ORIGINAL ARTICLE   **OPEN ACCESS**

Analysis of effect of Environmental Challenges in Agricultural Crop in Pakistan: A Case Study of Badin District

[1]Ghazala Umer Baghal, [2]Shahabuddin Mughal, [3]Erum Khushnood, [4]Zareen Khan Rind
[1]Lecturer, Sindh Development Studies Centre, University of Sindh, Jamshoro
[2]Professor, Sindh Development Studies Centre, University of Sindh, Jamshoro
[3]Assistant Professor, Department of Economics, University of Sindh, Jamshoro
[4]Assistant Professor, Sindh Development Studies Centre, University of Sindh, Jamshoro

ABSTRACT
This study aims at envisages the effect of environmental changes on agricultural production. Sindh province is richest in terms of agriculture crop but due to environmental factor includes climatically changes, disaster, global warming we have to face many challenges. According to the reports About 4.5 billion years of world's creation is effected due to environment. Pakistan is placed 28th amongst severely affected amongst other countries due to change in climate. production of crop is directly linked with climate. In order to analyze the impact of environment on agricultural sector we have to collect data from Badin District and sample of 110 respondents have selected for data collection by close ended questionnaire. It has concluded that due to environmental factor which may adversely effect on our cash crop like (cotton, wheat, Rice, Sugarcane). This table shows effect of climate on different crop About 48% respondent reported that of their cotton crop are damage hue to 52% reported that get low productivity due to flood. And 64.9 and 83.3% of respondent reported that wheat and crop are partially damaged. About 454.8% of respondent reported that sugarcanes crop are partially damage and 54.6 % of respondent reported that they get low productivity.
Keywords: WMO, Environmental Changes, Agricultural Crop

INTRODUCTION

Climate refers to ordinary weather or temperature of any region or area over a given period of time. Climate include the sun, atmosphere, oceans, water system and topography. Climate change refers to the fluctuation in the whole eco system at global level over time. He further elaborates that changes in atmosphere has been taken places over time from centuries [1, 9, 15].

According to World Meteorological Organisation (WMO), Climate is traditionally defined as the variation occurs in atmospheric parameters such as temperature, precipitation and wind. Climate can be viewed as a situation of weather or seasonal cycle, probability of extremes such as severe frost and storms, etc.

Asif [1] defined that Climate change may refer to a change in average weather conditions, or long term variation in weather which disaster and shortage of water and may directly effect on crops yield.

Climate change has adverse effect on socio-economic condition of people specially who live in rural area and totally depended on agriculture

Adejuwon, S.A. [2] further elaborated that Climate change is happening due to human actions that change the ecosystem at global level. About 4.5 billion years of world's population is effected due to environmental variation. It is recorded that in terms of highly effected Pakistan is placed 28th affected amongst other countries due to change in climate. production of crop is directly linked with climate. For better production and rapid economic growth suitable climate is necessary are interrelated.

Climate change is defined by the IPCC [9], that variation in climate due to act of human activities and due to the Industrial Revolution, installation of power house plant from fossil fuel from deforestation activities have been enhancing global warming. The rise in temperature is main factor which may change in rainfall pattern, rise in sea level, and frequency occurrence of cyclones and droughts in most of region. The sum of all these changes is referred to as climate change.It is also observed by different authors that large numbers of residents live in low coastal areas or river deltas where sea level rise and flooding are the likeliest devastating consequences of rises in global temperatures as the climate shifts [2, 4, 11, 14].

Himalayan glaciers have been disappearing at a faster rate would increase level of water and will bring uncontrolled heavy floods which may cause household damages, loss of human life, livestock, crops and infrastructural facilities in Pakistan and other south Asian countries. Variation in climate not only impact in agricultural sector but all sectors of the economy will be affected it include health, forests, energy, coastal area, biodiversity and ecology all over the globe.

FACTORS OF CLIMATE CHANGE
Variations in Temperature
In the 19th century Climate scientific discipline made wonderful changes in theoretical and practical fields which an increase in instrumental meteorological monitoring. Meteorological records analysed that frequently increase in temperature on earth started from World War-I. In 1940s after a Second World War and industrialization and Green Revolution indicating rapid rising in global temperature which may rising cost of environment at national level.
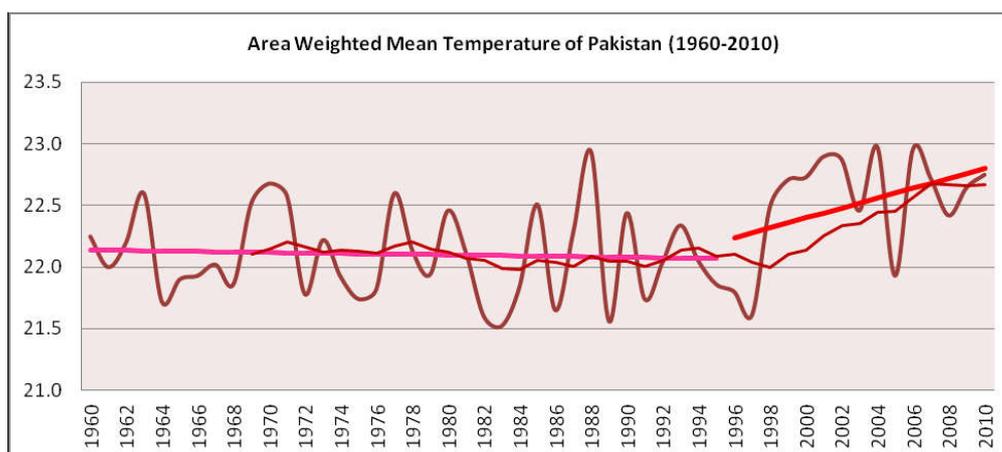

Fig. 1: Time series of area weighted mean daily temperatures averaged over each year shows a sharp rise in
Temperature during the first decade of 21st century except the year 2005.

This table analyse that since 1960 upto 1997, there was frequent variation in variability of mean daily temperatures. Due to a loss of vegetation, and cropping area, deforestation which may continue intensity of heat waves and heat continued to persist irregular rain cycles.

Precipitation
Whatever water dropped into clouds is form of precipitation. It is actually form H_2O or solid are named as "precipitation. Due to lower temperatures vapours combine to make droplets or ice crystals heavier in clouds which finally drop in the form of precipitation when gravity overcomes buoyancy. Precipitation happen as rain or hail at low elevation plains whereas in the form of snow at high elevations especially in winter when surface temperatures in mountainous are well below freezing point of water i.e. 0^0C.
This chart represented record of changes of precipitation during the half century in Pakistan from 1960 to 2010.
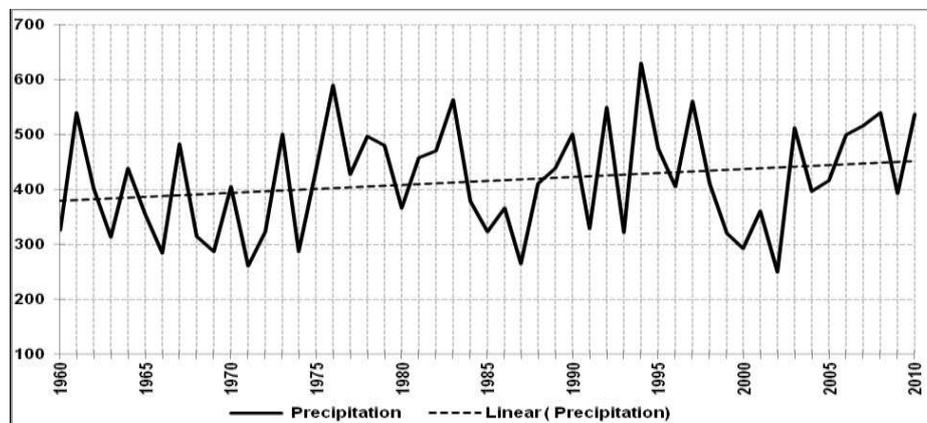

Fig 2: Time series of precipitation over Pakistan based upon data records of 56 meteorological observatories located in all the climatic zones of the country.

MELTING GLACIERS

Global warming is major factor to melt glaciers which may flows into the sea and rising their level. Thermal expansion of water and melting snow and ice of mountain glaciers are increasing water flow into sea due to warm temperature of environment. Frequent decline in the mass balance of all glaciers can be seen since 1990s.

Global Emission Projections

There are four gases emitted from different sources by human activities which are harmful environment and may called Green House Gases (GHGs) i.e. Carbon Dioxide (CO_2), Methane (CH_4), Nitous Oxide (N_2O) and Sulpher Dioxide (SO_2). It has been recorded that about 8 gigaton carbon is being released from different sources including industrial agricultural sector, forest, automobiles which may affect whole atmosphere. Nitrous Oxide is considered a harmful gas of greenhouse gasses with high warming heat and air and it is emitted from industry, fertilizers and polluted stagnant water. Methane released in high quantity from paddy fields of rice cultivation usually done by irrigation. China, Bangladesh and Philippines are recorded main emitter of methane due to major production of rice. Other sources include animal waste and flood. Presently it has recorded that methane released to atmosphere is 590 terragrams which is expected to be increase twice by the end of 21st century.

Sulphur Dioxide is extremely dangerous gas for human creature and it makes sulphuric acid when it mix-up with moisture in atmosphere. Water of rain is full of acid which may harmful for crops, fruit and vegetables human being and animals and may cause the Liver cancers. This gas is mostly release from chemical industry in liquid and gaseous forms. Below table shows warming potential of major GHGs.

According to Task Force on Climate Change [19].The phenomenon of Greenhouse Gases (GHG) has been going on ever since the universe came into being. Due to industrial revolution which released different harmful gases which may destroy ozone layer and may increase heat temperature at atmosphere.

EFFECT OF CLIMATE

Effect of climatically changes may differ from area to area and depend upon country's economy especially the agrarian countries highly effected due to variation in nature and climate. Due to rising temperature, and extreme climatically changes events may affect the productivity of agricultural crop, income, health, of society. The magnitude of future changes in climate forecasted by most global climate models would cause a major impact on food supply, health and ecosystem .Previous record and forecasted by GCMs and RCMs describe that extreme events (drought and flooding) would become more frequent with high magnitude in different parts of the country and that would destroy whole economy and livelihood of poor people. In other words, Apata [3] describe impact of climate change in low income countries. He explained that low income countries are fully dependent on agriculture productivity and variation of Climate change effect the whole economy of country.

Kumar and Parikh [10] estimated in India net revenue reduce by 8.4 percent due to rise in temperature by 2 percent and due to increase in mean precipitation by 7percent. Due to change in climate. Due to increase in temperature by 1°C productivity of wheat crop are decline by 6–9 percent in semi-arid, and arid area.

In the same way, [8] recorded that due to 0.3°C rise in temperature could have a severe impact on important cash crops like cotton, mango, and sugarcane [12].

Table 1. Comparison of Different Countries on the Basis of Their Per Capita Energy Consumption, Per Capita CO_2 Emission from Fuel Combustion and Ratio of CO_2 Emission from Fuel Combustion to Energy Consumption (2004)

Country/Region	Per Capita Energy Consumption (toe/capita)	Per Capita CO_2 Emission (tCO_2/capita)	CO_2 Emission Per Unit Energy Consumption (tCO_2/toe)
World	1.77	4.18	2.37
South Asia	7.91	19.73	2.49
OECD	4.73	11.09	2.34
China	1.25	3.66	2.93
India	0.53	1.02	2.40
Pakistan	0.49	0.76	1.56
Bangladesh	0.16	0.24	1.47

Source: Final Report, Task Force on Climate Change, 2010.

This table shows amount of greenhouse gasses emitted from different sources in different countries. The results showed that in 2008 about 54 percent of C02, 36 percent methane, 9 percent nitrous oxide and one percent other gases emitted. [19]
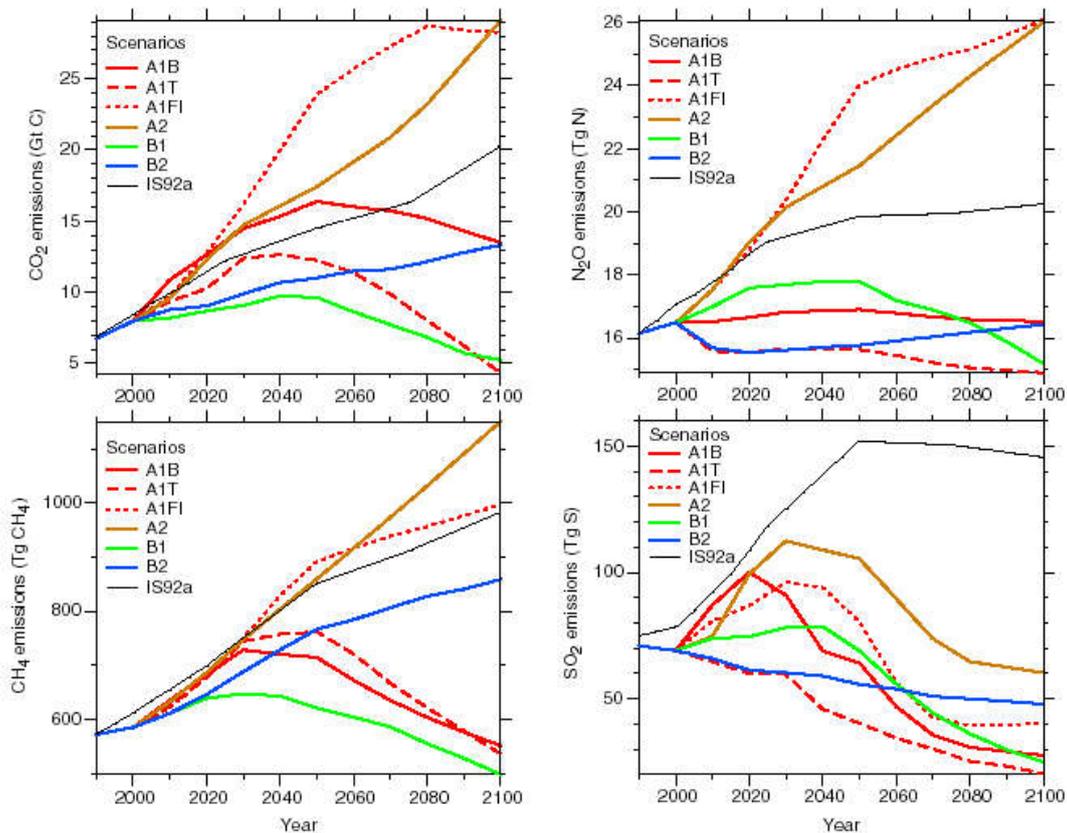

Fig 3: Global emission projections of Carbon Dioxide (CO_2), Methane (CH_4), Nitous Oxide (N_2O) and Sulpher Dioxide(SO_2) under different scenarios during 21st century.

Effect of climate change in Pakistan

Pakistan has been facing many challenges due to climate change and it has predicted due to increasing temperature which may cause global destruction. Pakistan is placed 28th amongst severely affected countries from climate change.

Whole land is separated into two region arid and semi-arid zone. About 60 percent of the area has less than 250 mm rainfall annually and 24 percent receives 250-500 mm. Hindu Kush Karakoram-Himalayan glaciers are recorded to be melted at faster rate due to high temperature. Pakistan's economic performance and growth depends on the agriculture production due to fluctuation in the climate changes may bring extreme destruction in overall agriculture production.

It has predict by researcher that at the end of this century, reduction in rise crop by 5-20% reduction and 90% in Punjab due to climate change and recorded that twice of the impact on wheat crop [8].

Sindh and Balochistan provinces comprise arid climate zoneand agriculture is not possible without irrigation system and tube wells. Source: [4, 5, 20, 21].

Siddiqui *et al*. [18] found that Major crops of Pakistan like(cotton, wheat, rice) are highly affected due to changing climate. Rice crop needs high temperature at initial level after sowing when crop grow high may cause destruction of production

Another major cause are natural disaster which may destroy the crop of production and also may affect the whole economy. South Asia is known to be the most disaster prone region in the world [21].

The damage caused by disasters are different which may depend on geographical location, climate severity of country. Disasters have been classified into two categories - natural disasters and man-made disasters. Cyclones, tsunami, floods, droughts, earthquakes and volcanoes are examples of natural disasters; and wars and nuclear accidents are considered man-made disasters. Source : [11]

Pakistan have faced socio-economic crises caused by flash flooding during the heavy monsoon rains in 2010. Many districts of Sindh were hit and destroy due to flood it has been observed that most of the infrastructure have damaged and thousands of people were displaced. Many of them took shelter in

Government buildings such as schools and public parks. Consequently the economy of the Province has had greatly been destroy. [6]**.**

Drainage capacity of the infrastructure may increase due to heavy rain such as the LBOD. It has been estimated that about 8.9 million populations were affected, homes were destroyed and over a million acres of crops and agricultural lands were damaged during the heavy rain in 2011, The flood occurs. In 2010 which may considered largest flood in living memory about7.8 million people were losses their lives by the largest floods, many people of whom were still not recover from the damages of flood.

PDMA conducted a survey to determine the damages of houses in coordination with respective District Governments, which recorded that 679,539 damaged houses, of which around 428,168 are completely damaged.

Historical Record of Damaged Caused by Disaster

Disaster	Year	death	Houses damaged	Land degraded	Livestock	Displaced people
Cyclone	1964-65	90	1650	20000	80000	170000
Heavy rainfall	1973	20	1400	30000	40000	250000
Flood	1976	40	2000	30000	98000	210000
Flood	1988	15	1000	10000	20000	160000
Heavy rainfall	1994	20	1200	15000	60000	225000
Cyclone	1999	176	56678	263055	17289	452000
Earth quake	2001	05	800	28000	5000	171000
Flood	2003	115	22567	80037	85000	560000
Flood	2006	02	500	5000	3500	45000
Cyclone	2007	-	1500	-	-	25000

Source: (Monsoon 2011.pakmet.com.pk retrieved on September 2011).

This table shows historical record of damages caused by different disaster .Badin district is disaster prone in terms of cyclones, coastal floods, heavy rainfalls, sea intrusion and hydrological as well as metrological droughts. The 215,080 acres of land is affected while 370,000 individuals are living in danger zone where as 294 Dehs are directly affected by all prevailing disasters.

Objectives of the Study Area

- To examine the situation of climate in the study area
- To analyse the effect of climate on agricultural production in study area.

HYPOTHESIS

- Due to disaster and shortage of water agriculture productivity are most affected in the study area.

RESULTS AND DISCUSSIONS

Table .1 Percentage Distribution of Cultivated Crop according to Acres n=110

Crop area	Frequency	Percent
1-30 acres	45	40.9
31-60 acres	32	29.0
61-90 acres	25	22.7
91-120 acres	8	7.2
Total	110	100.0

This table shows the area and crop sowing percentage in which 40.9% are 1 to 30 acres and 31 to 60 are 29.0 and 61 to 90 22.7%.

Table 2.Distribution of major crops cultivated in Study Area

Main crops sown	Frequency	Percent
Sugarcane	41	37.2
Wheat	29	26.3
Cotton	32	29.0
Rice	8	7.2
Total	110	100.0

This table explain the crop which are sown 37.2% are sugarcane 26.3% are wheat 269.0% are cotton while 7.2 % are rice.

Table.4- Crops Damage by flood

Area of the crop damage by rain fall	Frequency	Percent
1-15acres	17	15.4
16-30 acres	33	30
31-60 acres	48	43.6
61-90 acres	12	10.9
Total	110	100.0

This table shows the area of damage due to rain fall about 43.6% respondent reported that their crop damage which comprises at31 to 60 acres of land and 33% reported that their land comprises 5 to 10 acre of land were damage during occurrence of flood.

Table:5- Effect of climate on different crop in Study area n=110

Most Effected crop				Effect ofClimate			
				Crop Damage	Partially Damage	Low Productivity	Total
Cotton	Factor climate	Flood	Count	12	0	13	25
			%	48.0	0.0	52.0	100.0
		shortage of rain	Count	0	12	0	12
			%	0.0	100.0	0.0	100.0
	Total		Count	12	12	13	37
			%	32.4	32.4	35.1	100.0
Wheat	Factor climate	Flood	Count	13	24	-	37
			%	35.1	64.9	-	100.0
	Total		Count	13	24	-	37
			%	35.1	64.9	-	100.0
Rice	Factor climate	shortage of rain	Count	-	10	2	12
			%	-	83.3	16.6	100.0
	Total		Count	-	10	2	12
			%	-	83.3	16.6	100.0
sugarcane	Factor climate	Wind storm	Count	-	-	-	
			%	-	100.0	-	100.0
		high temperature	Count	-	11	13	24
			%	-	45.8	54.8	100.0
	Total		Count	-	11	13	24
			%	-	45.8	54.8	100.0

This table shows effect of climate on different crop About 48% respondent reported that of their cotton crop are damage hue to 52% reported that get low productivity due to flood. And 64.9 and 83.3% of respondent reported that wheat and crop are partially damaged About 454.8% of respondent reported that sugarcanes crop are partially damage and 54.6 % of respondent reported that they get low productivity

Chi-Square Tests				
Most Effected crop		Value	df	Asymp. Sig. (2-sided)
Total	Pearson Chi-Square	44.946[a]	6	.000
	Likelihood Ratio	59.048	6	.000
	Linear-by-Linear Association	2.167	1	.141
	N of Valid Cases	110		
a. 5 cells (41.7%) have expected count less than 5. The minimum expected count is 1.30.				

The results show there is relationship between effect of crop due to climate change. Because of significant value is 0.00 which is less than 0.5 with the degree of freedom 8, which shows hypothesis is accepted.

Trends of temperature with Crop Production in Badin District

Year	Temperature	Annual production
2000	32	32000
2001	35	35000
2002	35	36000
2003	30	32000
2004	32	38000
2005	30	38000
2006	38	30000
2007	32	35000
2008	39	23000
2009	39	22000
2010	42	18000
2011	45	12000
2012	40	15000
2013	43	15000
2014	45	13000

Source: District Disaster Management Authority [6]

Relationship between temperature and production

Regression Statistics	
Multiple R	0.924370307
R Square	0.854460465
Adjusted R Square	0.843265116
Standard Error	2.083461047
Observations	15

The value of R-Square is 0.92, this indicate that 92% variations in dependent variable is explained by this model. Results shows smaller difference between R-Square and Adjusted R-Square (i.e. only 1) that is good sign. Small value of standard error indicates no any indication of numerical problem in this analysis.

ANOVA

	df	SS	MS	F	Significance F
Regression	1	331.3028042	331.3028	76.32281	8.42E-07
Residual	13	56.43052916	4.34081		
Total	14	387.7333333			

	Coefficients	Standard Error	t Stat	P-value
Intercept	50.22856857	1.592553909	31.53963	1.14E-13
X Variable 1	-0.00049855	5.70665E-05	-8.73629	8.42E-07

The results show there is 8.4 significant value which shows negative relation between dependent and independent variable with increasing temperature in every year which leads to reduction in crop production

CONCLUSION AND RECOMMENDATION

As we know all over the world global warming is major issues know a day. It has been concluded from the results that Climate change has adverse effect on agriculture productivity which may adversely affect socio-economic condition of people specially who live in rural area who totally depended on agriculture it has been recorded that Pakistan is ranked 28th amongst severely affected countries from climate change. Climate change and crop production are directly linked with climate. For better production and rapid economic growth suitable climate is necessary are interrelated. In this regard have identified three main factors of climatically change i.e. climate change, shortage of water and disaster. We have assessed the impacts of climate change in our agriculture crops. We have examined that how the rising temperature effect on agricultural production. Climatically changes do not remain same pattern but these changes vary time to time. Due to the Industrial Revolution, installation of power generation plant from fossil fuel

power generation from fossil fuels deforestation activities have been continuously increasing global warming. The rise in temperature is main factor which may change in rainfall pattern, rise in sea level, and frequency occurrence of cyclones and droughts in most of region. Due to global warming glaciers has been melting which may increase the se level. it has concluded from survey that due to rain fall about 43.6% respondent reported that crop damage which comprises as 31 to 60 acres of land and 33% reported that 5 to 10 acre of land crop damage of land most of the crop were damage during flood situation. The government should have prepared advance polices against policies control on effects of climatically changes in agriculture crop.The institutional capacity of different countries of government should be reinforces to implement measures side by side with the communities. And government and private organization must provide local knowledge regarding how to manage or control risk during disaster.

REFERENCES

1. Asif, M(2013), " Climatic Change, Irrigation Water Crisis and Food Security in Pakistan" Master thesis in Sustainable Development at Uppsala University, No. 170, 39 pp, pp, 30 ECTS/hp
2. Adejuwon, S.A(2004)' " Impacts of climate variability and climate change on crop yield in Nigeria" Paper presented at Stakeholders' workshop on assessment of impacts
3. Apata, T.G(2010), " Effects of global climate change on Nigerian Agriculture : An empirical analysis. CBN J. Appl. Statistics
4. Chaudhry, Q. Z(2001), "History's Worst Drought Hit Pakistan" Farming Outlook. Soil, Agriculture, Fertilizer and Environment (SAFE) Foundation, Pakistan
5. Ghulam Rasul (2010), "Building Capacity on Climate Change Adaptation in Coastal Areas of Pakistan (CCAP)"An European Union funded WWF Pakistan project
6. Disaster Risk Management book 2011
7. Fischer, G at el (2002), " Climate Change and Agricultural Vulnerability" Special Report to the UN World Summit on Sustainable Development, Johannesburg 2002. Laxenburg, Austria: IIASA.
8. Iqbal at el (2009), " Climate-change aspersions on food security of Pakistan" Science Vision, 15(1): 15-23
9. IPCC(2007), "Climate Change 2007 "Impacts, adaptation and vulnerability"Contribution of Working Group II to the Fourth Assessment Report of IPCC. Cambridge. UK. Cambridge University Press.
10. Kumar, K. and J. Parikh (2001), "Socio-economic Impacts of Climate Change on Indian Agriculture" International Review of Environmental Strategies 2:2, 277–293.
11. Kelkar U, Bhadwal S (2007), "South Asian regional study on climate change impacts and adaptation: implications for human development. Human Development Report" Office, Occasional Paper. United Nations Development Programme.
12. MoE (Ministry of Environment (2003), "Pakistan's initial national communication on climate change. Islamabad"MoE, Government of Islamic Republic of Pakistan. http://unfccc.int/
13. Maddison, D. (2000), "A Hedonic Analysis of Agricultural Land Prices in England and Wales"European Review of Agricultural Economics 27:4, 519–532.
14. Maddison, D (2001), "The Amenity Value of The Global Climate"London: Biddles Ltd.
15. Mendelsohn, R(2007), " Past climate change impacts on agriculture. Chapter 60, Handbook of Agricultural Economics" In: Evens on R. and P. Pingali (eds.) North Holland: Elsevier. 3: 3009-3031
16. Rasul, Chaudhary *et al* (2004), Technical Report No. PMD-25/2012).
17. Rosenzweig e*t al* (1995), "Climate change and agriculture: analysis of potential international   impacts" ASA Special Publication No. 59. Madison, WI: ASA, CSSA and SSSA.
18. Siddiqui, R., G *at el* (2012), "The Impact of Climate Change on Major Agricultural Crops: Evidence from Punjab, Pakistan" The Pakistan Develop. Rev. 51(4): 261-276
19. Task Force on Climate Change (2010) Final Report. Islamabad: Planning Commission of Pakistan.
20. Tubiello, F. N (2005), " Climate variability and agriculture: perspectives on current and future challenges. In Impact of climate change, variability and weather fluctuations on crops and their produce markets" (ed. B. Knight), Impact Reports, Cambridge, UK.
21. UNEP(2003), United Nations Environment Programme.