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An appraisal of cotton growers' perceptions regarding consequences of climate variations causing adoption of Climate-smart agricultural practices in Punjab, Pakistan

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Abstract

Cotton is the main cash crop in Pakistan and the lifeline for the economy of the country. The present study was carried out in two districts Khanewal and Vehari of the Punjab province in Pakistan. The main objectives of the study were to explore the demographic profiles of the respondents; to assess the compliance of COVID-19 SOPs during field activities, to understand the perceptions of respondents regarding consequences of the climate variations; to assess the adoption level of the climate smart agricultural practices among the cotton growers, and to study the relationship of the adoption level of climate smart agricultural practices with those of demographic profiles of the respondents. A survey was conducted with the help of a well-structured survey instrument. The survey instrument was prepared on the likert-type scale to measure various factors involved in the study. Correlation analysis shows that education and compliance of COVID-19 SOPs have a weak positive significant correlation. Findings depicted that change in rainfall pattern is the main consequence of climate variation in the study area. Findings further showed that laser land leveling and mechanical weeding are the most adopted climate-smart agricultural practices by the cotton growers in the study area. It is also inferred from the results that an increase in education level and area under cotton cultivation may increase the trend for the adoption of climate smart agricultural practices, which will further result in the increase of cotton production in the country at large.

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Introduction

Agriculture is one of the strong pillars of the economy of Pakistan and plays a pivotal role in other economic activities in the country. It accounts for 24 % of the GDP and accounts for half of the employed labor force. The majority (63%) of the country's population is directly or indirectly linked with agriculture for its livelihood. Cotton (*Gossypium Hirsutum* L.) is an important crop of the world. It enjoys a unique position among the cash crops of Pakistan and is the lifeline to earn foreign exchange. It contributes substantially to the national exchequer. Raw cotton and byproducts of cotton are the main exports of the country. It accounts for 8.6% of the value-added in agriculture and about 1.8% of GDP (Pakistan Bureau of Statistics, Govt. of Pakistan, 2019).

In the present agricultural production system of the country, cotton production is badly affected by climate variations and other input factors. According to present environmental researchers, climate change is a great threat to cotton crops, food security, as well as one of the biggest challenges of the 21st century (FAO, 2013). It is widely accepted that pace of climate change can be reduced by controlling changes in temperature rise within 2°C, which is a threshold number (IPCC, 2014). The agricultural production system is under pressure to increase food production for the global population, which is expected to reach 9.1 billion in 2050 and over 10 billion by the end of the century (World Bank, 2011). Branca *et al.* (2011), in their study, pointed out that the agricultural system must increase the productivity and stability of smallholders in the wake of climate change. Rising temperatures and changes in rainfall patterns further affect agricultural production with a significant decline in crop and livestock production.

In Pakistan, due to climate change, groundwater resources are shrinking day by day. Naheed and Rasul (2010), in their study, concluded that the water requirement of the cotton crop during August and September is highest. In one recent study, Nisar *et al.* (2021) pointed out that the river Indus starts from the foothills of the Himalayas and goes all the way to the Arabian Sea in the south of Pakistan; supports the groundwater resources in the country. However, due to environmental and climate changes, the researchers have to find ways and means to enhance the underground water table to meet the water requirement of the cotton crop during the peak requirement time of the year.

Climate change is already known to threaten the built-in adaptive capabilities of the Earth System's ecology (Steffen *et al.,* 2015). In agro-ecological managed systems, human decision-making is required to develop adaptive and managerial capabilities for climate risks that directly threaten the soil, water resources and agricultural productivity (Bryan *et al.,* 2013). The world's current climate model described that the intensity of rainfall variability would continue in the future (Daniel, 2015; Winkler *et al.,* 2012).

The world has started to concentrate on conservation technologies in agriculture. The Food and Agriculture Organization defines climate-smart agriculture as "agriculture that increases productivity, resilience (adaptation), reduces GHGs (mitigation), and enhances achievement of national food security and development on a sustainable basis" (FAO, 2011). According to Wolfe (2012), many approaches have been proposed for the adoption of CSAP and to tackle climate change, such as genetic modifications for drought, reduced tillage, shifting sowing dates, irrigation, crop and weather insurance. Delgado *et al.* (2011) and White (2015) pointed out that uncertainties in complex climate conditions make adaptation somewhat difficult to streamline research resources. Among strategies planned for adaptation, cover crops have great potential to shield such rainfall variability. Cover crops can play a significant role in soil conservation.

Cover crops offer various antidotes such as oat and cereal rye crops reduced rill erosion by 42-95% and inter-rill erosion by 51-62% (Kaspar *et al.,* 2001). In addition, the use of cover crops adds organic carbon to cropping systems to enhance physical characteristics of soil, such as improving aggregate stability and reducing compaction (Blanco-Canqui *et al.*, 2013), and for benefits to improve soil response in drought (Al-Kaisi *et al.,* 2013). According to fresh data extracted from the United States Department of Agriculture (USDA, 2020), the following are the top ten cotton-producing countries in the world where Pakistan stands at number 5 in Fig. 1. Following are the two graphs in Fig. 2 and 3, respectively showing average monthly rainfall data of the districts Khanewal and Vehari; the study locations of the area.

Research objectives

The following objectives were designed and measured to accomplish the overall purpose of the study.

i. To find out the demographic profiles of the respondents

ii. To assess the compliance of COVID-19 SOPs (standard operating procedures) at the time of cotton field activities by the respondents

iii. To assess the perceptions of the respondents regarding consequences of the climate variations

iv. To assess the attitude of the cotton growers for the adoption of different climate smart agricultural practices to deal with climate variations

v. To measure the change in attitude for the adoption of CSAP due to certain demographic factors of the cotton growers in the study area.

Materials and methods

The conceptual framework of the study, research instrument (survey questionnaire), study population, the sample size plays a pivotal role in measuring the objectives to achieve the overall purpose of the study.

Conceptual framework

The conceptual framework shows what the researcher expects to find through present research. It defines all the relevant variables of the study and points out how they might relate to each other. A conceptual framework may be constructed before the data collection, generally represented in a visual format as given below

The conceptual framework of the study in Fig. 4 reflects the overall structure and design of the study. Model highlights the important factors involved in the survey for drawing necessary conclusions.

Population and sample size

The target population was unknown; therefore following formula was employed as suggested by Casely and Kumar (1989) to compute the accurate sample size for the unknown population.

$$n = \frac{Z^2 V^2}{d^2}$$

Where;

Z= Normal variant or confidence level 95% = 1.96

n= Sample size

V= 51% variation assumed in the responses of the selected respondents in the sample

d= assumed marginal error (5%)

$$n = \frac{(1.96)^2 (0.51)^2}{(0.05)^2} = 399.68 \sim 400$$

The sample size was rounded off to the nearest discrete number of 400 respondents. Two districts i.e Khanewal and Vehari were selected for the study. A multistage random sampling technique was applied. In the first stage, two tehsils i.e Khanewal and Vehari, one from each district, were selected purposively. Secondly, 5 rural union councils were selected randomly from each selected tehsil. Thirdly, 2 villages were selected randomly from each selected union council. Lastly, 20 cotton growers were selected randomly from each selected village. Thereby making a total sample size of 400 respondents as suggested by the formula designed by Casely and Kumar (1989).

Research instrument

The study employed a self-administered structured questionnaire (survey instrument) for the collection of the data from respondents. The validity of the instrument was established by a panel of experts from the discipline of Agricultural Extension.

The instrument was reviewed and corrected according to the suggestions of the experts. The reliability of the instrument of the pilot study was computed through Statistical Package for Social Sciences (SPSS) value Cronbach's α = 0.729 = 72.9%, which is considered good reliability and the instrument was revised accordingly. Reliability of the instrument before final data collection for the study was also computed using Cronbach α = 0.943, which is 94.3% shows that instrument was highly reliable for final data collection.

Data analysis

The collected data were coded, entered and analyzed by Social Sciences statistical software SPSS-version 22. The statistical techniques of descriptive and inferential statistics such as percentages, frequencies, mean scores, and regression analysis were applied to conclude the results of the study.

Results and discussion

The results of the study included assessment of demographic profiles of the respondents such as age, education level, tenancy status, sowing month of cotton, awareness of respondents for climate smart agricultural practices (CSAP) and area under cotton cultivation, the compliance of COVID-19 SOPs (standard operating procedures) at the time of cotton field activities by the respondents, the perceptions of the cotton growers regarding consequences of climate variations, the adoption level of different climate smart agricultural practices and regression analysis to observe the change in the adoption of CSAP by the cotton growers.

Table 1. Distribution of the respondents regarding their demographic profiles (n=400).

Cotton growers' age groups (years)	Frequency	Percentage
15----24	14	03.50
25----34	108	27.00
35----44	130	32.50
45----54	101	25.20
55----64	40	10.00
65----74	6	01.50
75----84	1	00.30
Educational level		
Illiterate	70	17.50
Elementary (8 schooling years)	101	25.30
Secondary (10 schooling years)	122	30.50
Higher Secondary (12 schooling years)	67	16.70
Graduate (16 schooling years)	20	05.00
Post-graduate (18 & above schooling years)	20	05.00
Experience in cotton cultivation (years)		
Up to 10	78	19.50
11 --- 20	157	39.20
21 --- 30	137	34.20
31 --- 40	20	05.00
41 --- 50	7	01.80
51 --- 60	1	00.30
Tenancy status of the respondents		
Owner	284	71.00
Owner cum tenant	72	18.00
Tenant	44	11.00
Sowing month of cotton	33	08.30
March	197	49.10
April	141	35.30
May	29	07.30
June		
Awareness regarding CSAP		
Respondents have awareness (Yes)	272	68.00
Respondents have no awareness (No)	128	32.00
Area under cotton cultivation in acres		
Up to 20	362	90.50
21 --- 40	34	08.50
41 --- 60	1	00.30
61 --- 80	3	00.80

*CSAP: Climate smart agricultural practices.

Demographic profiles of the respondents

Numbers of factors such as age, education, experience in cotton cultivation, tenancy status, sowing months, the area under cotton cultivation, awareness regarding CASP techniques and compliance of COVID-19 SOPs by the respondents during cotton field activities were measured and recorded in the following Table 1.

Table 2. Distribution of the cotton growers as per compliance of COVID-19 SOPs during farm activities in the months of April-May 2020.

S. No.	COVID-19 SOPs	Frequency	Percent	Cum Percent
1.	Use of Mask during farm activities	15	3.80	3.80
2.	Observance of social distancing during farm activities	56	14.00	17.80
3.	Neither use of Mask nor observance of social distancing	266	66.50	84.30
4.	Frequently washing hands during farm activities	63	15.70	100.00
	Total	400	100.00	

Age

The findings of the study from Table 1 showed that mean age of the respondents in the study area was 40 years, while more than 32% of the respondents fall into the age group of 35-44. Hence, it concluded that the majority of the respondents were middle-aged in the survey.

Education

Education is the basic right of any individual and the responsibility of the state to provide standard and free basic education to all citizens of the country. Findings showed that more than 30% of the respondents had had a secondary school certificate, followed by 25% who had education up to Elementary education level. More than 17% of respondents had no education at all. Only 5% of the respondents had up to graduate and post-graduate levels of education, respectively, in the study area. Related literature showed that education has a central role in human growth and development. Education further refines the inner potentials of the individuals.

Moreover, to understand the advanced research-based agricultural knowledge and available technologies, one has to increase his or her education to play a role in sustainable agricultural development in the 21st century when climate changes are an imminent threat not only to the cotton crop but also to other crops in the study area.

Table 3. Correlations among different demographic factors of the study.

		Education	COVID-19 SOPs	Age groups
Education	Pearson Correlation	1		
	Sig. (2-tailed)			
COVID-19 SOPs	Pearson Correlation	0.102**	1	
	Sig. (2-tailed)	0.042		
Age groups	Pearson Correlation	-0.265**	-0.031	1
	Sig. (2-tailed)	0.000	0.534	

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

*. Correlation is significant at the 0.05 level (2-tailed).

Experience in cotton cultivation

Respondents of the two study locations were also had considerable experience in cotton cultivation. On average, respondents had had almost 20 years of experience in cotton cultivation. More than 39% of the respondents in the study area had had 11-20 years of cotton cultivation experience. It is therefore inferred that they must have good techniques to deal with climate changes irrespective of their educational level.

Table 4. Perceptions of the cotton growers regarding consequences of climate variations (n=400).

Sr. no	Perceptions of the cotton grower	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree	Mean	Std. Dev.	Rank
1	Unpredictable start of the rainy season	8%	23%	38%	21%	10%	3.02	1.08	4
2	Late or delayed start of the rainy season compared with the previous decades	13%	22%	31%	26%	8%	2.94	1.14	5
3	Changes in rain-fall pattern	2%	12%	31%	41%	14%	3.54	0.93	1
4	Prolonged dry spells with extreme hot conditions	17%	32%	34%	14%	3%	2.53	1.01	6
5	High rate of deforestation	8%	21%	20%	25%	26%	3.40	1.29	2
6	Emission of greenhouse gases (GHG) into the atmosphere	6%	19%	27%	34%	14%	3.32	1.12	3
7	Heavy flooding due to deforestation	20%	43%	20%	11%	6%	2.39	1.11	7
8	Desertification	23%	42%	22%	10%	3%	2.28	1.02	8

Tenancy status

The results from Table 1 showed that the majority of the respondents (71%) in the study area were owners followed by owner cum tenants (18%), whereas the tenants were only (11%) of the respondents.

Sowing months of cotton

As the time of sowing plays a vital role in managing the negative effects of climate variations hence the time of the sowing was also determined in the study. Findings of the study regarding sowing month show that about 49% of the cotton was sown in the month of April, followed by 35% in the month of May. In contrast, 8 % of the sowing was done in the month of March, while only 7% of sowing was done in the month of June.

Awareness regarding CSAP techniques

The results of the study show that 68% of the respondents had had awareness regarding climate smart agricultural practices up to some level so that they may apply these techniques for cotton cultivation in the field.

Area under cotton cultivation

The results from above Table 1 show that more than 90% of the cotton growers in the selected sample had had up to 20 acres of land area under cotton cultivation. The mean area under cotton was 8.40 acres. The number shows that majority of the cotton growers of the area were small to medium-size farmers.

Compliance with COVID-19 SOPs

Cotton growers' farm activities during the corona virus pandemic in the months of April and May 2020 were also observed and measured. Since this was an unexpected calamity ever faced by the growers and they have little information available through mobile phone and electronic media services in the study area. The growers had no prior experience to deal with such a type of unforeseen situation.

They felt reluctant to comply with the SOPs during their farm activities. However, they only had their inherited knowledge, little formal education and information available from media to deal with COVID-19 as per government prescribed standard operating procedures (SOPs) announced to protect themselves and other fellow farmworkers.

The results from Table 2 show that the majority of the cotton growers, more than 66%, neither used masks nor observed social distancing during cotton farm activities. Almost 4% have used a mask and 14% of the cotton growers observed social distancing during farm activities. In addition, more than 15% of the growers understand the significance of washing hands frequently during farm activities at the time of this ordeal in the history of mankind.

Table 5. Attitude of the respondents for the adoption of different climate smart agricultural practices to deal with climate variations (n=400).

Sr. No	CSAP for cotton growers	Not ready at all to adopt	Ready to adopt up to some extent	Moderately ready to adopt	Ready to adopted	Surely ready to adopt	Mean	Std Dev.	Rank
1	Use of organic matter	11%	35%	26%	24%	4%	2.74	1.07	13
2	Changes in sowing time	9%	41%	26%	21%	3%	2.68	1.01	14
3	Changes in the dates of land preparation	11%	43%	20%	25%	1%	2.63	1.01	16
4	Mulching	35%	27%	22%	15%	1%	2.20	1.11	23
5	Weeding	6%	26%	27%	29%	12%	3.16	1.11	03
6	Changes in planting depth of seeds	8%	40%	35%	12%	5%	2.65	0.95	15
7	Use of Water conservation technique	33%	24%	29%	10%	4%	2.26	1.12	22
8	Expansion of cultivated area	27%	25%	32%	13%	3%	2.40	1.09	19
9	Flexibility in the location of watering points	11%	27%	39%	21%	2%	2.77	0.96	12
10	Cultivation of marginal land	16%	39%	25%	17%	3%	2.50	1.04	17
11	Lengthened fallow	26%	27%	30%	13%	4%	2.42	1.13	18
12	Use of weather forecasts	7%	27%	34%	23%	9%	2.99	1.06	06
13	Increased mechanization	8%	26%	42%	18%	6%	3.42	1.08	02
14	Use of better drought tolerant varieties	8%	26%	42%	18%	6%	2.89	0.99	09
15	Use of heat tolerant varieties	7%	33%	37%	17%	6%	2.82	0.99	11
16	Irrigation schemes	7%	22%	48%	17%	6%	2.91	0.94	08
17	Zero or minimum tillage	25%	32%	30%	11%	2%	2.31	1.02	21
18	Water harvesting	31%	40%	15%	12%	2%	2.13	1.04	24
19	Laser land leveling	5%	19%	22%	33%	21%	3.46	1.15	01
20	Crop rotation	6%	24%	33%	24%	13%	3.14	1.11	04
21	Crop diversification	7%	28%	34	26%	5%	2.92	1.00	07
22	Use of early maturing varieties	4%	35%	37%	19%	5%	2.85	0.93	10
23	Use of high yielding certified seed varieties	8%	26%	34%	22%	10%	3.02	1.09	05
24	Intercropping	29%	25%	28%	15%	3%	2.40	1.15	20

It is further evident from the results of correlations analysis shown in Table 3 that education and compliance of COVID-19 SOPs have weak positive significant correlation indicates that educated respondents have little importance for compliance of COVID-19 SOPs during farm activities.

It may be due to the fact that they do not have any prior experience to deal with such calamities in the past and initially, they did not take it as a serious issue in rural areas of the country. However, age groups of the respondents and compliance of the SOPs have a weak negative insignificant correlation and it is inferred that cotton growers of different age groups (old-age respondents) were reluctant in compliance with coronavirus SOPs during farm activities as compared to young farmers who have little education. The same phenomenon can also be observed from the significant negative correlation between the age groups and education.

Perceptions of the cotton growers regarding consequences of climate variations

When asked the perceptions of the respondents regarding the consequences of climate variations, they described their undecided opinion for the majority of perceptions mentioned in Table 4.

However, their opinion varies from "neither disagree nor agree" to "agree" on 5-point Likert- type scale about change in rainfall pattern with a mean score of 3.54 and ranked at number 1.

Table 6. Regression Analysis for the dependent variable (Adoption of CSAP) and independent variables (education and area under cotton cultivation).

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
	.344	0.118	0.114	10.76288

a. Predictors: (Constant), Area under cotton cultivation, Education.

This shows that of the 400 respondents, many were convinced that change in rainfall pattern is actually a consequence of climate variations. When asked about the high spreading rate of deforestation, the respondents showed a "neither disagree nor agree" attitude that deforestation is a consequence of the climate variations with a mean score of 3.40 and ranked at number 2. In addition, respondents showed a "disagree" to "neither disagree nor agree" attitude when asked the remaining 6 statements on a 5-point Likert-typer scale.

This attitude described that they do not have any guiding principle or prior information to give a clear opinion about the statements asked in the survey. However, they showed different mean responses from disagreeing to neither disagree nor agree for the six statements asked during the survey.

Table 7. Analysis of variance for regression model.

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	6181.970	2	3090.985	26.683	**.000**
Residual	45988.307	397	115.840		
Total	52170.277	399			

a. Dependent Variable: Attitude of cotton growers for adoption of CSAP.

b. Predictors: (Constant), Area under cotton cultivation, education.

Attitude of the cotton growers for the adoption of different climate smart agricultural practices

The factor for the adoption level of the respondents regarding required climate smart agricultural practices was analyzed. Under this factor, 24 statements were asked from the respondents and their responses were measured. The results are presented in the following Table 5.

Table 8. Description of unstandardized and standardized regression coefficients.

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	(β)	Std. Error	(β)		
(Constant)	59.078	1.281		46.109	**.000**
Education	2.318	0.418	0.267	5.540	**.000**
Area under cotton cultivation	0.176	0.051	0.166	3.444	**.001**

a. Dependent Variable: Attitude of cotton growers for adoption of CSAP.

When asked the opinion of the respondents regarding the statements in the survey, they described their attitude for the adoption of the majority of the climate smart agricultural practices (CSAP) between "ready to adopt up to some extent" to "moderately ready to adopt" on 5-point Likert-type scale. When asked about applications of Laser land leveling, the respondents described that they are moderately ready to adopt the use of Laser land leveler with a mean score of 3.46 and ranked at number 1. This shows that of the 400 respondents, many were convinced that Laser land leveling is applied moderately as climate smart agricultural practice than other techniques of CSAP to avoid the negative effects of climate variations on cotton crops and to increase crop productivity. When asked about increased mechanization in the wake of climate variations, the respondents were almost showed a moderate attitude for the adoption of mechanized farm practices with a mean score of 3.42 and ranked at number 2. It is inferred from these results that respondents in the study area understand the significance of the use of mechanized tools to combat climate variations and to avoid future food insecurity.

Rank	Country	Production (1000 480 lb. Bales)
1	India	29,500
2	China	27,500
3	United States	15,949
4	Brazil	12,000
5	Pakistan	4,500
6	Uzbekistan	3,500
7	Turkey	2,800
8	Australia	2,400
9	Argentina	1,375
10	Benin	1,350

Fig. 1. Graph showing the world's top ten countries for cotton production.
Source: USDA, 2020.

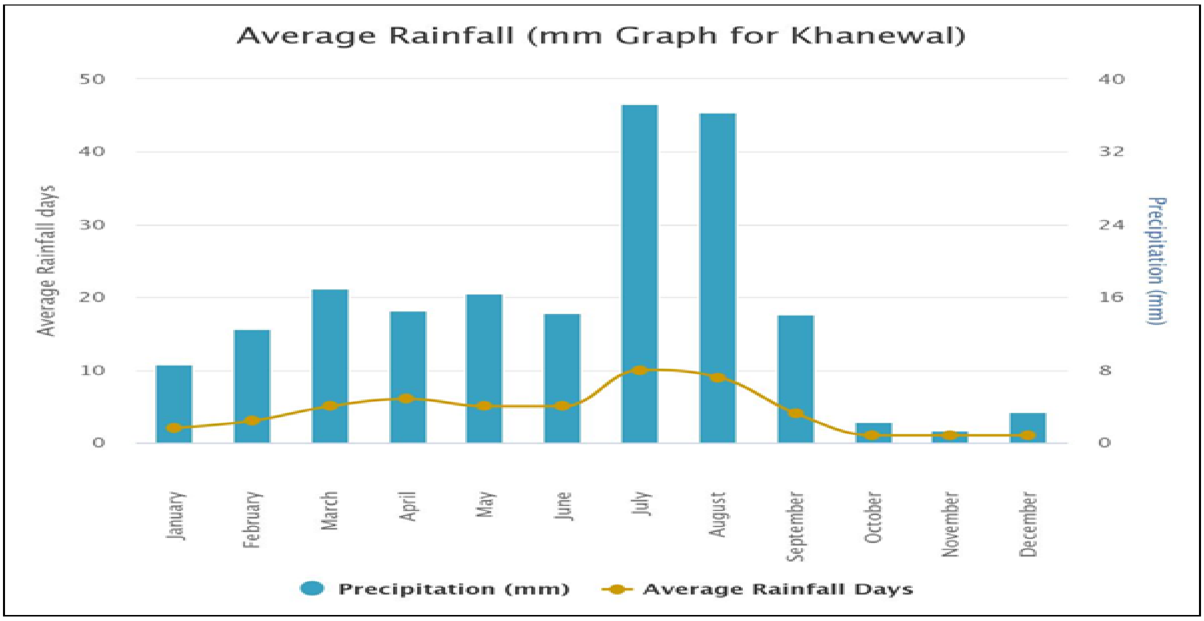

Fig. 2. Monthly Rainfall data of location1 (Khanewal-Punjab, Pakistan).
Source: https://www.worldweatheronline.com/khanewal-weather-averages/punjab/pk.aspx.

The respondents showed moderate attitude to adopt other important CSAP such as; use of organic matters, changes in sowing time, weeding, flexibility in the location of watering points, use of weather forecasts, use of better drought-tolerant crop varieties, crop rotation, crop diversification, use of early maturing and high yielding seed varieties.

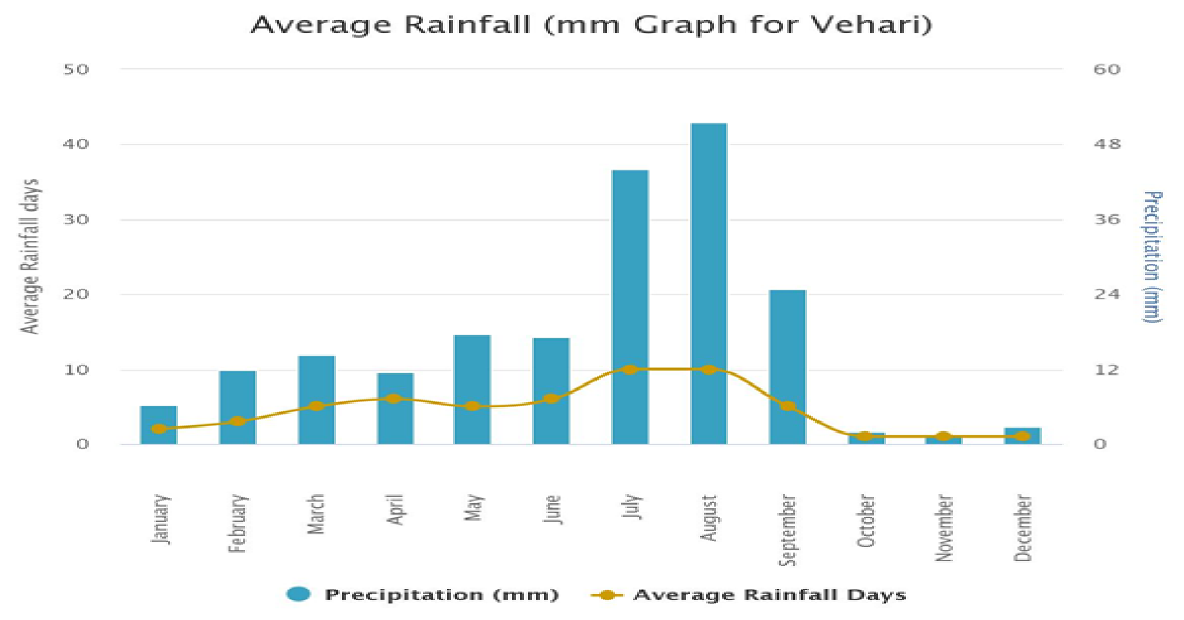

Fig. 3. Monthly Rainfall data of location2 (Vehari-Punjab, Pakistan).

Source: https://www.worldweatheronline.com/vehari-weather-averages/punjab/pk.aspx

Change in attitude for the adoption of CSAP due to certain demographic factors of the cotton growers

The Multiple regression model was applied to predict the change in the attitude of the cotton growers due to certain demographic factors of the study.

The results from table 6 showed only 11.8% of the variance in the dependent variable of "attitude of the cotton growers for the adoption of climate smart agricultural practices" was predicted by independent variables such as "education" and "area under cotton cultivation".

The null and research hypotheses are as under:

H_0: There will be no significant change in the "attitude of cotton growers for the adoption of climate-smart agricultural practices" by "education, and area under cotton cultivation."

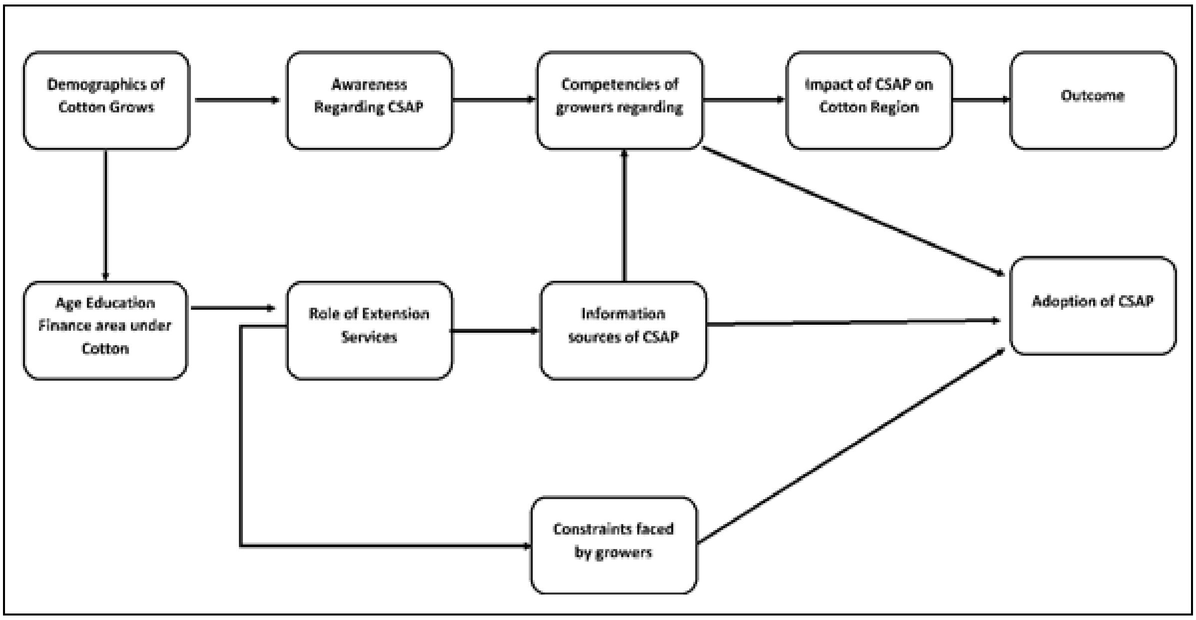

Fig. 4. Conceptual framework of the study.

Source: Literature review

H_1: There will be a significant change in the "attitude of cotton growers for the adoption of climate smart agricultural practices" by at least one of the independent factors of "education and area under cotton cultivation."

Statistically the hypotheses are;

H_o: $\beta 1 = \beta 2 = 0$;

H_1: $\beta_j \neq 0$ for at least one $j \neq 0$

The significance level (p-value) was assessed with $F (2, 397) = 26.683$, $p = 0.000$ (Table 7).

Table 8 depicted that the un-standardized coefficients showed a one-unit increase in the educational status of the respondents and the residual predictive variables remain constant; the attitude of the cotton growers for the adoption of CSAP would be increased by 2.318 units. With the one-unit increase in the area under cotton cultivation, the attitude of the cotton growers for the adoption of CSAP would be increased by 0.176 units. Similarly, for standardized Beta coefficients, one-unit standard deviation change in any predictive variable such as "education" and "area under cotton cultivation", the attitude of cotton growers for the adoption of CSAP would be changed to 0.267 and 0.166 respectively.

Conclusion

The majority of the cotton growers were of the age group 35-44 and due to low education they use their personal experiences to deal with climate variations. In the wake of the corona virus pandemic, the cotton growers were not ready to comply with the government SOPs for COVID-19 due to a lack of prior information to deal with this ordeal in the history of mankind. They were “neither disagree nor agree” to express their opinion for the majority of the perceptions statements regarding consequences of climate variations asked during the survey. However, they opined that change in the rainfall pattern is actually the consequence of climate variations. It is inferred from their attitude that whatever they experience on the farm and inherit from their elders, they only use those techniques to deal with climate variations for the cultivation of cotton crop. Moreover, findings show that cotton growers were moderately ready to adopt the use of Laser land leveler and the mechanized farming techniques to deal with climate variations in the study area. Moreover, it is also concluded that better educational facilities and increased area under cotton cultivation could gear up the adoption of climate smart agricultural practices among the cotton growers of the area.

Recommendations

Following are few recommendations made with reference to the findings of the study:

i Adoption of CSAP is highly recommended and required higher education and awareness of the growers.

ii Improvement required in physical and human assets for better understanding of consequences of climate variations.

iii Crop rotation, cropping system, use of Laser land leveler and applications of certified cotton seed varieties are the important approaches to deal with climate variations and changing sowing dates of cotton crop

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Conflict of interest

The author and co-authors have declared no conflict of interest in this study.

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