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Crop management practices for better maize production in mountainous areas of Khyber Pakhtunkhwa, Pakistan

Ikramul Haq[1], Karim Ullah[1], Khalid Nawab[1], Rahmat Ullah[2], Kashif Shehzad[1]

[1]*Department of Agricultural Extension Education and Communication. The University of Agriculture Peshawar, Pakistan*

[2]*Department of Agriculture Extension, Balochistan Agriculture College Quetta, Pakistan*

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Abstract

Crop management practices and the technical efficiency of farmers can lead to a rise the crop productivity. Extension Field Staff (EFS) were performing different management practices for maize crops to enhance their yield; thus, a study was carried out in Dir Upper, one of the mountainous districts of Khyber Pakhtunkhwa, to find out the role of EFS in using different crop management practices. A validated interview schedule was used to collect the primary data. While applying multistage sampling, four union councils were selected, in which one village from each union council was selected for the collection of primary data. The results show that majority of the respondents were in the middle age group (26-35 years), whereas most of them were literate. The main source of income for the farming community was agriculture, as most of them were the owner of their land and cultivating maize as their major crop. The majority of farmers were in contact with EFS and satisfied with the Extension department. Applying t-test on the production of maize crop, a highly significant difference (P = 0.00) occurs showing that the yield is increased significantly after the application of management practices. They were applying ranking system on different management practices animal wastes and feeding management ranked 1st which followed by irrigation management and vice versa. By applying different management practices, the yield of maize has increased significantly compared to the last few years. Some of the farmers lacked management practices, so they needed training and that would be possible if the government built offices nearby.

* **Corresponding Author:** ✉

Introduction

Agriculture is derived from the Latin words ager (field) and colo (cultivate) and refers to the tillage of land. The term agriculture is rarely used to refer to crop production alone, without keeping domestic animals, despite the fact that it normally implies both. (Haris and Fuller, 2014). Agriculture contributes 18.5 percent to the country's GDP and employs 38.5 percent of the workforce (GoP, 2019).

Maize is used in the art of cooking in various parts of the world, including Asia, Africa, and North America. It offers 60 percent of all human caloric consumption when combined with other crops such as rice and wheat. Maize is a major source of micro and macronutrients. The bio-nitrification process of maize has improved the carotenoid, vitamin A, protein and zinc content of maize through plant breeding and genetics (Palacios *et al.,* 2020). People use the maize crop in three ways: as food, as livestock feed and as a raw material for industry. The grain is utilized as food when it is mature or immature, such as maize meal or maize flour. Maize is high in nutrients, with 72% starch, 10% protein, 4.8% oil, 8.5% fiber, 3% sugar and 1% ash (Enyisi *et al.*, 2014).

In the year 2018, the world's total maize production was 1,147 million thousand tonnes. Global maize production climbed from 269 million tons in 1969 to 1,147 million tons in 2018, with an average yearly growth rate of 3.38 percent. The US produced 345,894 thousand tons of maize in 2019, accounting for 33.04% of global maize production. In Asia, China produced maize in the Asia Pacific area, approximately 257 million tons in 2019 (Knoema, 2020).

In Pakistan, maize is the third most important cereal after wheat and rice. Though maize is mostly known as a Rabi crop, it is normally cultivated twice a year in Punjab and once a year in Khyber Pakhtunkhwa (KP) (FAS Islamabad, 2019). In agriculture, the contribution of maize to value addition is 2.6 percent and to GDP is 0.5 percent (GoP, 2019). Boddy (2017) stated that management is the activity about getting things done together with the help of people and other resources. Montana & Charnov (2008) revealed that management is working with and through other people to accomplish the objectives of both the organization and its members.

Crop management practices are utilized to increase the growth, enhancement and yield of farming crops. Crop management practices vary according to the type of crops (winter or spring) and biological features. Perennial grasses require harrowing in the spring, harrowing after cutting grass and topdressing. Management practices for some other crops include hilling, suckering, pinching, and chopping. Other field practices include crop irrigation, biological and chemical methods of controlling weeds, pests and diseases. Time management is also one of the management practices. Optimum sowing time management is very important for maize crops. Identification of suitable time is a key factor to high yielding variety to plant for future farming. Every area has its own sowing time management. Sowing time management shows a better response to crop phenology as well as crop morphology, i.e., the stage of tasseling, silking & maturity, plant height and length of the leaves (Waqas *et al.,* 2018).

Land management is another important factor that leads to high yields. The appropriateness of soil is very significant for nourishing plant growth and maintaining biological activity because soil disturbance is one of the processes modifying soil properties and influencing crop productivity. Digging exposes harmful pests and diseases to the heat of the sun. It also supports bringing nutrients to the surface of the soil, helps to improve water and air movement and loosens the soil for easy root growth. The best land preparation method identified for maize production could be doubled tillage of ploughing followed by harrowing or ploughing twice (Awe and Abegunrin, 2017).

In Agriculture, Best Management Practices (BMPs) can lead agricultural productivity to a better yield; such practices include conservation tillage

management, crop nutrients management, pest management, irrigation management, animal feeding operation management, erosion and sediment controls management. These management practices will come in the proper process when there is appropriate technology, inputs and education.

In District Dir Upper, maize is the most important crop used as food and feed. Most of the people depend on agriculture, but they are facing some issues like land leveling conditions, land degradation, less fertile soil, lack of modern techniques, lack of infrastructure, and low Extension and Research services, due to which the production of maize is very low. To enhance the production of maize crop, it is very important on the part of the extension field staff to provide them education and training on the sowing management practices, tillage management, irrigation management, safe management of wastes, safe management of animals wastes, animals feeding operation management, nutrients management, pests control management, erosion and sediment control management practices. According to the best of my knowledge no research work has been done to assess and improve the management practices of maize crop. Thus the present study is conducted on crop management practices performed by Extension field staff for maize crop in district Dir Upper.

Material and methods

Universe of the study

The present study was carried out in District Dir Upper of Khyber Pakhtunkhwa (KP), Pakistan. District Dir Upper act as the universe of the study regarding crop management practices performed by the Extension field staff. District Dir Upper is located in the Malakand Division of Khyber Pakhtunkhwa in the northwestern region. It is densely mountainous with a total area of 3,699 square kilometers and the total population of 946,421 (GoKP, 2017).

Selection of respondents

For the selection of respondents, the researcher has used the multistage sampling technique (Casley and Kumar, 1988).

$$ni = \frac{Ni}{N} X\, n \ldots\ldots\ldots\ldots 1.1$$

Where:

ni= No of sampled farmers in each village

Ni= Total no of farmers in i^{th} village

N= Total population in the sampling villages

n= Total no of farmers chosen for the current study

Sampled respondents = 112

Data collection and analysis

The data was collected through interview schedule which was pre-tested and consisted of both open and close ended questions after data collection the collected data was analyzed using Statistical Package for Social Sciences (SPSS) version 20 and following statistical tests were applied.

Paired-sample t-test

To check the difference between different variables paired sampled t-test was used at a 5% level of probability.

$$t = \frac{\bar{d}}{Sd\sqrt{n}} \quad \ldots\ldots\ldots\ldots (1.2)$$

Where:

d = difference between two sample observations (before and after the membership)

n = number of pairs

Sd = standard deviation

Results and discussion

Socio-economic characteristics

Fig. 1 shows that the maximum (33.93%) of the respondents fall in the age group 26-35 years involved in the cultivation of maize. This shows that younger farmers were associated with the farming activities and will be more inclined to adopt innovations, have high potential in making the decision. Fig. 2 shows the educational status of the respondents, indicating that the majority (20.54%) of the respondents were literate and had primary and matric educational levels. This shows that literate farmers were having a positive impact on the adoption of the latest technology of maize crops.

Table 1. Maize crop management practices performed by extension field staff.

Management practices	1	2	3	4	Mean	Stand deviation	Rank order
Animal wastes	29(36.7)	15(19.0)	20(25.3)	15(19.0)	2.27	1.151	I
Animals feeding	29(36.7)	15(19.0)	20(25.3)	15(19.0)	2.27	1.151	II
Irrigation management	16(20.3)	22(27.8)	19(24.1)	22(27.8)	2.59	1.104	III
Nutrients Management	14(17.7)	18(22.8)	26(32.9)	21(26.6)	2.68	1.057	IV
Soil management	13(16.5)	18(22.8)	25(31.6)	23(29.1)	2.73	1.059	V
Weeds management	11(13.9)	16(20.3)	30(38.0)	22(27.8)	2.80	1.005	VI
Insects/ pests/ disease management	13(16.5)	17(21.5)	19(24.1)	30(38.0)	2.84	1.114	VII
Seed management	11(13.9)	18(22.8)	21(26.6)	29(36.7)	2.89	1.071	VIII
Harvesting management	11(13.9)	17(21.5)	21(26.6)	30(38.0)	2.89	1.074	IX
Crop rotation	8(10.1)	18(22.8)	21(26.6)	32(40.5)	2.97	1.025	X

Scale: 1. Not at all 2. Some extent 3. Average extent 4. High extent.

Fig. 3 depicts the information about the source of income. It was observed that the majority (81.25%) of the respondents were getting satisfactory income from agricultural produce. The majority of the respondent's major profession and source of income is farming.

Table 2. Comparison of maize crop production before and after getting assistance of extension agent.

Variable	Yield (Kg/kanal) before		Yield (Kg/kanal) after		Mean difference (Kg/kanal)	t-value	*p*-value
	Mean	SD	Mean	SD		-3.818	0.000***
Production	177.23	.496	164.12	.501	13.11		

***Level of significance at the rate of 99%.

Extension services at village level

An efficient and successful Extension services that are necessary for agricultural development. It serves as a link between farmers and scientists.

According to FAO (1985), these services are very poor in underdeveloped countries, limiting farmers' adoption of new technologies. Knowledge about agricultural extension services in fig. 4 shows that 70.54% of the respondents had knowledge of the Agricultural Extension Department while 29.46% of the respondents were not aware of the Agricultural Extension Department.

The data presented in Fig. 4 further show the satisfaction level on the Agriculture Extension Department (AED), which shows that 75.95% of the respondents were satisfied with the services provided by the Agriculture Extension Department while 24.05% of the respondents were not satisfied with the services provided by the Agricultural Extension Department (AED). When comparing individuals who received higher yields to those who received lower yields, it was discovered that those who had higher yields were more satisfied.

Rating maize crop management practices

To find out the performance of Extension Field Staff, the respondents were asked to rate various Maize crop management practices performed by Extension Field Staff. It was found that they were trained about different Maize crop management practices, i.e., Soil management, Seed management, irrigation management, Nutrients management, Animals waste management, Animal feeding management, insect/ pests/ disease management, weeds management, Crop rotation management and Harvesting management.

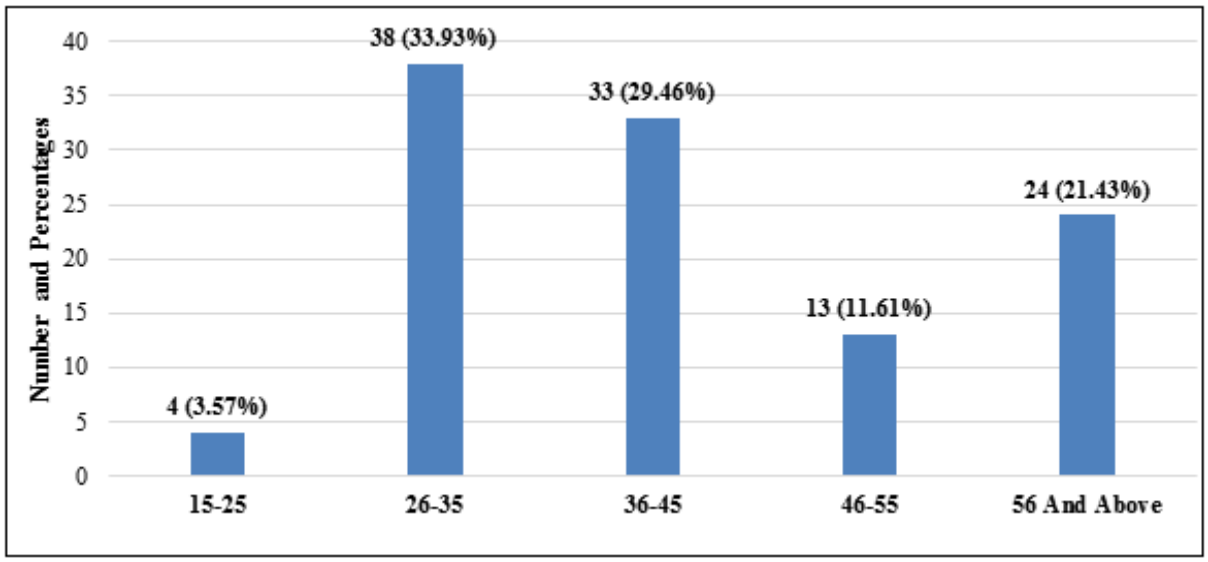

Fig. 1. Age of the respondents in the study area (In Years).

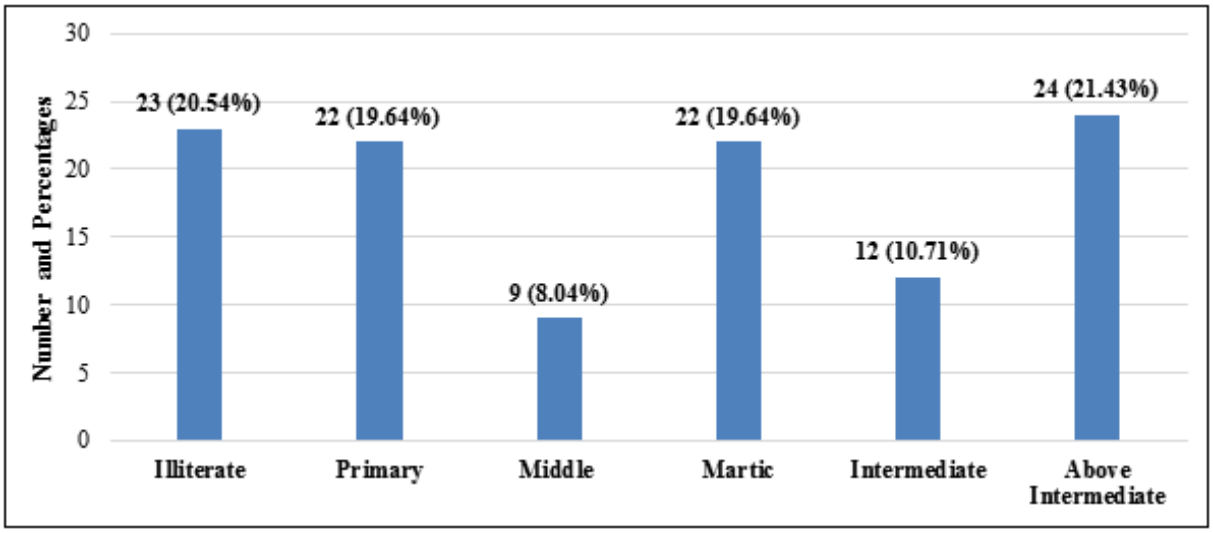

Fig. 2. Education level of the respondents in the study area.

The rating of various management practices for maize crop performed by Extension Field Staff was made by using a 4 point Likert scale, namely 'not at all' 'some extent' 'average extent' and 'high extent' which were assigned scores of 1,2,3 and 4 respectively.

The ranking of different management practices performed by extension field staff was done on the basis of their weighted score, calculated by mean and standard deviation of the responses from each of the 4 columns of specific management practices and tabulated in Table 1. The data presented in table 1 showed that the animals waste and feeding management practices were ranked I and II, respectively, followed by irrigation management practices was ranked III. Furthermore, nutrients management practices were ranked IV with M= 2.68 with the highest value of SD= 1.057. Soil management practices were ranked V with M= 2.73, with the highest value of SD= 1.059. Weed management practices were ranked VI with M= 2.80 with the highest value of SD= 1.005. Insects/ Pests/ disease management practices were ranked VII with M= 2.84 with the highest value of SD= 1.114. Seed management practices were ranked VII with M= 2.89 with the highest value of SD= 1.071. Harvesting management practices were ranked IX with M= 2.89 with the highest value of SD= 1.074. Crop rotation management practices were ranked X with M= 2.97 with the highest value of SD= 1.025.

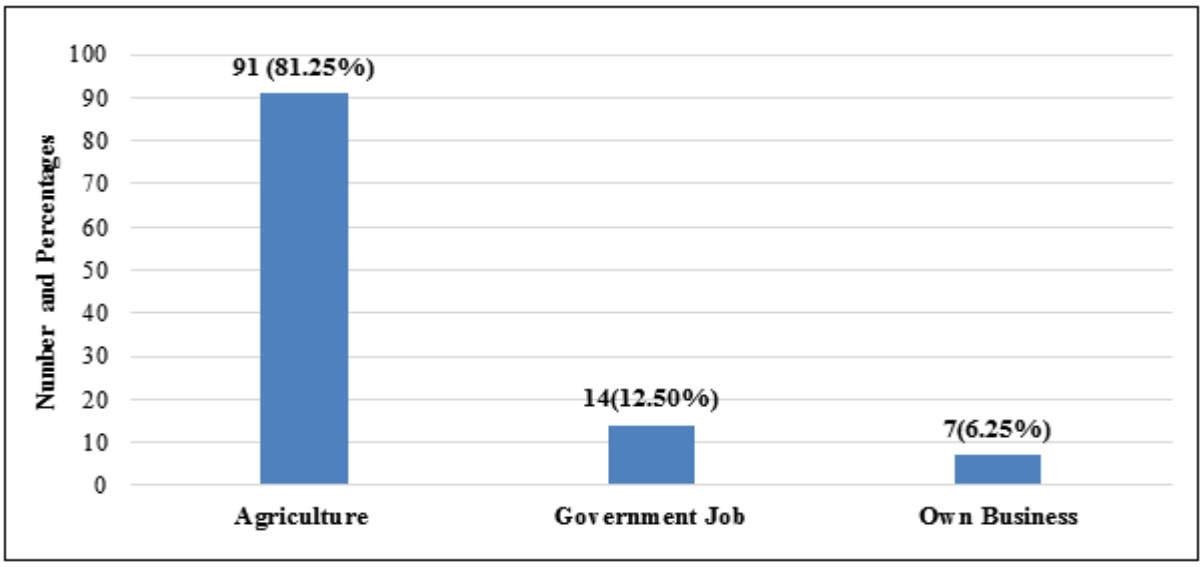

Fig. 3. Source of income of the respondents.

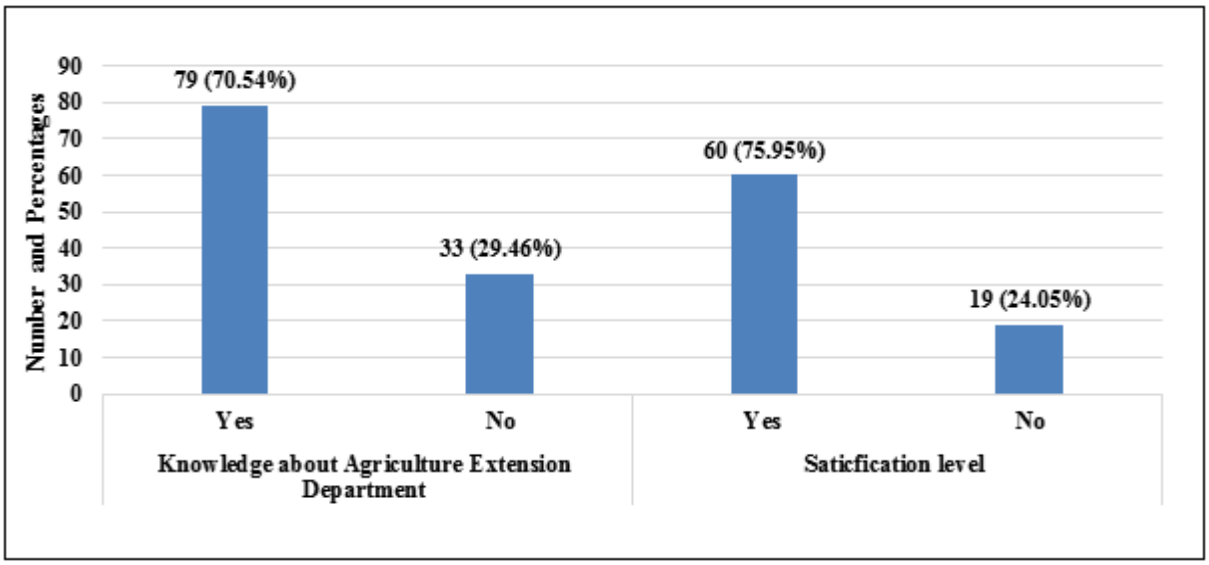

Fig. 4. Knowledge and satisfaction level of respondents about agriculture extension department.

Paired t-test comparison of the production of maize crop

Table 2 shows the distribution of the respondents based on yield before and after the assistance of extension agents in the study area. Paired t-test was performed. The mean value 177.23 was recorded before the assistance of extension agents and the mean value 164.12 was recorded after the assistance of extension agents. The result shows a mean difference 13.11 after the assistance of Agricultural Extension Agents. There is a highly associating ($P \leq 0.05$) difference between before-after yield, which is clear from the obtained mean difference value that is 13.11. It means that Agricultural Extension Agents facilitate and provide necessary resources to maize growers in the study area.

Conclusion

The study area was observed fertile and the climatic conditions were suitable for all varieties of maize crops, and the majority of the respondents were associated with the farming activities. It was observed that Agricultural Extension Department was well known by the majority of the respondents and was satisfied with the Department of Agriculture Extension as they were providing suitable seeds, inputs, fertilizers and traning/information about management practices etc. Sub offices may be built in

nearby areas so that farmers may access the contact points easily. Extension field staff should test the soil of the area for better crop production. As this area is more suited for maize cultivation, So Agriculture Extension field staff should focus on the cultivation of maize crops and provide the latest technologies for the promotion of maize crops.

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