Alwang, J., Norton, G. and Barrera, V. 2016. Does IPM Have Staying Power? Revisiting a Potato-producing Area Years After Formal Training Ended. Journal of Agricultural Economics, 67: 308-323.