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MITIGATION AND ADAPTATION STRATEGIES FOR CLIMATE VARIABILITY: A CASE OF COTTON GROWERS IN THE PUNJAB, PAKISTAN

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A B S T R A C T

Climate change has become a severe threat to the development and communities around the globe are already experiencing the sudden impacts. It is also being assumed that climate change will have significant negative impacts on agricultural productivity of developing nations of Asia in forthcoming years. Pakistan is one of the Asian countries' most vulnerable to climate variability. In this respect present study was conducted in southern Punjab, Pakistan. Southern Punjab is famous for cotton productivity and cotton is also assumed as risky crop as well. In this respect 80 cotton growers were interviewed as respondents to explore the climate variability/change awareness and farmers mitigation strategies. Findings of the study indicated that farmers' awareness regarding climate variability was very poor they were just having knowledge on behalf of their farming experience. Moreover, role of information sources including public and private sector, electronic media and ICT's was very poor. Farmers were having awareness about climate change impacts on cotton crop of medium level (Average mean value: 2.12). Varied response was seen regarding causes of climate change. In addition, adaptations of mitigation strategies such as conservation agriculture, cover cropping, migration to less weather prone area and usage of weather resistant varieties were almost negligible. Conservation agriculture could be the most viable strategy s farmers have to utilize their existing resources in judicious ways. It is suggested on the basis of findings that role of extension field staff should be diversified. Farmers need capacity building regarding conservation agriculture. Moreover, it is dire need to popularize climate variability/change and its adaptation through effective media campaign.

Keywords: climate change, conservation agriculture, cotton, resource conservation.

INTRODUCTION

Agriculture is innermost to economic growth and development in Pakistan. Being the dominant sector it contributes 21.4 % to GDP, employs 45 percent of the country's labour force and contributes in the growth of other sectors of the economy as well. Moreover, agriculture also directly or indirectly provides several raw materials to the agro-based industry including cotton textile industry; largest sub sector of manufacturing sector. The healthy expansion in agriculture stimulates domestic demand for industrial goods and other services and supplying raw material to agro-based industry notably cotton textile industry which is the largest subsector of manufacturing sector (GOP, 2013). During the years 2012-13, agriculture sector of Pakistan exhibited a growth of 3.3% on the back of positive growth in agriculture related sub sectors, Crops grew at 3.2 percent, Livestock 3.7 percent, Forestry 0.1 percent and Fishing 0.7 percent (GOP, 2013). The performance of agriculture sector dependent upon weather condition, in time availability of input especially water. During 2012-13 weather condition and water situation has an impact on these Kharif crops that paved the way for decrease in output of rice and cotton crops. Generally in Pakistan farmers are not attaining the potential of crops. Several reasons are the reason for this lower productivity. Among several reasons climate change is the most noteworthy issue affecting the productivity badly. In recent decades, extended rise in temperature has been seen in Asia and the pacific regions. Within these regions agriculture is more vulnerable to climate change as 37% of the total world emission from agriculture

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production is accumulating from Asia and the Pacific. Most vulnerable countries to climate change includes Bhutan, Indonesia, Pakistan, Papua New Guinea, PRC, Sri Lanka, Thailand, Timor-Leste, Uzbekistan, and Vietnam (Asian Development Bank, 2009). Janjua et al. (2011) narrated that Pakistan is the more vulnerable to climate change because of its geographical locations. They further reported that due to anthropogenic activities, temperature in earth is increasing which may have negative impacts on productivity of crops such as wheat. Similarly, Shakoor (2011) depicted significant negative impacts of increased temperature on productivity. In addition, he also added that rainfall has positive impacts on agricultural productivity. Anyhow, the negative impact of temperature was greater than the positive impact of rainfall for Pakistan. Agriculture sector is also a possibility to harm the climate as 14% nitric oxide and methane is imminent from the agricultural activities and 18 % is due to deforestation for agricultural purpose (Paul et al., 2009). Several agricultural activities could have potential to harm the climate such as excessive mechanization and excessive utilization of inputs. Resultantly resources are depleting. Especially soil and water are endangered because of immense degradation and un-judicious use. The proof of excessive mechanization is that during 2012-13 total 36121 tractors were produced in Pakistan, 34.6% greater than previous year (GOP, 2013).

In this perspective, present study was planned and conducted in southern Punjab which already has faced the severe flood which is also the outcome of climate change. Cotton is the major cash crop having significant share in agriculture and textile sector.

Therefore, cotton season was selected for the data collection as when flood prevailed cotton was the major affected crop. Moreover, cotton is also assumed as risky crop.

Present study was focused on following objectives.

- To explore the farmers level of understanding about climate change and its causes
- To assess the level of awareness of farmers regarding impacts of climate change on cotton crop
- To identify the information sources helping in disseminating the information about climate change among farming communities
- To discover the farmers adaptation strategies to mitigate climate change impacts.

METHODOLOGY

Study area: The study was conducted in district Dera Ghazi Khan of Punjab province. District is generally famous for cotton cultivation. Moreover, Indus River crosses from the said district and this district also has faced the devastations of flood in 2010.

Sampling procedure and selection of study respondents: Convenient sampling technique was used for the sample selection. Time limit and resources were kept in mind. In this regard, researchers were not able to cover up entire district and 80 respondents were selected through convenient sampling technique as respondents. All the selected respondents were cotton growers and were cultivating cotton at their farms.

Research Instrument for data collection: Interview schedule was used as research tool, which was prepared keeping in mind the all set objectives of the research. The interview schedule was pre-tested before final data collection. The reliability and validity of research instrument was also checked. Further, respondents were personally interviewed for the accurate acquisition of data.3 point likert scale was used for the extent assessment.

Data analysis: Collected data were analyzed through computer software Statistical Package for Social Sciences (SPSS) for tabulating results and drawing conclusions and recommendations. Average mean and standard deviation were also computed for the better understanding.

RESULTS AND DISCISSION

Average mean age of respondents was 33.52 followed by the average literacy level of 6.42 years. Education seems poor in the study area. No doubt some respondents were also graduates but overall educational scenario implies more literacy rate for development. Size of land holding in the study area was sufficient to grow multifarious crops. About 16.76 acres was the average land pointing the lesser proportion of small farmers owned up to 12.5 acres land. In addition, majority of the respondents found were owner of their lands with average farming experience of 13.05 years as shown in table 1.

Data mentioned in Table 2 depict that overall understanding of farmers about climate variability/change was not much impressive as average mean falls between the low and medium level. Only rainfall pattern and flood/disasters were known to the

majority (Mean Value: 2.70 & 2.05). Major reason of this understanding was the increased intensity of rainfall rather than frequency. It is common now that, if we go couple of years back, rainfall used to happen with intervals which prove to be more useful. Now rain happens but with the increased intensity. Rainfall persists for the long time without intervals. Which is dangerous as it can cause floods.

Table 1: Personal information of farmers' respondents.

Demographics	Mean
Age	33.52 years
Education (years of schooling)	6.42 years
Land holding size	16.76 acres
Tenancy status	Owner: 92.3%
	Owner cum tenants: 5.8%
	Tenants: 1.9%
Farming experience	13.05 years

Table 2: Farmers understanding level regarding indicators of climate variability/Change

Indicators of climate variability/change	Level of Understanding	
	Mean	S.D
Increase in temperature	1.00	0.000
Rainfall pattern	2.70	0.464
Increased incidents of drought	1.03	0.354
Flood/disasters	2.05	0.232
High winds/heat waves	1.05	0.272

Average Mean: 1.56, Average SD: 0.264.

Understanding of rest of the all indicators was almost of low level with mean value of almost 1.00. This situation is alarming that without understanding farmers' couldn't be able to mitigate climate change for long term benefits. Similarly Adetayo & Owolade (2012) reported generally lower awareness of climate change among resource poor farmers.

Table 3: Farmers awareness regarding impacts of climate variability/change on cotton.

Effects on cotton	Level of Awareness	
	Mean	S.D.
Enhanced flower shedding	2.37	0.732
Loss of production	1.72	0.844
Loss of farmland due to flood	1.81	0.474
Reduced boll size	2.56	0.698
Shortens the crop cycle	1.54	0.343
Loss of income	2.16	0.762
Attack of pests and diseases	1.98	0.573
Decrease in soil fertility	2.34	1.032
Soil erosion	2.54	0.983
Degradation of fiber quality	2.20	0.897

Average Mean: 2.12, Average SD: 0.738.

Farmers revealed enhanced flower shedding as the major impact of climate variability/change on cotton productivity. Farmers explained that when night temperature increase flower start to shed because of excessive heat/warmness. Reduced boll size was also the impact of climate change and increased night temperature. This phenomenon was known to the cotton grower almost in between the medium and high level. Cotton is the cash crop and livelihood of farmers remains dependent on it. Reduced boll size and flower

shedding are definitive cause of low income. Farmers were also known to this aspect. To cover the income shortage farmers go for the intensive mechanization, tillage, improved varieties and exploitation of natural resources. Thus results in degradation of soil fertility through soil erosion. Farmers were found familiar to theses aspects almost of medium to high level. In case of soil fertility loss awareness was more inclined toward high level. Several other impacts were not known to farmers to greater as most of them fall to low level. Cotton growers were further inquired about their information sources.

Table 4: Information sources playing role in dissemination of information about climate change.

Information Sources	Response	
	f	%
Extension agents (public sector)	12	6.66
Extension agents (private sector)	24	30
Television	9	11.25
Radio	7	8.75
Internet	0	-
Mobile phone	6	7.5
Helpline	0	-
Seed sale agencies	19	23.75
Friends	46	57.5
Neighbor farmers	58	72.5
Farmers cooperatives	9	11.25
Researchers	26	32.5
Newspaper	3	3.75
Roadside advertisements	0	-

Description of Table 4 illustrates the poor awareness dissemination by various sources among farming communities. It is modern era now and world has transformed into global village. Through various technologies we can share bundles of information in very short time. Despite of this quickness and available technology none of the respondents was found getting information from internet. Electronic media (TV, Radio and helpline) was also found substantial. Neighbor farmers were the mostly used information sources among the farmers. On one side it shows the cooperation of farmers. On other hand it also creates conspiracy that neighbor farmers are not much experts regarding awareness dissemination and they also not have any exact information. In this case they might cause miscommunication. When we talk about experts role, extension agent role was substantial as only 6.66% farmers were getting information from the typically about climate change. Meanwhile private sector was ahead of public sector as reported by 30% respondents. One third respondents narrated researchers as information sources. During informal discussion farmers revealed that these researchers are students who came there for their research purpose or for internships training. During their visits to some extent they made us aware. It is hard for the farmers to illustrate the technical aspects such as the causes of climate variability change. They just can share their perception on basis of their farming experiences. These perceptions are mentioned in table 5.

Table 5: Farmers' perception regarding causes of climate variability/change

Causes of Climate Change	Yes	No
Domestic activities (i.e. Ac & refrigerators, oven and automobile plants)	31	38.75
Industrial activities	58	72.5
Deforestation	17	21.2
Emission of greenhouse gases (CO2, CH4and NO2)	12	15
Extreme use of Automobiles	24	30
Natural process destined by God	68	85

Climate is altering and that process of climate change has been started from several decades and no one is sure about its occurring as it is uncertain process. Anyhow, farmers showed their concern in elaborating the causes of climate change. Majority (72.5%) respondents reported industrial activities as source to cause climate change. Smoke and flames emission in the air directly cause climate variability/change. About 39% respondents declared domestic activities as source of climate change. Greenhouse gases are the major source of climate change now days. Agricultural activities are also increasing the greenhouse gasses emissions. Only farmers who were educated greater than inter were known to the greenhouse gases emissions and they reported this as cause of climate change. Literacy level was not impressive of the area that's why overwhelming majority stated climate change as natural process destined by God.

Table 6: Adaptation measures adopted by farmers to mitigate climate variability/change.

Adaptation Measures	Adoption	
	Mean	S.D.
Conservation of resources)	1.00	1.322
Use of organic manures	1.23	0.534
Planting pest and disease resistant crop	3.00	0.000
Draining of wetland	1.34	0.594
Cover cropping	1.89	0.432
Use of minimum tillage system (zero or minimum)	1.00	0.674
Reforestation	1.18	0.931
Use of early/late sowing varieties	1.00	1.211
Protection of water sheds and mulching	1.00	0.934
Reducing access to eroded and erosion prone area	1.00	0.743
Mixed farming practices	1.85	0.342
Out migration from climate risk areas	1.00	0.657
Use of windbreaks/shelter belts	1.57	0.414
Reduction in farm mechanization	1.22	0.782

Average Mean: 1.37, Average SD: 0.68.

Farmers were inquired about their adaptation strategies to mitigate the climate variability/change impacts. For longer term benefits it is necessary to reserve the resources for tough times. Unfortunately, farmers were exploiting their resources only to earn maximum benefit. Soil and water are the epic resources which have no alternates but still farmers are unaware and exploiting again and again through mechanical manipulation. Excessive tillage, non-judicious use of resources, water wastage and excessive chemical application were seen as most utilized practices. Farmers were lower incline toward cover cropping to save the nutrient efficiency and fertility of soil. Turner et al. (1995) narrated soil cover as the biophysical utter of earth surface and subsurface. Moreover, Feranec et al. (1998) depicted that soil cover is management practice made up of lagoons, streams and other naturally occurring earth surface. Soil cover protects the land and keeps the soil fertility sustained. Unluckily farmers were unaware of it. Average mean (1.37) clearly indicates that adoption of strategies to mitigate climate change was in between low and medium level but more closer to lower level which is not enough to mitigate climate variability/change. Table indicates that conservation agriculture, use of early/late sowing varieties, crops mulching and migration to less disaster prone areas were the strategies not being adopted by the single respondent. It is also obvious that migration si not any easy job as Mcgranahan (2007) revealed that migration can be costly and difficult to implement without causing severe disruptions.

Likewise above mentioned strategies Adetayo & Owolade (2012) narrated the adoption of climate change coping strategies including drainage channels construction (21.7%), ,usage of local herbs and drugs (30%), increasing the level of household properties (15.8%), while 16.7% gave no response about coping strategies. Generally these strategies are different from the strategies given in table but both have the similar

purpose the mitigation of climate change.

CONCLUSION AND RECOMMENDATIONS

Study concludes that climate change is occurring and has potential to strengthen the difficulties. In addition, the uncertainty of its happing and impacts make it more severe. Therefore, mitigation is necessary. Conservation agriculture could be the viable option as farmers have to utilize their available resources. Through conservation agriculture soil and water resources can be reserved from long term benefits.

On the basis of results following recommendation are made

Awareness dissemination about climate change via electronic media and print media Public sector extension needs to diversify their role. These agents must have to contribute in popularizing climate change as risk and its possible solution among farming communities. Capacity building of extension agents and farmers is needed to popularize “use soil according to its capability for long term benefits”

Farmers have resources; therefore it is time to convince farmers toward adoption of conservation agriculture as mitigation strategy toward climate change. Through conservation technologies farmers will be able to conserve resources, cost of production will decrease and productivity will increased.

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