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CLIMATE CHANGE, POVERTY AND AGRICULTURAL RESOURCE DEGRADATION: A CASE STUDY OF DISTRICT D.G. KHAN

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Global development agendas are now being bonded with adaptation to climate change. Sustainable biodiversity and community adaptation to climate change are closely associated as depletion of natural resources adversely affects the living standard of people. Rapid climatic changes and intervention to regulate water resources in Indus delta of Pakistan have put the lives of millions of people residing near the Indus river belt at the stake of climate change. Therefore, this study was designed to inquire the socio-economic conditions of the people residing near the Indus river bank and the perceived impact of climate change on river belt agricultural resources specifically in district D. G. Khan. Based on primary data study employed univariate and bivariate analysis which suggested flood, wind storm and temperature as the significant climate change parameters affecting the land fertility, forest and fisheries. The Foster Greer and Thorbeck technique for calculating the poverty indicated that majority (82%) of population was below poverty line and most of them entirely depend on river belt agricultural resources which were found to be depleting due to rapid climate change.
Keywords: Climate change, poverty, indus river, resource degradation

INTRODUCTION

Climate change refers to a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period. The impact of climate change on poor communities varies greatly, but generally, climate change has aggravated the existing vulnerabilities. If the damage due to climate change continue at the current pace it would possibly reduce access to drinking water, quality health and will pose a real threat to food security in many developing countries across the continental frontiers **(**McCarthy *et al., 2001***)**. In areas of limited livelihood choices, anticipated risk of famines due to decreasing crop yields is obvious. Although macroeconomic cost of the damages due to climate change is uncertain, yet it has the potential to threaten global development (Schjolden, 2004).

Pakistan's economy which unambiguously depends on the sustainability of Indus River system, is struggling as the country becoming increasingly water-stressed. The long-term effects of climate change on Pakistan's water-resources are challenging the sustainability of country's water sector along with aggravating the regional and ethnic tensions (Vaughn *et al.,* 2010). A considerable proportion of population in Indus delta is striving for its survival on irreversible ecological resources. The unavailability of needed infrastructure near Indus river belt has forced these communities to rely on consuming natural resources for their survival. The existence of forests is considered to be an essential component of river bio-diversity but these forests are disappearing from the delta due to river bank communities, who are compelled to make those a source of livelihood (Jamil and Afser, 1996). As a consequence, demise of riverine forests has exacerbated the rate of flood occurrence due to rising river bed erosion (Sheikh and Soomro, 2006).

Climate Change usually slow down rates of improvement in food security, putting the lives of millions at stake of hunger that often lead to malnourished society. Based on crop and economic modeling, it is projected that in 2080 around 1300 million people could be at risk of hunger under the most extreme climate scenarios (Parry *et al.,* 2004). Similarly, another long-standing model result revealed that an anticipated increase in drought is expected mainly due to a gradual drying of mid-continental areas with increasing CO_2 (Rind *et al.,* 1990).

Livestock is the major component of our agricultural production sector and its capacity could be enhanced by finding the local comparative advantage. Diversity in the food components of livestock in free grazing fields of riverbank enhances the milk and meat quality. The participation of river belt communities in adopting improved livestock production and distribution techniques is essential and could generate dual benefits; one on improving the living standards of these deprived ones and secondly, the economic contribution that would be realized through livestock development (Abruzzi, 1995).

Apart from direct influence of climate change on river belt communities, its damages to mainstream society are huge in

size and diverse in composition. It leads to unplanned urban expansion as huge influx of migrants move towards urban hubs in times of disaster and deprivations. These migrations on the part of climate change accrued to cultural losses as well. The cultural values of deprived river belt communities are dying as their aspirations about the future get faded. Consequently, some river belt communities are losing their identity as vulnerability leads to weaker social and moral values (Gadi *et al.,* 2003).

The effects of climate change on the living standards of people have been widely discussed. However, the multiplication of these effects in regions of low resource possession further fans the flames of poverty and vulnerability. The demand for urgent attention towards socio-economic and cultural conservation with efficient adaptation to climate change should have been considered. The rural areas of tehsil D. G. Khan adjacent to Indus river are highly disaster prone especially related to floods and therefore any significant change in climate change would be more visible in these areas. Pakistan's rural economy usually depends upon the water resources of Indus river system and therefore any potential threat to these river belt resources would determine the future course of socio-economic conditions of people in Indus delta. Moreover, the micro level research in investigating climate change and socio-economics of these deprived areas was absent in the literature. Therefore, this study has possibly contributed towards filling this research gap over the issue. Finally, the results of this study could be a step towards designing a development framework compatible to the socio-economic and environmental sophistication of the region.

MATERIAL AND METHODS

The universe of the study was district D.G Khan aimed to inquire the socio-economic conditions of the people residing near the Indus river belt along with effect of climate change on depletion of river based agricultural resources. For the purpose initially 4 union councils namely Peer Adil, Darahma, Sammeena and Jhok Utra adjacent to Indus river belt in D.G. Khan were selected using convenient sampling technique. Later, a sample of 120 respondents was selected using convenient sampling with 30 respondents from each union council. The data was collected through a well-structured interview schedule and tabulated using descriptive statistics.

***Limitations of the study*:**

- Only those respondents were interviewed who were permanent residents of Indus river belt of tehsil D.G.Khan.
- Respondents were asked for any significant change observed in climate over the last ten years as climate change observation required long time
- Only those respondents were interviewed who were above the age of 20 years so that to have a valid observation over the previous decade.

***Headcount pove*rty:** Poverty line is measured by the headcount index (Po) the proportion of the population that is poor. It is so popular because it is easy to understand and to measure. But it does not indicate how poorer the poor are.

***The squared poverty gap*:** ("Poverty severity") index (P2) averages the squares of the poverty gaps relative to the poverty line.

***Foster – Greer – Thorbecke*:** The headcount index, the Poverty Gap and the squared poverty gap index all are related to the Foster-Greer-Thorbecke class of poverty measures. It is one of the Foster – Greer – Thorbecke (FGT) classes of the poverty measure. This may be written as:

$$FGT_\alpha = \frac{1}{N}\sum_{i=1}^{H}\left(\frac{z - y_i}{z}\right)^\alpha$$

(Foster and Erik, 1984)

RESULTS AND DISCUSSION

The aim of this study includes investigation about the socio-economic status of respondents and to describe how these characteristics could influence the responses. When considering the age of the respondents it was apparent that most of the respondents were above 40 years of age which represents that response of the people would be based on valid observation as climate change is usually observed over long periods of time i.e a decade or so. River belt communities in Tehsil D.G. Khan possess very poor state of education which represents poor state of human capital which is also evident from the data on income of the respondents that more than 80% earning less than Rs. 10,000. People had no access to any public sector employment opportunity mainly because of low level of skill due to illiteracy and therefore, agriculture mainly took the burden of this low skilled labor force. Even though very few people consider themselves as unemployed which represents low level of awareness among the community as well. When asked about their residential status, a vast majority replied as living in mud houses which is expectedly having lower hygiene conditions and becoming more susceptible to health related climate change risks. Interestingly, a considerably large proportion of the people were living in nuclear families which was contrasting to the facts obtained from other rural areas of Pakistan where nuclear family structure was not still dominant over the joint and extended family structure.

Although poverty remained a vital hurdle in the development of Pakistan since decades yet some of the urban circumference made many developments in reducing levels of absolute poverty. Rural areas in Pakistan always remained the hub of poor mainly on the part of lower

Table 1. Measures of poverty headcount, poverty gap and its severity of poverty in river belt communities

Measures of Poverty	FGT Equation	Poverty Index	%age
Head count poverty	$P_\alpha = \frac{1}{n}\sum_{i=1}^{q}\left(\frac{1-y_i}{z}\right)^0$	99	82.5
Poverty Gap	$P_\alpha = \frac{1}{n}\sum_{i=1}^{q}\left(\frac{1-y_i}{z}\right)^1$	0.254478	25.44784
Severity of Poverty	$P_\alpha = \frac{1}{n}\sum_{i=1}^{q}\left(\frac{1-y_i}{z}\right)^2$	0.534949	53.49485

physical capital formation in the form of infrastructure and poor state of human capital development (Chaudhry *et al.*, 2006). In the current analysis of poverty Foster-Greer Thorbeck technique was used to measure magnitude of poverty which is said to be the most reliable method of calculating poverty. In this regard Table 1 indicates that the existence of poverty seem to be alarming which shows that there are 82% people in study area who suffer from poverty that accounts for 99 persons out of the sample of 120 people. Moreover the ratios of poverty gap are also mind striking which shows the average distance of poor from the internationally set poverty line of 2 dollars per day. Apart from this severity of poverty which was found to be 53% also indicates huge inequality within the poor in the study area. The main factors behind these alarming poverty ratios possibly include lesser resource possession, absence of physical infrastructure along the riverside, lack of market integration, poor indicators of human development (health & education) and inability of the state institutions to incorporate them into the national policies for poverty reduction **(**Israr and Khan, 2010**;** Turner, 2004; Joshi, 2008**)**.

Table 2. Distribution of respondents according to their level of poverty

Levels of Poverty	Frequency	%age
Very poor	21	17.5
Moderate poor	46	38.3
Poor	32	26.7
Non poor	21	17.5
Total	120	100

Note: F= frequency/ count of respondents in number

The Table 3 was designed to classify the poor according to their levels of poverty. In this regard international poverty line of 2 dollars which was Rs. 5160/month according to prevalent exchange rate was classified into 4 categories (IFAD, 2002). First class was taken as the 1/3 of poverty line, second between 1/3 and 2/3 of poverty line; third between 2/3 and poverty line and fourth class include those people who were not poor and these classes were ranked as very poor, moderately poor, poor and non-poor. The results in Table 2 evidently showed that although poverty strike quite severely in river belt community of D. G. Khan yet a large number of poor 26.7 % were just falling near the poverty line those could be evacuated from the trench of poverty by a little effort either through transfer payments in the short run and providing economic opportunities in the long run. Saboor *et al.* (2006) mentioned the similar poverty trends in Pakistan and dissecting poverty into many categories reporting that poverty is more common in weaker societies. Therefore, if due attention will not be paid to this deprived strata of our rural population which probably could accounts into millions in number along the entire Indus river belt it could create societal unrest and could hamper the growth trend (Roemer & Gugerty, 1997; Morrison *et al.*, 2007).

Table 3. Relationship between change in temperature and decrease in fish catchment

Temperature	Decrease in fish catchment		Total
	Yes	No	
Yes	39 (32.5%)	64 (53.3%)	103 (85.8%)
No	3 (2.5%)	14 (11.7%)	17 (14.2 %)
Total	42	78	120

χ^2=2.622* (p = 0.105), γ= .480* (p = 0.608)

The Table 3 shows the results of relationship between changes in temperature with decrease in fish catchment. This table narrates that 85.8 percent respondents lie in the category of their agreement of change in temperature and in this category 32.5 percent respondents said yes there is decrease in fish catchment, while 53.3 percent respondents said no decrease in fish catchment. The value of Chi square χ^2 = 2.622 was calculated at 0.105 percent level of significance which show an apparent association between them while value of gamma 0.608 shows that this association was very weak. In this context World Bank (2011) in country profile of Pakistan had reported that impact of climate change on water resources of Pakistan remain unclear however, it was evidently reported that temperature has gradually increased.

Table 4. Relationship between wind storm and deforestation

Wind Storm	Deforestation		Total
	Yes	No	
Yes	91 (75.8%)	4 (3.4%)	95 (79.2)
No	21 (17.4%)	4 (3.4%)	25 (20.8)
Total	112	8	120

χ^2=4.421* (p = 0.105), γ= 0.625* (p = 0.129)

The results presented in Table 4 reveal about relationship between storm and deforestation. The table narrates that 79.2 percent respondents lie in the category of their agreement of storm in area and in this category 75.8 percent respondents

said yes there is deforestation, while only 3.4 percent respondents were of the view that there was no deforestation. The value of $\chi^2 = 4.421$ was calculated at 0.105 percent level of significance which provides the evidence of association between two variables while value of gamma 0.625 represents that this association was weak in strength. The Hopkinson *et al.* (2008) reported that the impact of sea level rise and wind storms on forest ecosystem is quite severe in recent years which are restricting the ecosystem services.

Table 5: Relationship between land fertility and flood

Land fertility	Flood		Total
	Yes	No	
Yes	112 (93.3%)	6 (5%)	118 (98.3%)
No	1 (0.8%)	1 (0.8%)	2 (1.7%)
Total	113	7	120

χ^2=7.223* (p = 0.007), γ= 0.898* (p = 0.340)

The description of results in table 5 evidently proved the relationship between land fertility and flood. These narrated results indicate that 98.3 percent respondents lie in the category of their agreement of change in land fertility and in this category 93.3 percent respondents said that there was flood in their area. The value of $\chi^2 = 7.223$ was calculated at 0.007 percent level of significance which proved the association between the two variables; however the value of gamma 0.898 represented a weaker association between these two variables. Although there is an obvious relationship between flood and land fertility however the direction of relation depends on frequency and intensity of flood occurrence. Nancy *et al.* in (2011) reported that frequent periodic flooding lead to damage the soil texture, however occasional flooding leads to enhance land fertility.

Conclusions: It is imperative to note that rural areas adjacent to Indus river belt in D. G. Khan are facing severe climate change threats. Socioeconomic characteristics of people indicate that poor educational achievement is the main factor behind increasing poverty in the area. As lower level of education represents lower skill possession therefore, most of the people (72.5%) were engaged in agriculture as livelihood choice. As agriculture especially crop production is very sensitive to any mild change in climate therefore based on the evidences in table 4 , 5 and 6 of the results it is concluded that climate change phenomenon was quite visible in the study area which is adding towards the vulnerabilities of people living on agriculture as there major livelihood chooice. One of the reasons behind faster agricultural resource degradation along the Indus river belt is increasing poverty ratios which is further aggravated with fading economic alternatives as fish catchment, forests and land fertility are continuously depleting over time. Hence, there is need for urgent attention towards building community resilience against climate change as the sustainability of agricultural sector inextricably depends on natural resources. Moreover, as classification of poor indicates that majority of the poor belong from moderate to severely poor which necessitates for building some geographically specific social security nets that would help to develop the community in the area.

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