



# University of Agriculture, Faisalabad

Directorate of Financial Assistance & University Advancement.

Ref. No. 2982  
Dated: 09-04-2014

## NOTIFICATION

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Sr. No.	Name of Student	Discipline
1	Umar Nawaz 2011-ag-3520	B. Sc. (Hons.) Agri. Science 6 <sup>th</sup> Semester Agronomy

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Muhammad Zaheer  
Research Officer

**Title:**

**CLIMATE CHANGE AND WATER REQUIREMENTS IN AGRICULTURE SECTOR OF PAKISTAN,  
PROBLEMS AND ITS REMIDIES**

**Submitted by:**

**Name                   UMAR NAWAZ**

**Regd. # 2011-ag-3520**

**Degree B.Sc. (Hons) Agri. Sciences (Agronomy 5<sup>th</sup>)**

**E-mail [umar.nawaz92@gmail.com](mailto:umar.nawaz92@gmail.com)**

## **Introduction:**

Weather is defined as the 'state of the atmosphere at a given time and place, with respect to variables, such as temperature, moisture, wind velocity and barometric pressure. It is a short-term state, for a day or a week. Climate is the 'average weather' or statistical description of mean weather-conditions over a period of time, ranging from months to thousands or millions of years, typically 2 to 3 decades. The classical period is 30 years, as defined by the World Meteorological Organization (WMO).

Climate changes have caused direct effects on water scarcity throughout the world. Water scarcity includes both available amount and quality of water along with sanitation. Human security is on risk due to water scarcity and climate changes (UNFCCC). As being a developing country and facing a rapid increase in population we have this problem more severe than other developed countries. Earth's biodiversity is on a threat due to climate change. Valuations and studies predict that living conditions are destabilized due these changes. (Scheffram & Battaglini, 2010). Human induced climatic changes are severe reasons against water stress, food insecurity, soil degradation, natural disasters, and environmental exodus (Bosshard, 2006). A broad unanimity among scientists resulted that physical shortage of H<sub>2</sub>O is created due to climate changes and may result regional and international clashes (Mukheibir, 2010).

Water scarcity when explained by hydrologists, is judged by water-population equation (Mukheibir, 2010). Water stress index explains that country should not fall below 1000 m<sup>3</sup> of water/person annually. If falls below this limit will be considered as water scarce country; and below 500 m<sup>3</sup>, absolute scarcity of water is produced in that area (Falkenmark, Lundquist, & Widstrand, 1989). Currently, 1.2 billion people can't access to pure drinking water and in future this figure will reach up to 2.7 to 3.5 billion people by 2015 if proper recommendations not adapted to assuage H<sub>2</sub>O scarcity (Mukheibir, 2010). Middle East would be facing severe scarcity as it is to run out of water (Qadir *et al.*, 2003).

## **Climate Change and Pakistan:**

Tremendous environmental, social and economic impacts are affecting Pakistan due to climate change. Most common impacts are loss in biodiversity, sea level rise, weather pattern shifts, problems in fresh water availability, extreme weather induced events like floods. Human health is affected by climate change both directly and indirectly as well. Relatively, Pakistan's contribution to Climate change is little. Regarding per capita greenhouse gasses discharge, ranks 135<sup>th</sup> amongst the world. Figures issued by international Panel on Climate change 0.6-1.0°C rise in average temperature since 1900s in coastal land of Pakistan and a 10-15% precipitation decrease in coastal belt (IPCC, 2007). Studies based on climatic changes in Pakistan showed that Pakistan is on 12<sup>th</sup> number, when rated according to climate changes (Maplecroft, 2007). Economic losses are 5% to that of GDP, when counted annually and this damage could rise up to 20% in coming years. Pakistan's natural environment is under severe pressure and climate changes are to make the trend worst. Water shortage and unexpected decline in its availability is affecting food chain sustainability and food production.

## **Anthropologically Induced Climate Changes:**

Anthropologically induced climate changes are creating a serious imbalance in demand and supply of water in Pakistan. In Pakistan, most of the renewable resources are extensively used for irrigation purposes that are ecologically a threat for ecological sustainability (Khan and Hanjra, 2009). Major crop producing regions are semi-arid and water is exploited greatly in these regions. Meeting all these demands needs of these areas demands sophisticated machinery to extract groundwater and proper transportation of water (Schewatz & Ibaraki, 2001). Depletion rate of groundwater is higher than its replacement which is a major warning in groundwater consumption (Butler, 2009).

Major effects of climate change include, chronic and periodic shortfalls; particularly in arid & semi-arid regions (Mujumdar, 2008), global warming and scarcity of water specifically in semi-arid regions (Kanae, 2009), induced change in natural water availability from glaciers and snow-covers (Kanae, 2009), low water flow along with increasing temperature which is not only resulting waters shortage but also polluting water with slats, sediments, pathogens, nutrients and pesticides (Peterson & Ponser, 2010), Raised sea level leading saline water interruption in groundwater, reducing fresh water availability (Werner & Simmons, 2009), decrease precipitation level and causing higher demand for irrigation water including domestic and industrial water use (IPCC, 2001), Increased water temperature and alteration in operation rate of biochemical processes (IPCC, 2001). Studies predict that domestic scarcity of water is causing various health problems and diseases (Motoshita, Itsubo, & Inaba 2011). Scarce access to pure drinking water is associated with various non-diarrheal and non-infectious diseases too (Hunter, MacDownald, and Carte 2010).

### **Water Related Disaster Effects and Climate Changes:**

Among Pakistani community 40% people are highly vulnerable to disasters like floods, cyclones, intense rainfall and drought (Oxfam, 2009). All of these factors have affected the ecological and social balance of society as heavy rains during 1928, 1929, 1957, 1973, 1979 and 1996 and cyclones in areas of coastal region, droughts hitting the county between 1998-2001, all these are changing the fate of country regarding climatic changes (Oxfam, 2009). Archaeologically, most substantial snowfall, recorded during 2005. This year was also the warmest year recorded and in 2010 record floods and heftiest rainfalls with record temperature caused huge disaster in country.

Melting and bursting of glacial dams cause solemn risks to Pakistan due to temperature and climate change. Obstruction of Hunza River, buried village of Attabad and fetching of 7-miles (11 KM) long lake, flooding several villages and immersing 3 miles (5 KM) of Karakoram Highway, all which occurred due to a land sliding in Hunza Valley on January 4, 2010. Not only had this it flooded homes along with 2500 people. The Indus Delta is also wide-open to tempest flow flooding and strong rainfall (Rasul et al., 2005) related with the Humid Dejections and Humid Tornados progressively emerging now above the warmer water of Arabian Sea.

### **Water Division and Glaciers Melting:**

GCISC published that Western Himalayan glaciers will departure for the next future 50 years. Water security is facing following threats due to climate change:

1. Water flow due to uneven monsoon along with winter rains, is becoming risky. We are also losing our natural reservoirs like glaciers due to this affect;
2. Extreme floods and droughts occurring in an uneven pattern;
3. Seasonal pattern of rivers changed by the glacier melting specifically at elevated temperatures, shrinking the glacier volumes and causing less availability of water for Kharif and Rabi crops;
4. Enlarged and dangerous climate change and deprivation of water quality; and

This water shortfall is going to be up to 12% in coming years in Pakistan (GoP-PC, 2007). Pakistan is already listed on 17<sup>th</sup> number among those countries facing water shortage (WB, 2006), and rated on 36<sup>th</sup> number among countries facing flood threats and water crisis (WB, 2006). Country is expected to face more scarceness of water as it is greater due to dense sedimentation load (GCISC, 2009).

Pakistan has the 3<sup>rd</sup> largest ice mass of earth, melting rate of which is much higher than other glaciers in the world. If this melting continued with same ration, it might disappear in 2035 (Rees & Collins 2004, WWF, 2005; IPCC, 2009), and flooding rate will increase after with decreased river flow (IPCC, 2007).

## Agricultural Impacts of Climate Change and water shortage

Pakistan is highly susceptible to climate change. Having 65% of the population in rural sector; Pakistan is an agricultural country and any disaster to this sector affects population, agricultural productivity, bio-physical relationship, crop growth period along with many problems to agriculture (TFCC, PC, 2010). Reduction in crop productivity can occur due to climate change which may be able to affect the food security. It's expected by the researchers that in 2020s to 2080s, seasonal growing length of wheat will decrease by 9 to 23 days under B2 Scenario and 8 to 29 days by A2 scenario regarding climate change (GCISE, 2009). Length of growth period is shortening by this effect and crop yield is also reduced (Fischer *et al.*, 2002). Throughout the South Asian countries, 4-10% decline in expected till the end of this century; because of the most conservative climate-change scenario (Alam *et al.*, 2007). 80% of water in Pakistani Rivers comes from HKH glaciers (WAPDA-IDRC-WLU, 1990). Evapotranspiration is also increased. Land is being degraded day by day. 2 mha (0.8 mha in Punjab, 1.1 mha in Sindh) of the land in country is being affected by water logging (GoP, 2007). Salt affected area in country is 6.67 mha, 80% is in Punjab (Khan, 1998; GoP, 2007).

Reservoirs in Pakistan are lacking water shortage capacity which is decreased to 14.28 MAF from 17.372 MAF (18% decrease in capacity), due to siltation (WAPDA figures, 2004; Pervaiz, 2005). It is claimed that capacity is decreased to 33% at present.

Reservoir	Gross Capacity (MAF)	Live Capacity (MAF)	Loss of Live Capacity (MAF)	% loss in Capacity
Tarbela	11.62	9.68	2.01	18
Mangla	5.88	5.341	0.814	14
Chashma	0.87	0.717	0.28	32

Fig. Decrease in Dam Capacity

Source: WAPDA 2004 and (Pervaiz, 2005)

Arid and semi-arid climate is extremely variable in temperature. The watershed of Indus and its tributaries undergo disapproving moisture and soil command. Some of the areas have 0.5 to 4m high moving sand-dunes, posing danger to cultivation and local infrastructure (GoP, 2009).

11% of the GDP is accounted from livestock sector and also contributes to the half of the total agricultural productivity. Climate change is affecting it by listed manners:

1. Reduction in milk and meat production due to less heat intake and because of heat stress on livestock.
2. Rangelands and forage productivity will be reduced due to heat stress.
3. Frequent drought and water shortage will affect the animal resources.
4. Macro-parasites and vector borne diseases of animals are increased by the increase in temperature.
5. Either direct or indirect, negative effects are expected on fisheries sector as change in temperature will disturb the distribution and shifting of fishes.

### Susceptibility of coastal zones and desertification of land:

Raised temperature of sea surface in Arabian Sea has imposed the coastal areas to cyclonic activity, ultimately making these areas subjected to climatic effects. Sea water is already 80km out of it's boundary near Hyderabad and Thatta. This effect is warning about deluge of costal agriculture. Not only is this about 43 M.hec of Pakistan's area subjected to desertification triggering salinity, logging, over-exploitation of groundwater and unrestrained pasture foraging etc. This is not the end to climatic affects, if continued with same ratio; we will be facing high desertification of land with extremely unpleasant temperature (GCISC, 2009). Erosion damages in Pakistan are due to water (17%), Wind (8%), water logging (5%) and salinity and sodicity (8%); (GCISC, 2009). The adverse and extent temperature increase in more likely to exacerbate these soil problems thereby production potential of the country could be reduces. Without varying fertilizer quantity and seed quality, Wheat production is

already reduced to 880-1,020kg from 1,200-1,400kg per hectare in recent five years (GCICS, 2007). Energy sector of country is expected to be effected by the climate change and it will affect other sectors too. Mainly because there will be less water in rivers, high temperature and high energy demand (NECP).

### **Agriculture and Climate Change:**

IPCC, the apex international body on climate variation research, based on its latest Valuation Report (AR4), published in November 2007, the upcoming meditation of CO<sub>2</sub> was intended. The concentration in the troposphere has augmented from the pre-industrial revolt value of 280 ppm in 1780 to 383 ppm in 2007, and is predictable to upsurge to 550 ppm by 2050 (Iqbal and Arshad, 2008). The global typical temperature has increased by 0.6°C during the last century and is likely to increase by 1.8 to 4°C, by the end of this century. The changes in rainfall are not uniform; in sub-humid and humid areas there will be increase in monsoon rainfall, whereas in the coastal and hyper-arid areas there will be decrease in winter and summer rainfalls (IPCC, 2007).

### **Food Productivity and Agri. Sector during 1990-2009:**

Since the contribution of agricultural sector is decreased, from 53% in 1949-50 to 21.8 % in 2008-09, and an increase is observed in industry, 17%, agriculture is still the major subdivision of countrywide economy (GoP, 2009). Our agriculture sector has passed numerous disruptions through the past 50 years. Population increased over four-fold during this duration, while productivity raised to 5.56 m tons in 2007-08 from 0.86 m tons in 1950-51 (GoP, 2009). Considering all factors in agricultural productivity, climate change is the major one which is affecting production by different ways.

### **JUSTIFYING THE CONDITION- WHAT'S ESSENTIAL TO BE DONE?**

Based on above discussion, we can say that food, H<sub>2</sub>O and energy are almost close to each other and the ultimate need of time to overcome all problems related to the climate change and water scarcity if we want to save our agricultural sector from disasters. The best, we can do is grouping of various essentials plus technical progression and societal concern to response this daunting challenge. Water is considered essential for existence of community and economy which is exclusively reliant on this infrequent natural reserve.

Firstly we need to rearrange our National Water policy which needs an intelligible institutional context and policy. It's a matter of thinking for us that we do not have proper any water policy even after sixty years of independence. We also need to develop an integrated water resource management (IWRM) approach, concerning Water Accord 1991, based upon both ground and surface water. Thirdly, it is important to appraisal the water reallocation at the regional level by agreeing water obtainability to harvesting arrangements. Finally, gratitude and distribution of ecological disturbances should be joined with reasonable and ecologically / communally / economically justifiable room, so that the living of the people laterally with the ecology supporting the livelihood can be saved. A careful analysis shows that 90%-95% of Pakistan's freshwater is used (misused) by the agrarian sector.

### **Conclusion:**

There's a huge difference between water availability and its demand. We need to utilize water very carefully to meet our needs and to save it for future generations. Regarding agriculture, we have to practice conservative agriculture and to help the farmers save water, Government should provide subsidy on agricultural machinery. Efficient use of water on both domestic and industrial level is needed. Water pollution and water polluting agents should be minimized. We have biggest canal system in the world which needs to be limed from sides to stop seepage of water to the sides of banks.

Regarding climate change we need to develop our industrial system such as, pollution less and environment friendly. Anthropological activities which are causing climate change and effects on crop should be cared. Groundwater extraction through good machinery can minimize groundwater problems. As climate change is causing our glaciers to melt that ultimately results huge disasters like land-sliding, floods and uneven water scarcity. We are losing 60% of our water including convince losses, application losses and transpiration losses. Efficient water application, recommended methods and sustaining the water sources can reduce these losses.

Use of house implements which emit harmful gasses should be minimized to limit the greenhouse phenomena. In this regard over-population is also a rising issue that is resulting a huge difference between food demand and availability. Making new buildings to store water is also required to save water from going directly to the Indus and using it for better crop production when we doesn't have water in rivers ore there's no rain or providing water to those areas where it's arid and crop water requirements are not fulfilled by other sources. At the end we need to practice real agriculture so to produce maximum production and saving our soil, surroundings and ecosystem.

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