Agricultural extension workers' competencies in model farm services center for wheat production in District Malakand in the present scenario of climate change (evidence from remote areas of Northern Pakistan)

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Abstract. Pakistan is ranked 8th in wheat production and the current study is regarding extension workers' competencies about Model Farm Services Centers (MFSCs) in wheat production in changing climate by highlighting the constraints of farming communities. The government of Khyber Pakhtunkhwa established 24 Model Farm Services Centers (MFSCs) during 2005 for improvement of farmers' livelihood by supporting to help them in identifying and prioritizing the difficulties in the current resources by keeping in view climatic changes to ensure availability of modern technologies and quality of farm inputs. The data were collected from 125 wheat growers registered with MFSCs in five union councils who were selected randomly. The study revealed that 33.6% wheat growers were from middle age in category of 41-50 years where 61% were illiterate. Maximum (72%) respondents were having land up to 3 acres and running farming activities by their family members following by 43% who got MFSCs information from Agricultural Extension. MFSCs create awareness about the use of hybrid seeds expressed by 67.2% respondents while 32.2% of them grew local varieties. Mean difference in wheat yield before and after the membership with MFSCs was recorded 239 kg/acre. Problems regarding costly inputs, climate change, and access to MFSC were the main issues revealed by 34%, 40%, and 18% respectively. Agricultural extension workers' competencies in MFSCs for wheat production in present climate were essential. Best quality agro-inputs should be made available on cheaper prices for wheat production by taking the benefits of competent extension workers in climate if registered with MFSCs.

Keywords: Agricultural extension workers' competencies, climate change, model farm services centers, wheat production

1. Introduction

In emerging countries, agriculture may be a powerful engine for economic growth and stability. Yet, for decades, developing-country yields have lagged substantially behind those of developed-country harvests. Improved technology, such as fertilizers, improved seeds, and cropping practices, are one potential mechanism for raising yields and agriculture production. The primary natural resources in Pakistan are arable land and water. Agriculture accounts for over 25% of Pakistan's Gross Domestic Product (19.3%). (GDP)[1].

The arrival of new approaches and concepts in Agriculture Extension System (AES), present-daysensations of privatization, regionalization and particularly public-private firms turned to more success in agriculture. Recently many public and private sector organizations initiated working together by sharing the assets for getting individual and mutual benefits. In the year 2005 the Government of Khyber Pakhtunkhwa has initiated a new extension strategy by establishing 24 Model Farm Services Centers (MFSC). Farmers are registered as General Body (GB) member at MFSC by paying Rs.600/ who elect the Executive Body members for their representation at ratio of 25:1 from Union Council at MFSC. The GB members elect Management committee composed of President, Vice President, General Secretary and Finance Secretary for three years period to safeguard farmers' rights and interests by enhancing their knowledge and skills to avail laboratories' facilities to develop rural economy by increasing crop yields.

Pakistan's most important crop is wheat. It is grown in practically every country on the planet, and there are many different species that make up the genus Triticum. According to MINFA, the world's wheat population was 651 million tonnes. It is the third most important crop after maize and rice. Wheat production in Pakistan was 25.2 million tonnes, with 8.9 million hectares under cultivation. In the 2010-11 growing season (Table 1), the land that was rain fed produced 1260 kg ha^{-1}, while the area that was irrigated produced 3040 kg ha^{-1}. The total agricultural area in Khyber Pakhtunkhwa was 0.75 million hectares with a yield of 1.155 million tonnes, with the irrigated region producing 2140 kg ha^{-1} and the rain-fed area producing 1276 kg ha^{-1}[2].

Table 1. Areas, production and yield of wheat in Pakistan

Year	Area (000 ha)	Production (000 tons)	Yield (kg/ha)
2011-2012	8650	23,473	2714
2012-2013	8660	24,211	2796
2013-2014	9199	25,979	2824
2014-2015	9204	25,086	2726
2015-2016	9224	25,633	2779
2016-2017	9052	25750	2845

Source: Pakistan Bureau of Statistic

Department of Agriculture Extension provides extension services and farm inputs such as fertilizers, certified seeds, pesticides/insecticides since long but now a day private sector is carrying out these activities. Extension personnel had enough time to educate and persuade farmers to use contemporary agricultural technologies but the policy approval has resulted in a slew of issuesbecause the private agencieshaveslightapproach to the rural masses insupply of farmequipment'sthat results in low yield. The Department of Agriculture extension established rural support centers to address these issues. Each center receives a tractor and a 0.2 million money for input purchases [3].

Farm Services Centers were later enhanced, and the government of Khyber Pakhtunkhwa announced in its agriculture strategy of 2005 that it would create model farm services centers throughout the province. It is a process in which the public and private sectors pool their resources to achieve a common goal. They maximize the use of their resources, including items, machinery, equipment, and other assets in order to increase crop production. The building of model farm services centers creates conducive atmosphere and provides a vehicle for agriculture and livestock growth through public-private partnerships. MFSCs also pay special attention to the farming community's access to agricultural technologies and input [4].

Crop distribution and production is closely associated with the weather and climatic condition as climate regulates the compliance of specific crop in the region and weather directs the yield of a particular crop. In the last few decades, the climatic condition of the earth change a lot due to interferences of human in the form of greenhouse gases (GHGs) emanations. Concentration of Carbon dioxide in the atmosphere increased at alarming rate as it has crossed 400ppm level resulting

to a state called global warming. This situation upset the agriculture sector stereotypically than any other sector. In this regards, Agriculture Extension Field Staff worked extremely well to overcome on this issue to maximize production and to get rid of food insecurity. The objectify of the research are to explore the effectiveness of MFSCs in the dissemination of modern technologies to farming community for wheat production in the study area, to highlight the constraints faced by farming community in getting services from MFSCs in wheat production in the study area in the present climate scenario and to formulate suggestions for improving the performance of MFSCs for future policy recommendations.

2. Materials and methods

The different approaches that were employed to achieve the desired objectives will be discussed in this chapter. It consists of the study's scope, sampling strategy, data gathering equipment and data management software.

2.1 Site of the Study

The Malakand district was chosen as the study's site. It is located between the latitudes of 34°33 north and 71°55 east. Dargai and Batkhela are the two Tehsils that make up the district. Tehsil Batkhela was purposefully chosen from the two Tehsils of district Malakand because the bulk of farmers in Tehsil Batkhela are wheat growers. In Tehsil Batkhela, five union councils were chosen at random for data collection out of a total of 17. A list of farmers who were already enrolled with MFSC was acquired from the extension department. A total sample size of 125 respondents was collected from the study region using an equal allocation technique. Because the number of registered farmers in each union council was nearly equal, 25 farmers from each union council were chosen in this manner.

A well-structured questionnaire was constructed in English language to collect primary data while published and unpublished literature wasaccessed for secondary data collection. The original data was analyzed using the Statistical Package for Social Sciences (SPSS). Graphs, frequencies, and percentages were used to present the findings. The collected data was saved using excel sheets. The Chi-square test was used to examine the correlations between two variables. The Chi-square test has the following formula (1):

$$\chi_c^2 = \sum \frac{(O_i - E_i)^2}{E_i} \quad \text{..... (1)}$$

Here

O_i = Observed frequency

E_i = Expected frequency

$\sum$ = Summation

X^2 = Chi Square value

The Chi-square (1) test was used to investigate the age of the respondents, their educational level, and their relationship with Model Farm Services Center services. In order to offer new policies for future change the association between problems faced by the farmer's and services provision were analyzed through Chi-Square Test.

3. Results and discussion

3.1 Age of the respondents

One of the most essential considerations is age, which has a significant impact on the adoption of new technology. It also has a significant impact on innovation dissemination, acceptance, and diffusion [5]. The responses ranged in age from 31 to 70 years old. Respondents were the registered farmers of MFSCs Malakand in five union councils namely: Dheri, Agra, Julagram, Khar, Kot, and Totakan. Their ages were divided into four groups: 31-40, 41-50, 51-60, and 60-70.

Table 2. Respondent distribution regarding their age

Union Councils	Age (years)				Total
	31-40	41-50	51-60	60-70	
Agra	1 (0.8)	9 (7.2)	7 (5.6)	8 (6.4)	25
Dheri Julagram	10 (8.0)	9 (7.2)	2 (1.6)	4 (3.2)	25
Khar	3 (2.4)	6 (4.8)	6 (4.8)	10 (8.0)	25
Kot	4 (3.2)	8 (6.4)	9 (7.2)	4 (3.2)	25
Totakan	2 (1.6)	10 (8.0)	6 (4.8)	7 (5.6)	25
Total	20 (16.0)	42 (33.6)	30 (24.0)	33 (26.4)	125

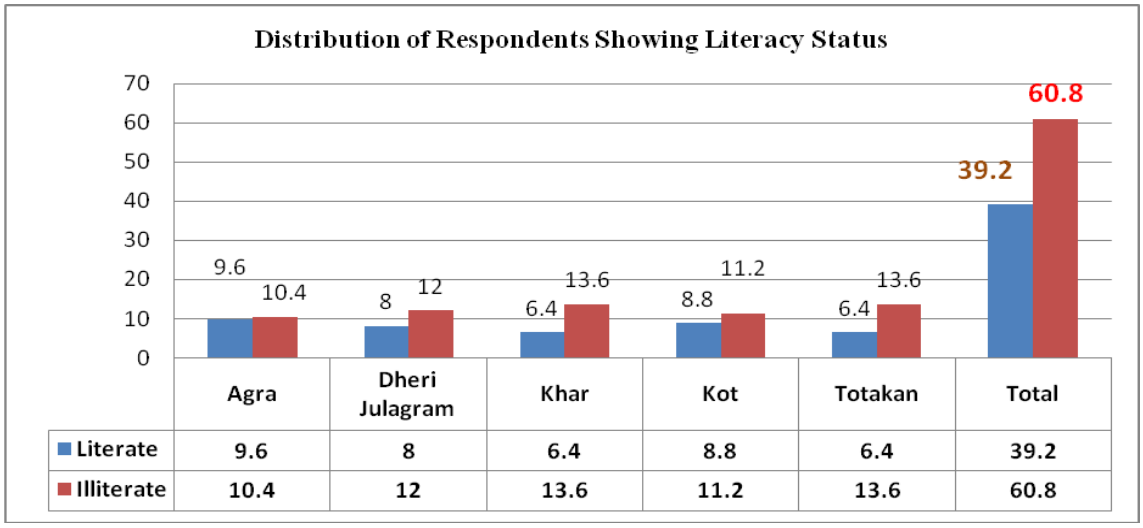
Source : Survey data, 2017
Note : Parentheses include percentages

Table 2 shows that the bulk of the farmers were in their middle years, accounting for 33.6 percent of the total number of farmers. The second group, which accounted for 26.4 percent of the respondents, was between the ages of 60 and 70, the third category which stood for 24 percent of the respondents were in the age of 51 and 60 years and 16 percent of the respondents were recorded in the age category of 31-40 years.

3.2 Literacy status

Education is the most important component in influencing farmers' behavior in terms of adopting new technology and improving farming practices and techniques. Miserably, the majorities of our farmers are uneducated and have little interest in modern technology [6]. The following figure1represents the literacy status of the respondents.

Figure 1 displays the literacy levels of the respondents from the five union councils that were chosen. The majority of the respondents (60.8%) were illiterate, with only 39.2% being literate. The bulk of literate respondents (9.6%) are from the Agra union council. Union council Kot has the second highest literacy rate, with 8.8% of the total literate respondents. According to the table above, the literacy rate in the study area is quite low. The most important role of education is to alter people's minds and motivate them to learn new things in order to accept technological advancement because they are culturally bound and fear economic loss, the majority of our farmers are unwilling to take risks [7].



Source: Field survey (2017)

Figure 1. Graphical representation of respondents regarding literacy status

3.3 Land tenured by the respondents

The Land occupancy of the respondents is shown in Table 3. Land Ownership represents the possessions right of land to human for cultivation and farmingpractices, and respondents were owners, owners-cum tenants and tenants [8]. For improved output and scarcity it was critical for a tenant to have a secure tenancy with greater freedom. The data regarding tenancy status is available in Table 3.

Table 3. Respondent's distribution regarding tenancy status

Union Council	Tenancy Status of the Respondents			Total
	Possessor/Owner	Owner-Cum Tenant	Renter/Tenant	
Agra	3 (2.4)	14 (11.2)	8 (6.4)	25
Dheri Julagram	10 (8.0)	11 (8.8)	4 (3.2)	25
Khar	11 (8.8)	2 (1.6)	12 (9.6)	25
Kot	9 (7.2)	4 (3.2)	12 (9.6)	25
Totakan	9 (7.2)	6 (4.8)	10 (8.0)	25
Total	42 (33.6)	37 (29.6)	46 (36.8)	125

Source : Survey data, 2017
Note : Parentheses include percentages

Table 3 shows the proportion of respondents with a tenancy position belonging to study area's selected Union Councils. The data shows that tenants made up the largest group of registered farmers 36.8 percent, shadowed by owners 33.6 percent and owner-cum tenants 29.6 percent respectively. Union council Dheri Julagram had the lowest percentage of tenants at 3.2 percent, while union council Khar and Kot recorded the highest percentage of tenants at 9.6 percent of total respondents. The highest ratio of Possessor-cum Renters was reported in union council Agra (11.2%), while the lowest proportion was recorded in union council Khar (1.6%). The lowermost ratio of Possessor cultivators was found in union council Agra, at 2.4 percent, while the highest percentage of owner cultivators was found in Khar, at 8.8 percent, among the study area's selected union councils.

3.4 Information about MFSCs and climate change

Farmers' awareness of MFSCs and the services they provide was gathered from a variety of sources. Farmers' experience and technical skills in farming are improved as a result of the flow of information from diverse sources. Extension workers, fellow farmers, and the media are among the many sources that help to educate and arouse interest in the farming community about contemporary agriculture.

Table 4 shows that 100 percent of participants remained conscious of MFSCs and climate change, and had sufficient knowledge about both. The respondents were also asked about the sources of information they used. Agriculture extension agents play a key role in this regard, with 40.0 percent of respondents benefiting from their services. About 32.2 percent of respondents acquired this knowledge from fellow farmers. Despite the fact that information technology has advanced to its full potential, mass media play a little role in conveying such information, which accounted for only 20.0 percent of the total. In the union council of Agra, the role of the media, particularly radio which was reported by 9.6 percent. Agricultural extension agents played a disproportionately large part in the union council of Khar and Dheri Julagram, with 10.4 and 12 percent respectively. The present study enlightened the rural masses regarding MFSCs and their provided facilities. This could be due to reason that the extension office and MFSCs are both situated in Batkhela Khar.

Table 4. Respondents distribution regarding awareness about climate change and MFSCs

Union Councils	Awareness regarding Climate change and MFSCs					Total
	Yes	Agri-Ext-Agent/workers	Fellow/Companion Farmers	ThroughMass Media	Others	
Agra	25 (20.0)	4 (3.2)	9 (7.2)	12 (9.6)	0 (0.0)	25
Dheri Julagram	25 (20.0)	15 (12.0)	10 (8.0)	0 (0.0)	0 (0.0)	25
Khar	25 (20.0)	13 (10.4)	12 (9.6)	0 (0.0)	0 (0.0)	25
Kot	25 (20.0)	9 (7.2)	9 (7.2)	6 (4.8)	1 (0.8)	25
Totakan	25 (20.0)	9 (7.2)	9 (7.2)	7 (5.6)	0 (0.0)	25
Total	125 (100.0)	50 (40.0)	49 (32.2)	25 (20.0)	1 (0.8)	125

Source : Field Survey (2017)
Note : Parentheses include percentages

3.5 Area under wheat crop

The kind and area of cultivable land have a direct relationship with production. More cultivable cultivation area, superior quality seeds, irrigation systems, fertilizer application, and suitable soil types are all required for improved production. Increased output can be achieved by upgrading technical understanding, farming practices, and techniques [9]. Because their total land size was limited to 6 acres, the study areas' wheat cultivation land was in the shape of terraces.

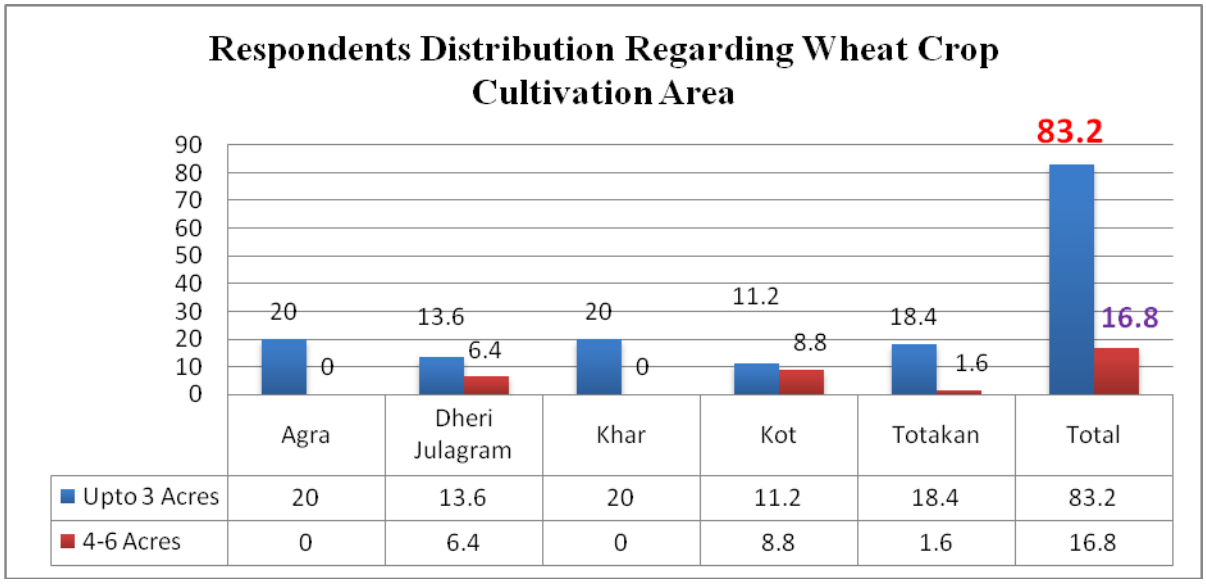


Figure 2. Graphical representation of area under wheat crop

Figure 2 represents the cultivable land of wheat crop in which maximum of respondents (83.2 percent) having an area of up to 3 acres and just 16.8 percent devoted 4-6 acres of land for wheat crop cultivation. All respondents in the Khar village council were restricted to 3 acres of land, accounting for 20.0 percent of the total respondents. The respondents were limited to cultivating wheat on a maximum of 6.0 acres, although having land holding up to 10 acres. They were unable to develop and maintain more land due to limited resources and costly farm inputs. Maximum of the respondents were from the Kot union council where 8.8% respondents cultivating 6 acres of land, followed by Dheri Julagram where 6.4% farmers recorded their 4-6 acres of land. In the union council of Agra, all of the respondents (20.0 percent) responded to own up to 3 acres. All of the

respondents in the union council of Agra own more than 3 acres, yet they are unwilling to develop extra land due to limited rainfall and the high cost of fertilizers. Union council Totakan responded by 18.4% followed by the Agra union council who were cultivating wheat crop up to 3 acres of land.

3.6 Provision of inputs by MFSCs

MFSC is responsible for providing inputs and improving farmer access to their services. As a result, the actual position of MFSCs in this regard was intended to be determined. Compost/manure, spray pumps, pesticides, Seeds and machinery were among the inputs offered by MFSCs to respondents in order to help them farm more productively and save money. The percentages of various inputs offered to respondents on subsidized rates are shown in the table below.

Table 5 highlight the proportion of respondents that were using various farm implements on subsidized rates along with loan basis provided by the MFSCs. The maximum respondents (48.0 percent) were given seeds of various types as mentioned in table 4. Fertilizers were given to 11.2 percent on subsidized rates. About 7.2 percent of the total respondents received spray pumps on loan. MFSCs enrolled a large number of farmers, yet the government only gave a limited amount of heavy machinery which was recorded by 4.8 percent only.

Table 5. Respondent's distribution regarding inputs provision by MFSCS

Union Councils	MFSCS Inputs Distribution						Total
	No	Seeds	Composts/Fertilizers on subsidized rates	Spray Drives/pumps	Insect Repellent	Heavy Machinery	
Agra	6 (4.8)	15 (12.0)	0 (0.0)	4 (3.2)	0 (0.0)	0 (0.0)	25
Dheri Julagram	0 (0.0)	5 (4.0)	3 (2.4)	2 (1.6)	9 (7.2)	6 (4.8)	25
Khar	0 (0.0)	18 (14.4)	7 (5.6)	0 (0.0)	0 (0.0)	0 (0.0)	25
Kot	16 (12.8)	7 (5.6)	0 (0.0)	1 (0.8)	1 (0.8)	0 (0.0)	25
Totakan	4 (3.2)	15 (12.0)	4 (3.2)	2 (1.6)	0 (0.0)	0 (0.0)	25
Total	26 (20.8)	60 (48.0)	14 (11.2)	9 (7.2)	10 (8.0)	6 (4.8)	125

Source : Field Survey, 2017
Note : Parentheses include percentages

Table 6. Association of age of the respondents and purpose of visit to MFSC

Age of the Respondents	Visit to MFSC and its purpose			Total
	Yes	Training	Getting Inputs	
31-40	2 (1.6)	4 (3.2)	14 (11.2)	20 (16.0)
41-50	17 (13.6)	3 (2.4)	22 (17.6)	42 (33.6)
51-60	14 (11.2)	11 (8.8)	5 (4.0)	30 (24.0)
60-70	6 (4.8)	8 (6.4)	19 (15.2)	33 (26.4)
Total	39 (31.2)	26 (20.8)	60 (48.0)	125 (100.0)

Source : Field Survey (2017)
Note : Parentheses include percentages
Chi-square=24.675, p-value= (0.012)

The Chi-square value (24.675) and p-value (0.012) in Table 6 indicate a significant relationship between respondents' age and the purpose of their visits to MFSCs, we reject the H_o that relationship doesn't exist between age of the respondents and their purpose of visits to MFSCs and admit the substitute that there is a relationship between respondents' age and the purpose of their visits to MFSCs. It is determined that there is a substantial relationship between respondents' age and the

purpose of their visits to MFSCs. Furthermore, the results are consistent with the findings of Abid et al. [10], with a chi-square value of 28.19 and a p-value of 0.001.

Table 7. Age comparison of respondents with problems (major) faced by them

Age Category	Problems faced by Farmers				Total
	High cost of inputs	Irrigation	Attainment of loans	Accessing to MFSCS	
31-40	4 (3.2)	3 (2.4)	10 (8.0)	3 (2.4)	20 (16.0)
41-50	18 (14.4)	4 (3.2)	13 (10.4)	7 (5.6)	42 (33.6)
51-60	6 (4.8)	7 (5.6)	7 (5.6)	10 (8.0)	30 (24.0)
61-70	14 (11.2)	10 (8.0)	6 (4.8)	3 (2.4)	33 (26.4)
Total	42 (33.6)	24 (19.2)	36 (28.8)	23 (18.4)	125 (100.0)

Source: Field Survey, 2017
Note: Parentheses includePercentages
Chi-square= 19.382.675, P-value= (0.022)

Table 7 shows that the principal challenges faced by farmers are strongly connected with their age, with a Chi-square value of 19.382 and a P-value of 0.022 at a 5% level of significance. As a result, we discard the h_o that there is no relationship between them and accept the alternative hypothesis that there is a relationship between respondents' age and the issues they experience, as the results are comparable to those of [11].

Table 8. Yield difference before and after MFSCs membership with MFSCs

Before membership Wheat Yield		After membership Wheat Yield		Mean Difference	t-value	Sig. (2-taild)
kg/acre (Mean)	SE (slandered error)	kg/acre (Mean)	SE (slandered error)			
516.936	9.66	794.584	10.70	239.328	25.926	0.000

Source: Field Survey, 2017

Table 8 shows the specific differences in wheat yield in kg per acre of 125 different wheat growers. As can be seen from the chart above, there is a significant difference in wheat yield kg/acre before and after MFSC registration. As a result, MFSCs play an important role in increasing wheat output in the selected union councils. Before the farmers were registered with MFSCs, the average wheat yield was 516.936 kg/acre, and after the registration, the average wheat yield was raised to 794.584 kg/acre, a mean difference of 239.328 kg/acre. Similarly, the t-value was found to be 25.92, which is statistically significant at the 5% level. The increased production suggests that MFSCs are effectively providing resources and facilities to wheat growers in certain union councils. As the results are comparable to those of [12] who indicated that a step-by-step examination of MFSCs in wheat production enhancement was conducted.

The following line graph's vertical axis depicts wheat yield in kilogram per acre (Figure 3), while the horizontal axis details the total number of participants. The bottom blue line in the graph above represents the respondents' wheat yield prior to registration with MFSCs, whereas the upper red line represents the respondents' wheat yield following membership with MFSCs.

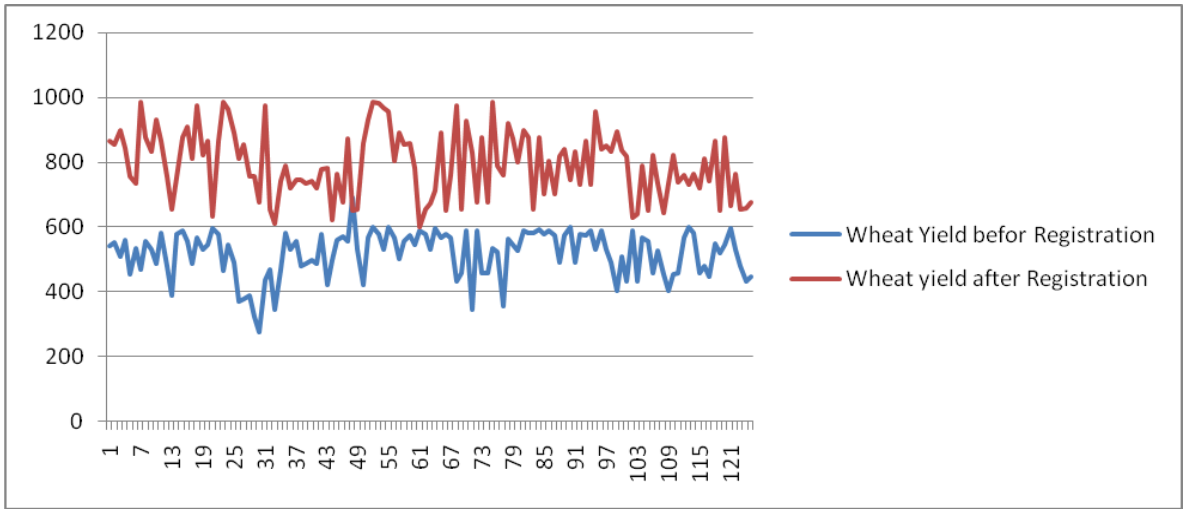


Figure 3. Represents the difference in yield before and after membership with MFSCs

Table 9. Climatic change impact and role of MFSCs

Union councils	Impact of Climate change and MFSCSs					Total
	Sowing Time	Rainfall Precipitation	Insect Attack	Early Maturity	Storage	
Agra	5 (4.0)	5 (4.0)	6 (4.8)	3 (2.4)	6 (4.8)	25 (20.0)
Dheri Julagram	2 (1.6)	5 (4.0)	6 (4.8)	7 (5.6)	5 (4.0)	25 (20.0)
Khar	5 (4.0)	5 (4.0)	4 (3.2)	5 (4.0)	6 (4.8)	25 (20.0)
Kot	3 (2.4)	2 (1.6)	10 (8.0)	7 (5.6)	3 (2.4)	25 (20.0)
Totakan	10 (8.0)	5 (4.0)	3 (2.4)	4 (3.2)	3 (2.4)	25 (20.0)
Total	25 (20.0)	22 (17.6)	29 (23.2)	26 (20.8)	23 (18.4)	125 (100.0)

In Table 9 it was observed that majority (23.2%) of the respondents claimed that due to climatic variations the insect and pest were observed that attack wheat crop in mid of March stated by 20.8% respondents who argued the early maturity which is favorable condition for insect growth. The early sowing which was noted by 20.0% respondents was due to change in rainfall pattern leads to early maturity. To overcome such condition MFSCs provide diseases resistant varieties, timely availability of fertilizer, chemical controls measures and farming equipments to enhance production of wheat crop.

4. Conclusions

The findings show that Model Farm Services Centers play a critical role in increasing agricultural productivity in a changing climate with major impact on the study areas registered farmers. Despite the fact of small farm, it makes a significant impact on actual and potential productivity. Model Farm Services Centers are well-known for their involvement in increasing registered farmers' wheat production per acre by providing agro-inputs such as seeds, machinery, and fertilizers to cope with variability in climate. The function of MFSC is not only o provide agro-inputs, but also disseminating important and advanced knowledge about climate change issues to wheat growers in the research study area by contributing positive response to climate change to the farming community.

5. Recommendations

- High-quality agro-inputs, such as certified seeds, agricultural machinery, fertilizers, and insecticides, should be available at affordable costs compatible to climate change.

- Consolidate suitable trainings by the MFSCs to wheat growers for improvement of agricultural practices, farming assistances and to manage their smallholdings properly with special reference to climate change.
- Line agencies may be accessed in order to enhance the link with farming communities in order to deal with the issue of climate change.
- Monthly and quarterly meetings may organize by MFSCs to facilitate the farming community regarding climatic change issue.
- The irrigation department improves on-farm water management in order to overcome on the problems associated with irrigation system.
- Increase the amount of land available for agriculture in order to increase yield and reduce land fragmentation.
- At the union council level, advisory services centers should be formed to address the problems of the farming community at their doorstep.
- To improve coordination among MFSC stakeholders, department heads must send their selected personnel to MFSCs.
- Encouragement of female farmers and facilitate them towards climatic change issues to improve their socio economic conditions.

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