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The Plant Protection Capabilities of Extension Workers in Enhancing Maize (*Zea mays* L.) Production: A case study of District Shangla Khyber Pakhtunkhwa, Pakistan

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ABSTRACT

This study analyzed farmers' perceptions about plant protection capabilities of extension workers in enhancing maize production in remote District Shangla Khyber Pakhtunkhwa-Pakistan. Educating farmers about modern technologies of crops is the mandate of the extension staff of the provincial agriculture extension department. For this research, two villages were taken purposively from three union councils of Tehsil Besham of District Shangla for data collection through a well-structured interview schedule. A total of 204 farmers were selected for data collection, which was analyzed using SPSS V.20 software. Descriptive statistics, 5 points Likert scale, and Chi-square tests were used. About 32% of respondents were found in the age 26-35 years, 46.6% respondents have 1-2 acres of land under maize crop while 57.8% maize growers were literate with 20.1% respondents educated up to matric. Maximum (82.4%) growers were getting 6400-12800 kg/acre maize production by cultivating local varieties. Awareness about alternative pest management technique was ranked 1st with the highest mean value of 3.04 and standard deviation of 1.13, and performing pest monitoring on maize were ranked 2nd with a mean value of 2.84 and standard deviation of 1.14. In contrast, identifying symptoms of major insects/pest diseases was ranked 5th with the lowest mean value of 2.67 and a standard deviation of 1.23. Their plant protection issues by educating them on disease-resistant varieties and weather suitability of maize hybrid varieties for higher production through local agriculture programs broadcasted on a local FM channel and pamphlets.

1. Introduction

The most important sector in agriculture in Pakistan's budget and is considered the keystone of every economy. Our country is an agrarian, contributes 19.3 % to Gross Domestic Product (GDP), employs nearly 42.3 % of the overall labor force, and accounts for a substantial portion of export earnings. Almost 68% of people in rural areas are engaged in agriculture, through the cultivation, refining, and trade of minor and major agricultural products. It is their primary source of income and support, meeting the population's food needs and supplying raw materials to industries **(GoP, 2019-2020)**.

As per the estimate of **(Borlaug, 2007)**, above the next fifty years, extra 3.5 billion people will need more feed than the world's present population. Only the three major cereal crops of wheat, rice, and maize production will be required to maximize by 70 percent to feed the growing rural and urban population by 2050. One of the most important crops is maize, mostly affected by the present climatic scenario known as the queen of cereal. After wheat, cotton, and rice, maize occupies an important position in the cereal crop of Pakistan. Maize is known as the Kharif crop, and the period of maize starts from June and lasts till November in the province of Khyber Pakhtunkhwa.

The scientific name *Zea mays* L, popularly known as maize, is utilized as a staple meal, fodder, and raw material in a variety of manufacturing processes all over the world. Maize contributes to a balanced diet containing approximately 3% basic minerals, 4% fats and fiber, 9% calcium, and almost 80% starches **(Ahmad *et al.*, 2014)**.

Maize contributes to food security in several developing countries of Asia and Africa as the staple food crop for most rural population feed and known as an industrial crop around the world. The maize crop is called “the other gold” due to its expanded consumption of industries. The yield of Food energy by maize is valued at about 6.9 million calories per hectare, which is equally high compared to wheat, estimated at 3.7 million, and rice estimate is almost 4.9 million in energy. Low soil fertility is a significant yield-limiting factor for cereal production in many rich and developing nations, including Pakistan. Around 60% of maize grain is used in the poultry/animals feed industry and some of its by-products. The industrialized world will cope with minimum soil fertility by providing sufficient food called nutrients in the form of chemical fertilizers. However, due to the high cost of fertilizers, this is not feasible in most countries. The farming community resultantly uses both sources of organic and chemical fertilizers in sufficient quantities to minimize chemical fertilizer costs and increase crop yields. However, because of energy scarcity, rising pesticide costs, deteriorating soil quality, and environmental issues, organic manures have resurfaced as a viable option **(Yaduvanshi, 2003)**. Organic matter, such as crop waste, aids in the recycling of nutrients, which serves to fix shortages. Organic origins, according to studies, will assist in sustaining a stronger Nitrogen and Phosphorus ratio for higher yield **(Bakhtiar *et al.*, 2002, Khanam *et al.*, 2001)**. Organic sources were shown to be effective at much higher rates, while this could be out of control for producers of small and minor and low income **(Ahmad, 2000; Alam *et al.*, 2000)**.

In other hand, the less production of agriculture can be related to the minimum or no adoption of improved recommended technologies of agriculture advised by agricultural extension workers **(Farooq *et al.*, 2007)**. In addition, the capacity of extension workers to achieve the defined program objectives depends directly on the quality of their skills, expertise and position. It was said that the professional and personal attributes contribute to success or high performance in the performance of tasks. **Mitchell (2002)** has urged all extension staff to gain individual strengths, skills as an educator, information competence and communication technologies together with skills in work. In addition, the most crucial element for success or otherwise in the agricultural extension program is the extension worker, which is

the most useful and vital individual inside the extension program. In all training activities, skills should be given the highest attention **(Nawaz *et al.*, 2020)**.

As maize is one of the important crop in the study area as maximum are growing this crop due to suitability of soil and favor of weather. This study was initiated with the objectives to examine the Maize growers' perception about extension workers' capabilities in maize production in the research area and to know the associations of demographic characteristics on production and yield of maize in the project area

2. Methods

This study was conducted in district Shangla on farmers' perception about plant protection capabilities of extension workers in enhancing maize production. The majority of the farmers cultivated maize, and the researcher hail from the study region where collecting data for the study was easy by knowing their customs. Two villages were selected purposively from three union councils in tehsil Besham for the present research. Purposively selected villages from the respective union councils of Tehsil Besham's data was collected through a well-structured interview schedule from 204 sample respondents for the present study. The acquired data were analyzed via Statistical Package for Social Sciences tools (SPSS v. 20). A Chi-square test was used to determine the relationship between two variables, and the link between variables was investigated. A 5-point Likert scale **(Likert, 1967)** was used to know the intensity of extension workers' capabilities from farmers' points of view. Maximum use of 5-point Likert scale was done for revealing the replies of the farming community during his study on the role of I.C.T. for sustainable agricultural production **(Salam & Khan, 2019)**.

3. Results and Discussion

3.1 Demographic characteristics of the respondents

The primary demographic characteristics assumed for this research study were age and literacy status along with level of education. These characteristics are quite useful for collecting data and obtaining essential information from respondents. Demographic traits always have an impact on other characteristics. For these reasons, data collecting in these areas is important **(Ekanem *et al.*, 2006; Fawole, 2006; Agwu *et al.*, 2008; Saadi *et al.*, 2008; Jensen *et al.*, 2009)**. Data regarding demographic characteristics were assembled and offered below.

3.1.1 Age of the respondents

The adoption or rejection of contemporary farming practices is strongly influenced by age. When compared to older people, younger people are more likely to adopt innovations **(Okwu *et al.*, 2007)** and the adoption of agricultural advances is directly influenced by age **(Agwu *et al.*, 2008)**. Age data of the maize growers were given in Table 1 in the categories of 4 groups. Out of 204 growers, 65 (31.9%) had age of 26-35 year, 58 (28.4%) belonged to the category of 36-45 years, 51 (25.0%) had age more than 46 year and the remaining 30 (14.7%) of the maize growers were having the age of less than 25 years.

Table 1. Age of the maize respondents in the project area

Villages	Age of Maize growers (in years)				Total
	Below 25	26-35	36-45	46 and above	
Kunshi	1 (0.5)	7 (3.4)	11 (5.4)	14 (6.9)	33
Barkaly	11 (5.4)	12 (5.9)	7 (3.4)	4 (2.0)	34
Zor Shang	1 (0.5)	16 (7.8)	12 (5.9)	5 (2.5)	34
Janrai	5 (2.5)	11 (5.4)	8 (3.9)	10 (4.9)	34
Bara Lahore	7 (3.4)	10 (4.9)	9 (4.4)	8 (3.9)	34
Chota Lahore	5 (2.5)	9 (4,4)	11 (5.4)	10 (4.9)	35

Total	30 (14.7)	65 (31.9)	58 (28.4)	51 (25.0)	204

3.1.2 Literacy status

Literacy status has a significant role in the implementation and acceptance of latest and modern farming technology. A person's aptitude toward acceptance of better farming techniques might be influenced through education. Education is a method of bringing about desired changes in people's behavior. An educated person is more likely to keep up with the newest information on the changes in his environment. As a result, an educated farmer is thought to be more aware of agricultural advancements and to be more scientific in his approach to farm techniques **(Aziz *et al.*, 2018)**. **Anandajayasekeram (2008)** findings emphasize that the adoption of modern extension services and methods is strongly influenced by farmer education. Farmers who are literate are more open to new ideas than those who are illiterate.

Data in Table 2 shows that from total 204 growers, (42.2%) of them were illiterate, while more than half that is (57.8%) of them were found literate. Among the literate, 19.6% growers had basic level of primary education, 9.3% growers were in middle level education, 20.1% of them were matriculate and 4.4% respondents each got education up to intermediate and graduate.

Table 2. Literacy status of maize growers

Name of Villages	**Literacy Status of the respondent**								**Total**
	Illiterate	**Literate**	**Total**	**Primary**	**Middle**	**Matric**	**Intermediate**	**Inter and above**	
Kunshi	10(4.9)	23(11.3)	33(16.2)	8(3.9)	2(1.0)	8(3.9)	2(1.0)	3(1.5)	23(11.3)
Barkaly	14(6.9)	20(9.8)	34(16.7)	5(2.5)	8(3.9)	6(2.9)	1(0.5)	0(0)	20(9.8)
Zor Shang	17(8.3)	17(8.3)	34(16.7)	4(2.0)	1(0.5)	8(3.9)	2(1.0)	2(1.0)	17(8.3)
Janrai	14(6.9)	20(9.8)	34(16.7)	9(4.4)	3(1.5)	7(3.4)	0(0)	1(0.5)	20(9.8)
Bara Lahore	16(7.8)	18(8.8)	34(16.7)	4(2.0)	3(1.5)	6(2.9)	3(1.5)	2(1.0)	18(8.8)
Chota Lahore	15(7.4)	20(9.8)	35(17.2)	10(4.9)	2(1.0)	6(2.9)	1(0.5)	1(0.5)	20(9.8)
Total	**86(42.2)**	**118(57.8)**	**204(100)**	**40(19.6)**	**19(9.3)**	**41(20.1)**	**9(4.4)**	**9(4.4)**	**118(57.8)**

Source: Field 2021

3.1.3 Area under maize crops

Area under maize crop is important aspect for mechanized farming as these field operations depend on size of allocated land for particular crop and ultimately with farm production **(Khan, 2012)**. According to former studies, inclination of implementation is linked significantly with the size of land as revealed by **(Dinar and Yaron, 1992)**. Land size has a prominent connection in the settlement approach of farming community in the adoption of innovations **(Sanaullah *et al.*, 2020)**. Data of area of the growers under maize crop were presented in Table 3. More maize growers (46.6%) had 1-2 acres of area under maize crop was recorded, 28.9% growers recorded 2-4 acres area under maize crop and the 24.5% of them reported the allocation of above 4 acres of land for the cultivation of maize.

Table 3. Area under maize crop by maize growers

Name of Villages	**Maize Crop area (Acre)**			**Total**
	1-2 acre	**2-4 acre**	**Above 4 acre**	
Kunshi	20 (9.8)	7 (3.4)	6 (2.9)	33
Barkaly	12 (5.9)	9 (4.4)	13 (6.4)	34
Zor Shang	15 (7.4)	14 (6.9)	5 (2.5)	34
Janrai	19 (9.3)	9 (4.4)	6 (2.9)	34
Bara Lahore	12 (5.9)	8 (3.9)	14 (6.9)	34

Chota Lahore	17 (8.3)	12 (5.9)	6 (2.9)	35
Total	**95 (46.6)**	**59 (28.9)**	**50 (24.5)**	**204**

Source: Field 2021

3.1.4 Total production of maize

Highest yielding crop in the world is maize and ranks fourth amongst most cereal crops. About two third of national output is produced during Kharif season and it is the only cereal crop that grows in both Kharif and Rabi season. Maize crop production data as revealed in Table 4 showing the total production of this crop in kgs in the research area. Maximum maize growers 42.2% revealed their production up to 6400 kg/acre in total and 40.2% growers told about their total production between 6400-12800 kg/acre. About 16.2% respondents reported 12800-19200 kg/acre maize production while only 1.5% respondents reported above 19200 kg/acre maize production in the study areas.

Table 4. Total production of maize growers in the research area

Villages Name	Total Production of Maize Crop (Kg)/acre				Total Growers
	Up to 6400	6400-12800	12800-19200	Above 19200	
Kunshi	14 (6.9)	16 (7.8)	3 (1.5)	0 (0)	33
Barkaly	12 (5.9)	10 (4.9)	11 (5.4)	1 (0.5)	34
Zor Shang	18 (8.8)	13 (6.4)	3 (1.5)	0 (0)	34
Janrai	14 (6.9)	17 (8.3)	3 (1.5)	0 (0)	34
Bara Lahore	12 (5.9)	10 (4.9)	11 (5.4)	1 (0.5)	34
Chota Lahore	16 (7.8)	16 (7.8)	2 (1.0)	1 (0.5)	35
Total Respondents	86 (42.2)	82 (40.2)	33 (16.2)	3 (1.5)	204

Source: Field 2021

3.2 Capabilities of extension workers regarding plant protection from farmers' point of view

Plant protection means, controlling of pests, weeds of the crops and trees as well as harmful disease along with a set of control method used in agriculture to prevent and eliminate the damages done to crops and plants by harmful organisms. The plant protection included cultural practices that must be done before and after cultivation of crops to prevent disorders appearance. Another thing is that the crop protection requires knowledge acquisition mode about the tools to protect the crops against certain diseases. Knowledge about the pest, diseases and insect identification task is also necessary **(Rafea, 2010)**.

Table 5. Farmers' perception regarding extension workers' capabilities in plant protection

Capability regarding Plant Protection	**1**	**2**	**3**	**4**	**5**	**Mean**	**S.D**	**Ranks**
Awareness about alternative pest management technique	16(7.8)	52(25.5)	70(34.3)	40(19.6)	26(12.7)	3.04	1.13	I
Perform pest monitoring on maize	25(12.3)	56(27.5)	70(34.3)	33(16.2)	20(9.8)	2.84	1.14	II
Commonly occurring weeds in maize	19(9.3)	60(29.4)	78(38.2)	30(14.7)	17(8.3)	2.83	1.06	III
Ability of identification of various weeds in maize	24(11.8)	58(28.4)	72(35.3)	34(16.7)	16(7.8)	2.79	1.09	IV
Identification of symptoms of major insects/pests, diseases and their causes in maize	38(18.6)	52(25.5)	68(33.3)	23(11.3)	23(11.3)	2.67	1.23	V

Extension workers of provincial agriculture extension department are playing the role of front line workers by having direct contact with the farming community who need trainings in crop protection measures. As per evident facts the weeds and diseases of crops along with the problems of insects/pest are changing with the climate change. By having the pivotal role in educating and motivating the farming community in adoption of recommended technologies, the importance of crop protection for extension workers is highly important to minimize the losses of maize crop. Table 5 depicts the ranking of agricultural extension workers capabilities in plant protection from maize growers' point of view along with mean and standard deviation through likert scale from very low, low, medium, high and very high. Awareness about alternative pest management techniques was ranked I with highest mean value 3.04 and SD 1.13 and performance of pest monitoring on maize was ranked II with mean value 2.84 and standard deviation 1.14. Furthermore familiarity with common occurring weeds in maize crop was ranked III with mean value 2.83 and SD 1.06 Likewise ability of identifying various types of weeds in maize was ranked IV with lower mean value 2.80 and SD 1.09 and identifying the symptoms of major insects/pests, diseases, and their causes in maize crop was ranked V with lowest mean value 2.67 and SD 1.23 This result shows the trust of farming community in agricultural extension workers capabilities, to protect their crops from harmful effects of pests and weeds which will consequently increase maize production. IPM measures can replace chemicals for controlling weeds and insect/pest attack along with having friendly effect on environment and human health.

3.3 Association of Education with the maize growers' problems

Table 6 depicting the association of education with the maize growers' problems faced by them in the research area by applying the Chi-square test. The findings showed the significant association ($P<0.05$) of education of the maize growers and the various problems in maize production. P-value for education was 0.000 indicating in regardless of education, maize growers faced numerous problems in the research area. Farmers are always interested in the immediate solution of their problem by extension staff to minimize yield loss. Farmers are always in difficult situation due to lack of information, expensive and non-availability of inputs due to poor visits of extension workers as revealed by **(Shah *et al.*, 2010; Swanson and Rajalahti, 2010; NRI, 2011; Horlings and Marsden, 2011)**.

Table 6. Association of education with various problems faced by the maize growers

Literacy Status	Problems of maize			Total
	Lack of information	Non availability of inputs	Costly	
Illiterate	41 (20.1)	39 (19.1)	6 (2.9)	86
Primary	3 (1.5)	37 (18.1)	0 (0)	40
Middle	8 (3.9)	11 (5.4)	0 (0)	19
Matric	8 (3.9)	33 (16.2)	0 (0)	41
Intermediate	2 (1.0)	7 (3.4)	0 (0)	9
Graduate	0 (0)	9 (4.4)	0 (0)	9
Total	62 (30.4)	136 (66.7)	6 (2.9)	204
	X^2=41.896	**P-value = 0.000*** **		

3.4 Association between Literacy Status and Total Production

Table 7 shows significant association (p=0.000) of literacy status with maize total production. It is evident already by past studies that educated farmers will take more interest in the adoption of new maize technologies than uneducated maize growers. Similar study was conducted by **(Demeke, 2003)** who stated that education has a positive role on the preferences of maize growers on adoption of new and improved production technologies in natural management practices uptake for adoption improvement. **Ndiema (2010)** and **Farouque (2007)** revealed that literacy enables farmers to get awareness regarding new information on agricultural practices through written material about different crops which can be availed by educated growers only.

Table 7. Associations between literacy status and total maize production

Literacy status	Total production of maize				Total
	up to 800 kg	800-1600 kg	1600-2400 kg	Above 2400 kg	
Illiterate	38 (18.6)	36 (17.6)	12 (5.9)	0 (0)	86
Primary	16 (7.8)	21 (10.3)	3 (1.5)	0 (0)	40
Middle	10 (4.9)	3 (1.5)	6 (2.9)	0 (0)	19
Matric	38 (18.6)	36 (17.6)	12 (5.9)	0 (0)	86
Intermediate	3 (1.5)	4 (2.0)	2 (1.0)	0 (0)	9
Graduate	3 (1.5)	0 (0)	6 (2.9)	0 (0)	9
Total	86 (42.2)	82 (40.2)	33 (16.2)	3 (1.5)	204
	x^2= 41.499			**P-value= 0.000*** **	

3.5 Association between Conducting field Trip and Perform Pest Monitoring on Maize Crop

Table 8 shows an association between conducting a field trip and performing pest monitoring on maize through Chi-square test. The analysis showed highly significant association between conducting a field trip and performing the pest monitoring on maize as (P<0.05). This finding shows that pest monitoring performance was improved by conducting a field trip.

Table 8. Association between conduct a field trip and perform pest monitoring on maize

Conduct a Field Trip	Perform Pest Monitoring on Maize					Total
	Very low	Low	Medium	High	Very high	
very low	25 (12.3)	33 (16.2)	0 (0)	0 (0)	0 (0)	58
Low	0 (0)	23 (11.3)	37 (18.1)	0 (0)	0 (0)	60
Medium	0 (0)	0 (0)	33 (16.2)	25 (12.3)	0 (0)	58
High	0 (0)	0 (0)	0 (0)	8 (3.9)	8 (3.9)	16
Very high	0 (0)	0 (0)	0 (0)	0 (0)	12 (5.9)	12
Total	25 (12.3)	56 (27.5)	70 (34.3)	33 (16.2)	20 (9.8)	204
	x^2= 360.201		P-value= 0.000***			

4. Conclusions and Recomendation

It is concluded that majority of the respondents were middle aged, literate and had 1-2 acres of land under maize cultivation. Majority of respondents had 6400-12800 kg/acre maize production. Awareness about alternative pest management techniques was ranked I with highest mean value 3.04 and SD 1.13 and performance of pest monitoring on maize was ranked II with mean value 2.84 and standard deviation 1.14. However, identifying the symptoms of major insects/pests, diseases, and their causes in maize crop was ranked V with lowest mean value 2.67 and SD 1.23. Highly significant association existed between education and problems faced, and education and maize production. Likewise highly significant

association was found between conducting field trip and perform pest monitoring in maize crop. Awareness of growers about plant protection was the need of the day and needed capacity building in identify symptoms of major insects/pests diseases and their cause in maize by extension workers. It is recommended that extension workers may be sensitized and trained through their respective department about plant protection measures along with regular visits to the maize growers for increasing their yield. The government should keep close eye on the price and quality of agricultural inputs and formulate extensive policy against substandard pesticides and herbicides in the markets through extension department by encouraging IPM through advance trainings.

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