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Impact of Climate Change Hostilities on Livelihood Strategies: A Case Study of Rainfed Pothwar Area of Pakistan

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ABSTRACT

The present paper is based on primary data collected by conducting farm level survey in Attock and Chakwal district in 2016. Data was collected from 64 respondents. Descriptive and bi-variate analysis was used to link different socio-economic characteristics of the farmers with different coping mechanisms against the climatic hazards. Farming is the major occupation at the study sites and most of the families depend on it for their subsistence. Farmers in the study area are well aware about climate change happening around them and have their own strategies to cope up with the challenges brought by these climatic disturbances. The harshness of the climate change has make the dependency of farm families on livestock and off-farm sources of income as the crop sector is unable to fulfill the livelihood needs of increasing population. People have opted to adopt off farm employment opportunities to retain their livelihood mostly away from their native areas. In this regard government should come forward and play its role to overcome these climatic challenges by introducing drought resistant/heat tolerant crop verities.
KEY WORDS: Climate Change, Livelihood, Strategies, Socio-economic

INTRODUCTION

It is estimated that due to climate change scenario the yield of different crops in Pakistan has decreased (IPCC, 2001). Especially its impact on water resources can be quite diverse and uncertain. In Pakistan where different climate conditions exist, the effect of climate change could be more significant. Pakistan's economy is based on agriculture and highly dependent on Indus irrigation system. Changes in flow magnitudes are likely to increase tensions among the growers, with regard to reduced water flows in the dry season and high flows and resulting flood problems during the wet season. Climate change is basically due to the increase in the concentration of greenhouse gases (GHGs) like carbon dioxide, methane and nitrous oxide in the atmosphere. These gases trap the sunlight and increase the earth's overall temperature. Although, Pakistan contributes very little to the overall GHG emissions; but remains severely impacted by the adverse effects of global climate change (Rasul 2014).

Due to agrarian based economy and high dependency on natural resources for livelihoods, it is highly vulnerable to extremity of climate. Farming is the major occupation in rural areas mostly rural families depend on it for their subsistence (Berkes and Jolly, 2001). Barani area make a significant contribution to agricultural and livestock production of Pakistan. Out of total cropped area 20 million hectares about 5 million do not have any irrigation facility and completely depend on rain. In Punjab barani area contribute about 20 percent of cropped area while in pothowar region cropped area is over 90% rain fed area is characterized as agriculture land which do not have access to any type of irrigation system. Due to low and unreliable rain condition of the region yields of main crops are low and farm income remains insufficient to maintain the family. Water availability for the cultivation of wheat in Pakistan is 26 MAF (million acre feet) which is still 28.6% lower than the normal requirement of water (Nelson *et al.*1999). In near future a drastic decline in the water availability would cast a sharp decline towards the production of agricultural productivity.

The existing cropping systems are not in harmony with the rainfall pattern and about 50% of the annual rainfall is lost due to low water intake rate and lack of suitable soil management practices (Kotir, 2011). Climate change is becoming serious threat for the farmers of the area and the farmers sometimes faced huge financial losses due to crop failure. Dependency of farm families on livestock and off-farm sources of income is increasing as the crop sector is unable to fulfill the livelihood needs of increasing population.

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Therefore, the present paper is designed to assess the vulnerabilities and coping strategies of farming community due to climate change in the rainfed area of Punjab Pakistan with the objectives to assess the impact of climate change on socio-economic and demographic characteristics of the rainfed area; to evaluate the their perception regarding livestock population, water resource; and income generating activities and to find out main copping strategies adopted by people to mitigate the adverse effects of climate change. And to suggest policy recommendations that can assist farmers to cope with negative effects of climate change.

METHODOLOGY

The present study was based on primary data. Data was collected from Attock and Chakwal district in 2016 through a well-designed, pre-tested questionnaire from the rainfed ecologies of Pothowar. Three tehsils from Attock and Chakwal district were selected and four villages from each tehsil were surveyed. A brief summary of the characteristics of the sampled farmers is presented followed by a descriptive analysis in the three rainfall zones. They were selected after stratifying the area into three rainfall zones (high rainfall, > 750 mm annual rainfall; medium rainfall, 500 to 750 mm; and low rainfall, < 500 mm) (Sheikh 1988). Hazro comes in high rainfall zone; Fatehjang falls in medium rainfall zone where as Talagang is considered as low rainfall zone. Simple random sampling technique was used for sample selection. SPSS and Microsoft excel were used for the analysis and tabulation of data. Descriptive analysis and bi-variate analysis was used to link different socio-economic characteristics of the farmers with different coping mechanisms against the climatic hazards. Overall, from all selected tehsils, 64 farmers were taken as sample farmers (Table 1).

Table 1: Area wise Sample Distribution

Selected Areas	Frequency	Percent
Hazro	20	31.3
Fateh jhang	24	37.5
Chakwal	20	31.3
Total	64	100

Source: Field survey, 2016

RESULTS AND DISSCUSSION

Socio-Economic Characteristics of Respondents

Majority of the sample respondents were heads of the household and their socio-economic characteristics were particularly asked to understand the farm manager's decision making power to adopt a particular livelihood strategy. Age, education and farming experience of the head have strong influence on the decision regarding the crops and livestock management and farm investments (Shah *et al,* 2005). The results indicated that the average age of the respondent was 50 years. Education is an important indicator of quality of human resources and development stage of a society. A high education level will help to leads the farmers to adopt better coping strategies against any climatic shock. In the study area mean education of the respondent was about 4 years of schooling which was quite low with having 28 years of farming experience on average. Average household size was 8 members per household while joint family system was dominant in the targeted area.

Table 2. Socioeconomic Characteristic

Variable	Mean	Std. D
Age (years)	50	13.56
Education (years)	4	4.2
Farming experience (years)	28	11.75
Household size (number)	8	3.2

Source: Field survey, 2016

Farm Characteristics

Land is considered as a sign of wealth and status in every society (Kafle 2008 and Sharma 1985). Those who possess large piece of lands have better livelihood opportunities as compare to others. But unfortunately Barani areas of our country are generally characterized by small farms which are owner operated. They are anticipated to be most vulnerable due to their low adaptive capacity and high reliance on climate sensitive resources such as water and ecological systems. Small scale of farming was observed in the targeted area.

The farmers were categorized on the basis of their land holdings (small, medium and large) having 1 to 40 kanal of land lies in the small farmers category while farmers between 41 to 80 kanal were consider medium farmers whereas farmers having above 80 kanal of land lies in the large farmer category. According to the estimated results mostly farmers hold small piece of land for agriculture purpose about 81.3% of the farmers have area less than 40 kanals whereas 17.2% of the farmers were medium farmers and a very few farmers 1.6% lies in the category of large farmers having above 81 kanalof land.

Along with land Irrigation water is also one of the important inputs for growing of crops. The availability of irrigation water results in multi cropping and diversification of the household income. Irrigation water is a vital resource for many productive and livelihood activities (Hussain *et al,* 2007). Irrigation sources are categorized in to different categories like rain fed, dug well, tube well, and water supply. In the underline study mostly area was rain-fed; however in Hazro all the respondents irrigate their land through tube wells while on the contrary Talagang and Fatehjang mostly farmers depend on rain water for irrigation purpose. A very few dug wells were also there in the field area. According to the results out of total respondent 35.9% of the respondent depend on tube well for their crop. About 9.4% of the household have dug wells 3.1% 0f the respondents have motors 1.6% of the respondents have ponds for farming purpose. Whereas a large numbers of the farmer were only relying on rain water for their crops.

Figure 1: overall Farm Size

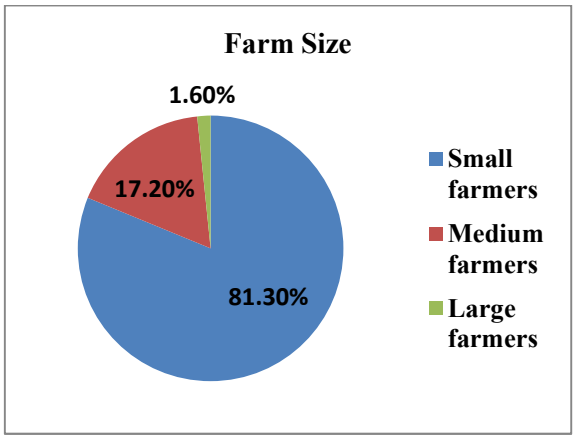
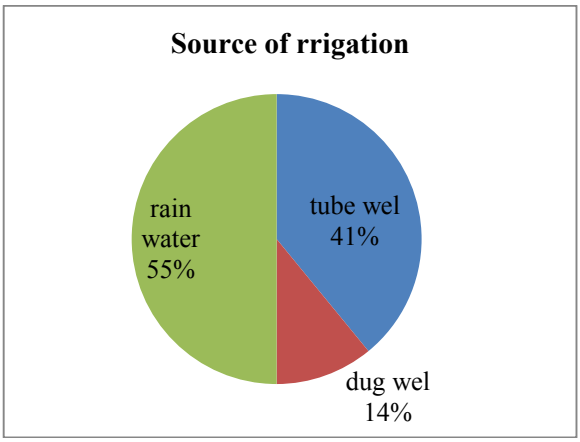


Figure 2: Irrigation Source



Source: field survey 2016

LIVESTOCK COMPOSITION

Livestock rearing is an important Part of agricultural economy and it contributes substantially to household income. The ownership of livestock plays a major role in the household wealth and income generation (Cain et al., 2007, Adams, 1996, Kurosaki, 1995). Keeping livestock has been a traditional activity in rain fed Pothwar area of Pakistan it is also been a primary source of livelihood for people below the poverty line. Mostly household in the study area kept small and large ruminants at their home. The different livestock products help in fulfilling the consumption requirements of household. 32.8% of the household keep livestock for commercial purpose while mostly household kept livestock for fulfilling their own requirements. Regarding the question that the household observed any increase or decrease the livestock population during last ten year the results indicate a minor increase in the number of buffalo population. An increase in number of goats was perceived over last three decades. Farmers perceived a minor increase in number of poultry birds while there is a reduction in the number of sheep. Due to increase in mean annual temperatures and irregular rains patterns, a decrease in area under major crops has occurred. Thus, people's dependence on livestock farming has increased, as increase in number of buffaloes, goats and poultry birds at the targeted site was perceived.

Table 3: Livestock Composition

	Responses	Frequency	Percentage
Having livestock	Yes	50	83%
	No	14	17%
	Total	64	100%
Purpose for keeping livestock	Domestic	37	61%
	Commercial	13	22%
	Don't have	14	17%
	Total	64	100%

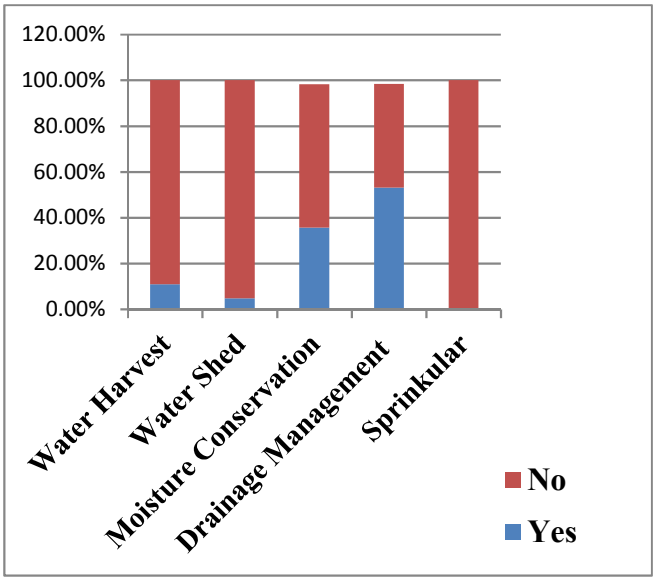
Field Survey, 2016

Climate Change and Mitigation strategies of the Respondents

Most of the respondents were well aware about the terminology of climate change. They feel and observed changes in nature in their surrounding due to change in climatic factor. Almost all of the respondents responded that due to climatic harshness water table is reduced and there is a scarcity of water for their crops. Due to climate change factor many changes occur in the agricultural practices of the respondents. Water table in Hazro was 41 feet on average. Survey data indicates that all the farmers in Hazro, irrigate all or a major portion of their lands through tube wells. In Hazro vegetables are the grown dominantly after wheat. The reason behind is that they grew vegetables and for it they need timely irrigation, but the rainfall in this area is not following any pattern. Fathjhang only one farmer uses tube well for irrigation purpose and groundwater table was 170 feet whereas in Talagang 30% respondents are irrigating their fields through tube wells and the ground water table was 167 feet on average.

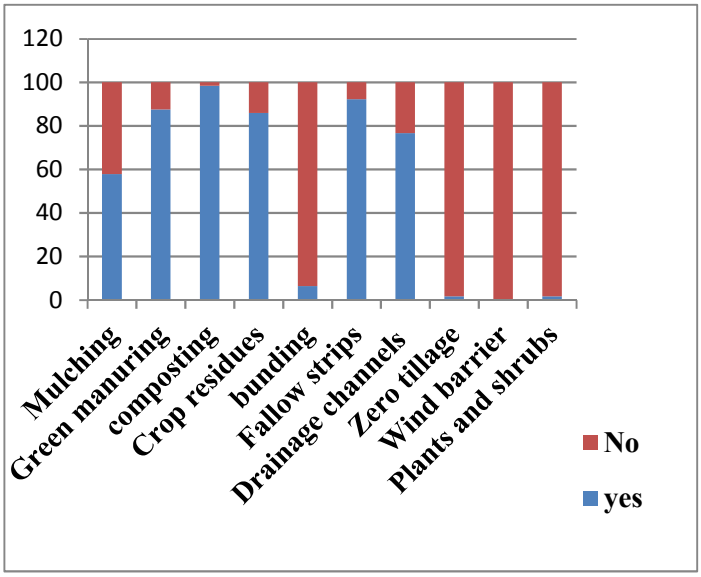
Regarding water management strategies practices mostly 54.7% of the farmers respond that they opt water management practices at their farm in which drainage and moisture conservation are most common while 45.30% of the farmers did not apply any water management technique at their farm and only rely on rain water for their crop. Land management practices were common in the targeted area mostly all the respondents were using different kind of land management practice on their land to protect their crop from any climatic harshness. Mostly common land management practices were green manuring, composting, crop residues drainage channels and zero tillage.

Figure 3: water Management practices



Source: field Survey 2016

Figure 4: Land Management Practices



Source: field Survey 2016

Coping Strategies against the adverse effect of Climate Change

Table 4: Land Categories and Adaptation Strategies

Coping Strategies	Land Categories		
	Small	Medium	Large
Borrowing	19 (30)	4 (6.2)	0(0)
Migration to non-farm	4 (6.2)	14(22)	0(0)
Partial sale of assets	1 (1.6)	2 (3.2)	1(1.6)
Reduce in consumption	8 (12.5)	4(6.2)	0(0)
Sale of Livestock	3(4.6)	4(6.2)	0(0)

Figure in parenthesis are percentage; Chi Square: 64.67 (significant at 1%)

Adoption of coping strategies to mitigate effects of climate changes mainly depends on the socioeconomic characteristics of the farmers (Adger*et al,*2003). Different copping strategies were adopted by farmers. As the incidence of poverty was more at the targeted area, small farmers reported sale of livestock followed by migration for nonfarm activities and reduction in consumption expenditures as the main coping mechanisms. Medium farmers at this site reported occasional sale of livestock, reduction in consumption expenditures and use of previous cash

saving as main coping strategies. Large farmers reported partial sales of assets and occasional sale of livestock as main mechanisms to cope environmental hostilities. Although, people are well aware of the climate change and its impacts on the productivity of crops and their livelihood; however, agricultural extension department should train them about strategies to mitigate environmental harshness. Farmer cooperatives and self-help groups are the institutions which can be used by agricultural extension department for speedy transfer of knowledge to the farming communities.

Table 5: Income categories and Adaptation Strategies

Adaptation Strategies	Income Categories		
	Poor	Lower Middle	Middle
Borrowing	10(15.7)	11(17.1)	2(3.1)
Migration to nonfarm	2(3.1)	4(6.25)	7(10.9)
Partial sale of assets	1(1.5)	4(6.25)	7(10.9)
Reduce in consumption	4(6.25)	7(10.9)	0(0)
Sale of Livestock	1(1.5)	4(6.25)	0(0)

Chi square: 25.2 Significant at 1%

The above table shows the bi-variate analysis of income categories and different coping mechanism which are common to lesser the loss of crop due to climate change according to the results mostly poor and lower middle farmers borrow money after facing crop loss due to any climatic hazard while the farmers in the middle income category mainly shift to nonfarm sources to earn income and also occasionally sale their livestock avoid the crop loss due to any climate change. The other suggestions were also noted which they also apply practically to save themselves from any clematises issue like some of the respondents reported choice of early sowing of wheat to respond to changing rainfall patterns and temperatures. Chemical weed control has replaced manual weeding. Use of chemical fertilizers has increased. Drill and harvester are commonly used. Due to water shortage, farmers are now planning to harvest rain water through constructing mini dams, check dams and construction of tube wells. They also suggest cultivation of more groundnuts which has low water requirement and gives higher return. Early sowing, tree cultivation, deep tillage, soil and water conservation practices are other suggested techniques to avoid losses due to less rain in autumn and early winter (the wheat season). They expect more research (by universities) on farming systems and crops to avoid losses due to inappropriate practices.

CONCLUSION

Punjab is the main food basket of Pakistan any factor affecting its productive resource such as climate change will exert adverse impact on the food production of the country. It is therefore concluded that in the semi-arid tropics of the country, farmers are well aware of the environmental changes happening around and have their own strategies to cope up with the challenges brought by these climatic harshness. Farming is the major occupation at the study sites and most of the families depend on it for their subsistence. The environmental disturbances like changes in the temperature and rainfall patterns have essential role in the development and growth of the crops. Change in the rainfall patterns and climatic harshness during the last few decades has adversely affected the area and productivity of major crops.

The food security situation is alarming and vulnerability of farm families has increased. Dependency of farm families on livestock and off-farm sources of income is increasing as the crop sector is unable to fulfill the livelihood needs of increasing population. People have opted to adopt off farm employment opportunities to retain their livelihood mostly away from their native areas. Although, people are well aware of the climate change and its impacts on the productivity of crops and their livelihood; however, agricultural extension department should train them about strategies to mitigate environmental harshness. Farmer cooperatives and self-help groups are the institutions which can be used by agricultural extension department for speedy transfer of knowledge to the farming communities. Research institutes should produce new drought resistant varieties of the crops. Forest department should create awareness in the rural communities of semiarid tropics of Pakistan about the importance of forest resources. District governments should endeavor to provide alternate sources of energy to reduce the pressure on forest reserves. Community lands should be identified and forest trees should be planted. To increase the productivity of livestock, farmers should also be taught to plant palatable shrubs and forage trees in rain catchments. Awareness about bee keeping, mushroom farming should also be generated in people, as these could be very good income generating activities for them.

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