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Farmers' Perception Regarding Impact of Climate Change on Wheat Crop Production in Layyah District-Pakistan

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Abstract

Pakistan is at 28th amongst the countries that are going to be hurt badly by climate change. It falls in ten major wheat-producing countries of the world in terms of area, production and yield per hectare. Global warming, as a result of climate change, may negatively affect morphological characters of wheat. The present study was undertaken in district Layyah to find out the impact of climate change on wheat crop. The district had a total of three (3) tehsils (sub-divisions) and two(2) tehsils were selected purposely which were badly affected by extreme climatic event like floods. Thereafter, there (3) union councils from each tehsil,three(3) villages from each selected union council and seven (7) farmers from each village were selected. Thus, a sample of 126 farmers were chosen and interviewed through a pretested structured interview schedule at their fields. The data collected were analyzed using Statistical Package of Social Sciences (SPSS).Vast majority (94.4%) of the respondents informed that climate change had effect on wheat crop productivity. Majority (above 90%) of the respondents reported that climate change was affecting their crop almost at every stage in the way of unpredicted rains, sudden rise in temperature and long drought periods.

1. Introduction

Climate change is influencing crops and livestock production, hydrologic balances, input supplies and other components of agricultural systems. However, the nature of these biophysical effects and human responses to them are complex and uncertain. It is evidenced that climate change will have a strong impact on Pakistan particularly in the areas of agriculture; land use, energy, biodiversity, health and water resources. Pakistan, like all other developing countries, is highly vulnerable to the impacts of climate change. It is among top ten countries of the world that are being affected by change in climatic conditions (Govt. of Pak., 2009).

Agriculture not only comprises a considerably high percentage of production but also supplies food and employment in all over the world. Pakistan is no exception to it. It is 6th largest country of world in terms of population with a total of 195.4 million individuals (Govt. of Pak., 2016). Agriculture is one of the main sectors of its economy. It contributes about 19.8% of the GDP, generates more than 85% of the foreign exchange earnings, and employs about 42.3% of the population (Govt. of Pak., 2016). The sector has strong backward and forward linkages. The agriculture sector in Pakistan has four sub-sectors including: crops, livestock, fisheries and forestry. The main agricultural products of the country are cotton, wheat, rice, sugarcane, fruits, and vegetables. In addition, milk, beef, mutton and eggs are the major products of livestock. God has bestowed Pakistan with four seasons' i.e. summer, autumn, winter and spring, but according to agriculture, there are two (2) principal seasons namely *kharif* and *Rabi*. Cotton, rice, and sugarcane crops are produced during the *kharif* season, which lasts from May to November. Wheat is the major *Rabi* crop, which extends from November to April (Govt. of Pak., 2016).

Agriculture in Pakistan is greatly affected by short term climate variability and could be significantly impacted by long term climate change. As the duration of crop growth cycles is related to temperature, an increase in temperature will speed up crop growth and shorten the time between sowing and harvesting. This shortening could have an

adverse effect on productivity of crops and fodder for livestock. The hydrological cycle is also likely to be influenced by global warming, necessitating the agriculture and livestock sectors, particularly in rain-fed areas, to adapt to climate change (Govt. of Pak., 2012).

1.1 Impact of Climate Change on Wheat Crop

Wheat is the most widely grown crop in the world. In Pakistan, wheat being the main staple food is cultivated on the largest acreages. It is among the top ten wheat producing countries of the world. Wheat is most essential food for the people of Pakistan (Govt. of Pak., 2013). Biswas et al. (2008) suggested that in monsoon regions, where rice &wheat crop rotations were common, heat stress could be mitigated by introducing minimum tillage which allowed wheat to emerge earlier and avoid overlapping of the reproductive stage with the warmest periods.

Global warming, as a result of climate change, may negatively affect wheat grain yield potentially increasing food insecurity and poverty, although it should be noted that current effects of climate change in relation to wheat are uncertain and model dependent (Tubiello et al., 2000). In many of the dry environments that suffer from severe heat stress during grain filling, it has been shown that the enzyme soluble starch syntheses in wheat appears to be rate limiting at temperatures in excess of 20^{o}C (Keeling et al., 1994). Furthermore, the grain filling of wheat is seriously impaired by heat stress due to reductions in current leaf and ear photosynthesis at high temperatures (Blum et al., 1994).Due to different geographical locations, agriculture sector in Pakistan is under threat of the climate change. Qian and Zhu (2001) conducted study on impact of climate change from 1880 to 1996 in seven provinces of China. The temperature was found different in all the regions. Temperature had increased between the periods 1930's -1940's. Extreme climatic events like floods, high rate of drought and natural disaster caused economic losses in Central Eastern and Southwest China and resulted in the evolution of monsoon system in East Asia.

Karl and Trenberth (2003) defined climate change as variations in weather conditions due to human activities. They found that changes in land use and migration to urban areas caused pollution in the atmosphere that caused rise in the temperature which resulted in melting of glaciers that caused rise in sea level. Lobell and Asner (2003) evaluated maize and soybean production relative to climatic variation in the United States, reporting a 17 percent reduction in yield for every 1ºC rise in temperature, but that response was unlikely because the confounding effect of rainfall was not considered.

2. Materials and methods

2.1 Sampling

The present study was conducted in district Layyah. The district had a total of three (3) tehsils (sub-divisions).The two (2) tehsils namely Layyah and Karor were selected with purpose. Both had been badly affected by extreme climatic event like floods. Tehsil Layyah and Karor consisted of twenty-three (23) and fourteen (14) union councils respectively. Thereafter, there (3) union councils from each tehsil and three (3)villages from each selected union council were chosen by using simple random method. At third stage a sample of seven (7) farmers from each village was taken purposively. Thus a total of one hundred and twenty six (126) respondent farmers were selected for the study.

2.2 Preparation of interview schedule

An interview schedules was developed based on the objectives of the study to collect data from the respondents. The data collection instrument was pre-tested on ten(10) farmers who were not included in the respondents list. The pre-testing was done to make needed amendments in the instrument based on the suggestions of the farmers and researcher's own surveillance.

2.3 Interviewing the respondents

The interviews were conducted from the respondent farmers at their fields. Although interview schedule was developed in English Language but was administered in in local language i.e. Urdu for convenience of the respondents.

2.4 Data analysis

The data were collected and interpreted in the Excel sheet. After that data were analyzed using Statistical Package of Social Sciences (SPSS). The results were tabulated and descriptive statistics were used to describe the data.

3. Results and discussion

Wheat is the most widely grown crop in the world. Wheat, as a human food is prized for its taste and as source of calories, protein, and certain vitamins and minerals, is the world's most important crop. All respondents were found to have faced problems due to climate change. One of the respondents said that "*our wheat is destroyed by flood every year all our investment and struggles gave no result to us, my economic condition became very poor and I have no money to support my family. The authorities should have to do something for us."*The respondents further reported that climate change was becoming a big threat to the mass impacts of climatic events were on all crops sown in

the area. That was in line with an earlier report indicating that climatic extremes in Asia could lead to a loss of 50 percent in wheat production (Govt. of Pak., 2009).

3.1 Farmer's perception regarding effects of climate change

Famers were asked about the effects of climate change and their responses are presented in Table 1. The data in Table 1 revealed that overwhelming majority (98.4%) of the respondents identified that changes in food grain quality of wheat, reduced access for winter logging, increasing effects of pests and diseases were the major effects of climate change. Vast majority (94.4%) of the respondents informed that climate change also had effect on the productivity. Lobell and Field (2007) also revealed that 1ºC increase in temperature decreased the global yield of wheat by 5.4%. However, majority of the respondents indicated that soil erosion was increased due to the last floods and they had shortage of drinking water during the floods.

3.2 Rating and ranking of effects of climate change

The summarized data in the Table 1 also represent the effects of climate change as perceived by the respondents. The data clarify that effects of climate change in food grain quality of wheat and diseases were rated very high by highest percentage (47.6 and 42.1%) of the respondents. Furthermore, 18.3, 28.6 and 23% of the respondents argued that problems of soil erosion, decrease in productivity and reduced access for winter logging were very high due to climate change.

The data in the resulted figure 1 reported the ranking order of the respondents according to different effects of climate change on mean and weighted score basis. The finalized data in the table resulted that changes in food grain quality of wheat, pests and diseases, productivity and abiotic damages stood 1st, 2nd, 3rd and 4th with weighted score of 457, 385, 378 and 344 and mean values of 3.68, 3.10, 3.17 and 2.17 respectively. While reduced access for winter logging, increase in erosion, provision of drinkable water and soil stood5th, 6th, 7th, and 8thin the ranking order with weighted score of 334, 308, 268 and 213 and had their mean values 2.69, 2.56, 2.52 and 2.04 respectively.

3.3 Effect of climate change on wheat at various stages

Data in the Table 2 demonstrate the effects of climate change on wheat crop at different stages as perceived by the respondents. Lawlor and Mitchell (2000) stated that a 1ºC rise in temperature would shorten the reproductive phase by 6 percent, grain filling duration by 5 percent, and would reduce grain yield and harvest index proportionately. Majority (above 90%) of the respondents alsoreported that climate change was affecting their crop almost at every stage in the way of unpredicted rains, sudden increase in temperature and long drought periods but those affects were high at milky stage, tillering stage, flowering stage and ripening stage with 100, 96.8, 96.8 and 96.8% respectively. The respondents further reveled that effects of climate change at milky stage were more as compared to other stages. Increase in temperature caused reduction in grain size and effected on the photosynthesis process (Paulsen 1994).

Table 1. Rating of various effects of climate change on crop production as perceived by the respondents

Effects	Yes	VL	L	M	VH	H	Mean
		Percentages					
Productivity	94.4	3.20	21.4	33.3	28.6	7.90	3.17
Soil	82.5	26.2	31.7	19.0	5.60	-	2.04
Provision of drinkable water	84.1	19.0	20.6	27.8	14.3	2.40	2.52
Pests and diseases	98.4	9.50	14.3	31.7	42.1	0.80	3.10
Abiotic damages	92.9	8.70	30.2	21.4	23.0	9.50	2.94
Changes in food grain quality of wheat	98.4	6.30	7.10	17.5	47.6	19.8	3.68
Reduced access for winter logging	98.4	11.1	31.0	33.3	23.0	-	2.69
Increases erosion	95.2	15.9	35.7	21.4	18.3	4.00	2.56

Abbreviations: VL = Very Low, L = Low, M = Moderate, VH = Very High, H = High

Table 2. Rating of effects of climate change on wheat at different stages as perceived by the respondents

Stages	Yes	VL	L	M	H	VH	Mean
		Percentages					
Land Preparation	84.9	26.2	36.5	15.9	6.30	-	2.02
Sowing	88.1	23.0	31.7	23.8	9.50	-	2.22
Germination	95.2	17.5	23.0	19.8	27.8	7.10	2.83
Seedling	93.7	20.6	17.5	29.4	19.0	7.10	2.72
Tillering	96.8	7.10	17.5	24.6	44.4	3.20	3.19
Stem elongation	88.9	17.5	19.0	20.6	28.6	3.20	2.78
Booting	92.1	15.9	17.5	22.2	30.2	6.30	2.93
Heading	96.8	8.70	31.7	25.4	27.8	3.20	2.84
Flowering	96.8	7.10	7.10	39.7	37.3	5.60	3.27
Milk	100.0	11.1	10.3	45.2	31.0	2.40	3.03
Dough	94.4	11.1	34.1	28.6	20.6	-	2.62
Ripening	96.8	11.9	24.6	34.9	21.4	4.00	2.8
Harvesting	95.2	37.3	22.2	23.8	10.3	1.60	2.12
Storage	77.0	23.8	19.0	14.3	17.5	2.40	2.42
Marketing	81.0	20.6	27.8	28.6	2.40	1.60	2.21

Abbreviations: VL = Very Low, L = Low, M = Moderate, VH = Very High, H = High

FIGURES

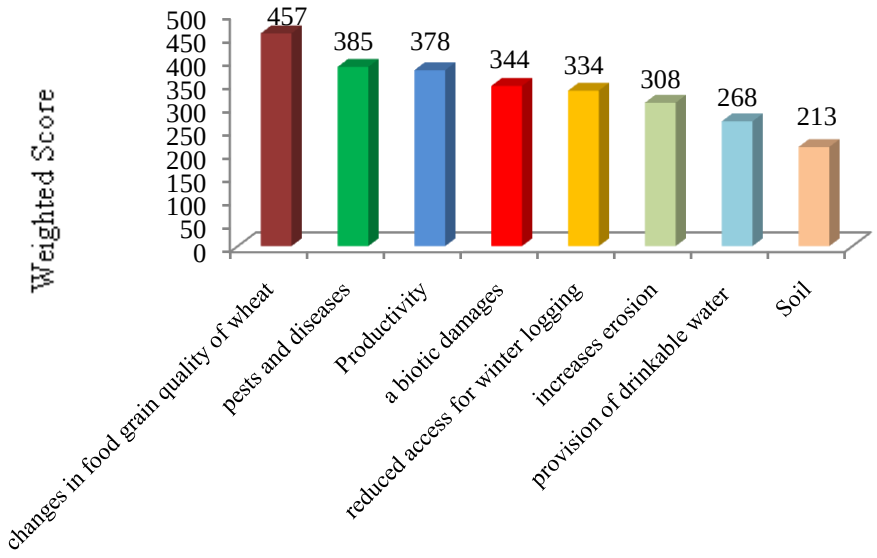

Figure 1. Various effects of climate change on crop production as perceived by the respondents

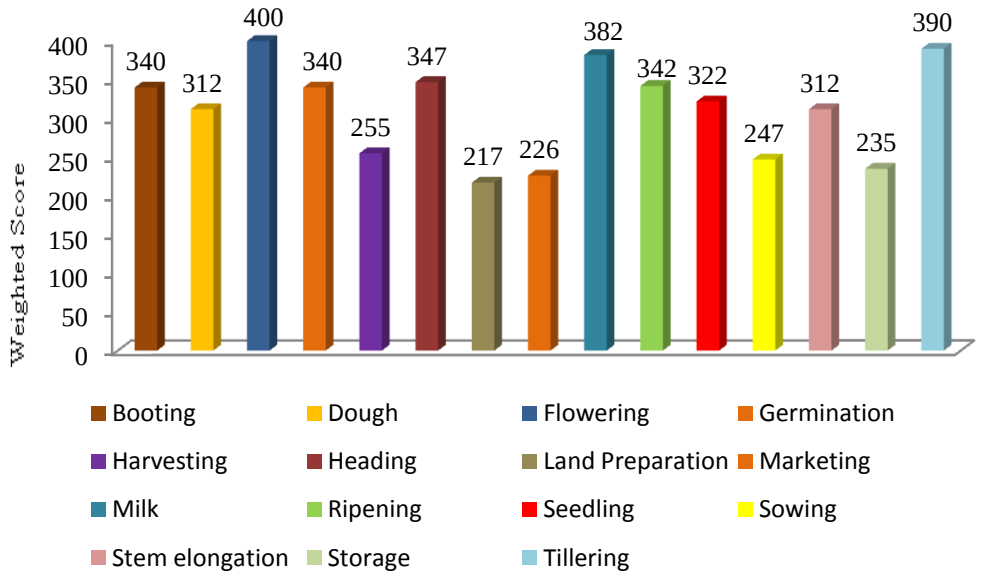

Figure 2. Effects of climate change on wheat at different stages as perceived by the respondents

3.4 Ranking and rating of effect of climate change on wheat at various stages

The data presented in Table 2 revealed that slightly above than one third (36.5%) of the respondents rated effects of climate change at land preparation stage as low, followed by dough stage (34.1%), heading (31.7%) and sowing (31.7%). Meanwhile, effects of climate change were rated high by highest percentage (44.4%) of the respondents on tillering stage followed by flowering (37.3%), milky stage (31%), booting (30.2%) and stem elongation (28.6%). Effects of climate change on sowing stage were rated very high by a minimum percentage (9.5%) of the respondents. Lobell and Field (2007) also reported 8.3 percent yield reduction per 1ºC rise in temperature.

The summarized date in the figure 2 show ranking order about effects of climate change on wheat at different stages as perceived by the respondents. The table show that flowering was the most effected stage by the climate change and stood 1st in the rank with weighted score of 400 and came in between moderate and high categories but show declined towards moderate (mean = 3.27) followed by tillering and milky stage which stood 2nd and 3rd in the rank order with weighted score of 390 and 382 and show decline towards moderate (mean = 3.19 and 3.03 respectively). Germination and booting fell in between low and moderate categories but show inclination towards moderate category (mean 2.83 and 2.93) and stood 6th in ranked order with weighted score of 340 each. Land preparation stood at bottom in the ranked order on position 12th.

4. Conclusions and recommendations

Climate change was posing a serious threat to farmers of Layyah district. The respondent farmers viewed that climate change was affecting their wheat crop in the form of floods, unexpected rains and sudden rise in temperature. The production and quality of wheat grain were changing and effects of disease and pest attack on wheat were increasing due to favorable climatic conditions. Climate change was affecting the wheat crop at almost every stage. However, according to the respondent farmers, flowering stage was considered as most hard hit by the climate change in the area. The recommendation are:

Climate change has been affecting farmer's life and income sources year after year. Floods destroy the crops close to the harvesting resulting some great losses to the farmer's investment on crops. It is therefore, suggested that the Government may initiate rehabilitation process to overcome the losses occurred in the area dueto climate change.

The government may also introduce crop insurance schemes with an effective monitoring and evaluation system for speedy survey to assess losses and timely payment to the effectors in the area.

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