CLIMATE CHANGE IMPACT ON AGRICULTURE AND CROP YIELDING

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Abstract: Natural systems, human health, and agricultural production have been badly affected by devastating environmental changes. With the rapid increase in the world's population, there is a corresponding increase in food demand owing to concerns about the stability of the global environment. Global climate change is a change in the long-term weather patterns that characterize the regions of the world. The term "weather" refers to the short-term (daily) changes in temperature, wind, and/or precipitation of a region (Merritts *et al.* 1998).

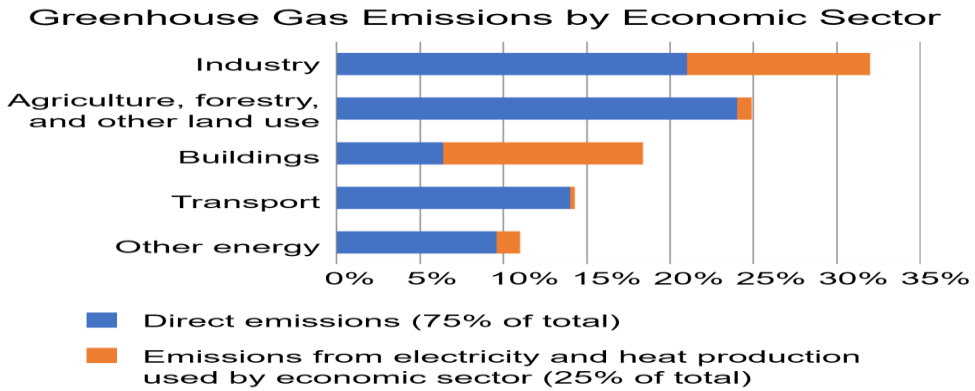
The consensus of the Intergovernmental Panel for Climate Change (IPCC) is that substantial climate change has already occurred since the 1950s, and that it's likely the global mean surface air temperature will increase by 0.4 to 2.6°C in the second half of this century (depending on future greenhouse gas emissions). Agriculture, and the wider food production system, is already a major source of greenhouse gas emissions.. It's estimated that the demand for livestock products will grow by +70% between 2005 and 2050.

The average global surface temperature have increased by 0.74^{o} C since the late 19th Century and is expected to increase by 1.4^{o} C - 5.8^{o} C by 2100 AD with significant regional variations (IPCC, 2007. The warming may be more pronounced in the northern parts of India. The extremes in maximum and minimum temperatures are expected to increase under changing climate , few places are expected to get more rain while some may remain dry. Leaving Punjab and Rajasthan in the North West and Tamil Nadu in the South, which show a slight decrease on an average a 20 per cent rise in all India summer monsoon rainfall over all states are expected. Number of rainy days may come down (e.g. MP) but the intensity is expected to rise at most of the parts of India (e.g. North East). Gross per capita water availability in India will decline from 1820 m3/ yr in 2001 to as low as 1140 m3/yr in 2050.

Keywords: Climate Change, Greenhouse Effect, Greenhouse Gases (GHGS), Inter Governmental Panel on Climate Change (IPCC), Parts Per Million(PPM).

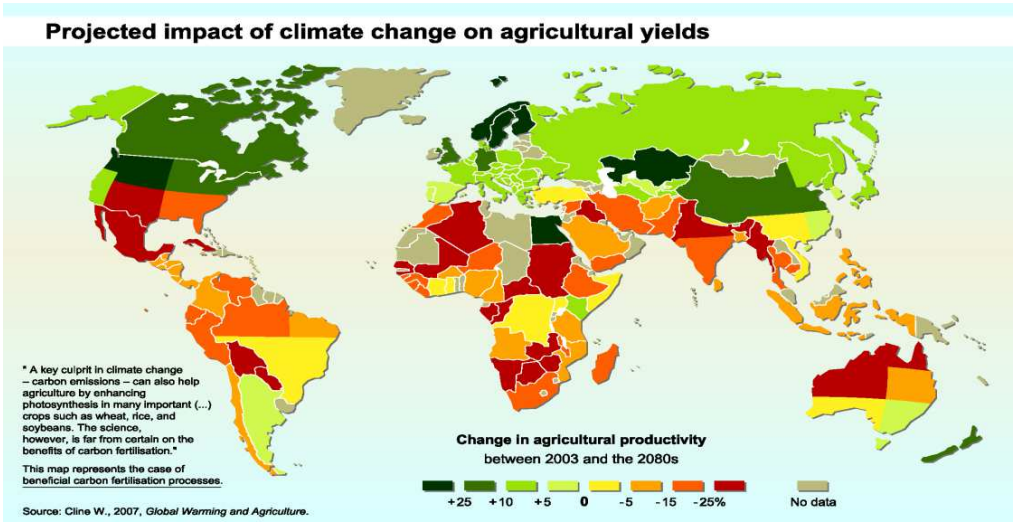
I. Introduction: Agriculture production is directly dependent on climate change and weather. Possible changes in temperature, precipitation and CO_2 concentration are expected to significantly impact crop growth. The overall impact of climate change on worldwide food production is considered to be low to moderate with successful adaptation and adequate irrigation. Global agricultural production could be increased due to the doubling of CO_2 fertilization effect. Agriculture will also be impacted due to climate changes imposed on water resources. India will also begin to experience more seasonal variation in temperature with more warming in the winters than summers]. India has experienced 23 large scale droughts starting from 1891 to 2009 and the frequency of droughts is increasing. Climate change is posing a great threat to agriculture and food security. Water is the most critical agricultural input in India, as 55% of the total cultivated areas do not have irrigation facilities. The agricultural sector represents 35% of India's Gross National Product (GNP) and as such plays a crucial role in the country's

development. Food grain production quadrupled during the post-independence era; this growth is projected to continue. The impact of climate change on agriculture could result in problems with food security and may threaten the livelihood activities upon which much of the population depends. Climate change can affect crop yields (both positively and negatively), as well as the types of crops that can be grown in certain areas, by impacting agricultural inputs such as water for irrigation, amounts of solar radiation that affect plant growth as well as the prevalence of pests. Global climate change has emerged as a major scientific and political issue in last two decades. There are sufficient evidences to show that the earth's temperature has risen by more than 0.5^{o} C since 1880 and continues to rise at faster rate (Martinez-Austria, 1994). The main reason for global warming is considered as increase in concentration of greenhouse gases in the atmosphere. Global warming due to greenhouse effect is expected to cause major changes in climate of some areas.



II. Impact of Climate Change on Soil Health under Rainfed Condition: The potential impacts on soil health resulting due to climate change would be in the organic matter supply temperature regimes, hydrology and salinity. The following are the major consequences of global climate change on soil health.

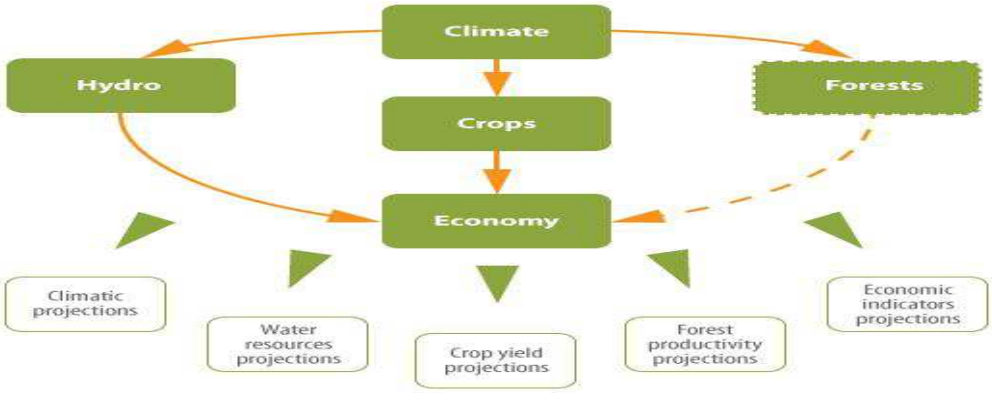
1. 1.Soil carbon levels are expected to decrease due to decreased net primary production Change in rainfall volume and frequency, and increasing events of intense wind may alter the severity, frequency and extent of soil erosion. Therefore, an increased risk of soil erosion and nutrient loss due to reduced vegetation cover in combination with torrential rainfall and greater wind intensities is expected.
2. Rise in seal level may lead to salt-water ingression in the coastal lands turning them less suitable for conventional agriculture. Transient salinity may increase as capillary rise dominates, bringing salts into the root zone in salt affected soils. Leaching during torrential rainfall events may be limited due to surface sealing.
3. Increased subsoil drying increase concentration of salts in the soil solution. Conversely the severity of saline scalds due to secondary salinisation may abate, as groundwater levels fall in line with reduced rainfall.
4. Soil biodiversity and its functions are expected to change under conditions of elevated $_{CO_2}$, and changed moisture and temperature regimes. As soil biodiversity regulates nutrient dynamics and many disease risks, nutrient availability



III. Indian Scenario of Climate Change: The warming may be more pronounced in the northern parts of India. The extremes in maximum and minimum temperatures are expected to increase under changing climate few places are expected to get more rain while some may remain dry. Leaving Punjab and Rajasthan in the North West and Tamil Nadu in the South, which show a slight decrease on an average a 20 per cent rise in all India summer monsoon rainfall over all states are expected. Number of rainy days may come down (e.g. MP) but the intensity is expected to rise at most of the parts of India (e.g. North East). Gross per capita water availability in India will decline from 1820 m3/ yr in 2001 to as low as 1140 m3/yr in 2050.

Agriculture in India continues to be vulnerable to the vagaries of weather, and the looming threat of climate change has the potential to expose this vulnerability further. Most of the studies are either cross-country studies, or focus on developed countries, primarily for data reasons, and therefore may not be applicable to a large, climatically diverse country such as India (Deschênes and Greenstone 2012, Dell *et al.* 2012, 2014, International Monetary Fund (IMF), 2017, Burke *et al.* 2015).There are a couple of important exceptions. Guiteras (2009) finds that crop yields will decline by 4.5-9% in the short-run (2010-2039) and by a whopping 25% in the long-run (2070-2099) in the absence of adaptation by farmers. Further, Burgess *et al.* (2014) find that a one standard deviation[1] increase in high temperature days in a year decreases agricultural yields and real wages by 12.6 % and 9.8%, respectively, and increases annual mortality among rural populations by 7.3 % in India. By contrast, in urban areas, they find virtually no evidence of an effect on incomes and a substantially smaller increase in the mortality rate.

IV. Impact of Climate Change on Crop Productivity in India: Rainfall in India has a direct relationship with the monsoons which originate from the Indian and Arabian Seas. A warmer climate will accelerate the hydrologic cycle, altering rainfall, magnitude and timing recharge. It would be worthwhile to give high priority to "more crops per drop" approach, rainwater harvesting, aquifer recharge, revival of water bodies and conservation technologies. In the last decade, the Central Government has tried to address the issue through several initiatives such as subsidies for micro-irrigation (which optimizes water usage for Agriculture), national watershed development project for rain fed areas and artificial recharge to ground water through dug wells in hard rock areas and rural water supply enhancement programmed through the catchment area approach.



V. Climate Change Impact Probabilities: There is probability of 10-40% loss in crop production in India with the expected temperature increase by 2080-2100. Rice yields in northern India during last three decades are showing a decreasing trend (Aggarwal et al., 2000). Further, the IPCC (2007) report also projected that cereal yields in seasonally dry and tropical regions like India are likely to decrease for even small local temperature increases. wheat production will be reduced by 4-5 million tones with the rise of every 1degree C temperature throughout the growing period that coincides in India with 2020-30. However, grain yield of rice declined by 10% for each 1ºC increase in growing season. A 1ºC increase in temperature may reduce rapeseed mustard yield by 3-7%. Thus a productivity of 2050-2562 kg/ha for rapeseed mustard would have to be achieved by 2030 under the changing scenario of climate, decreasing and degrading land and water resources, costly inputs, government priority of food crops and other policy imperatives from the present level of nearly 1200 kg/ha. In future, plant protection will assume even more significance given the daunting task before us to feed the growing population Every year, about USD 8.5 billion worth of crops are lost in India because of disease and insects pests and another 2.5 billion worth of food grains in storages. In the scenario of climate change, experts believe that these losses could rise as high as four folds. Global warming and climate change would lead to emergence of more aggressive pests and diseases which can cause epidemics resulting in heavy losses. The range of many insects will change or expand and new combinations of diseases and pests may emerge. The effect of climate on pests may add to the effect of other factors such as over use of pesticides and the loss of biodiversity, which already contribute to plant pests and disease outbreaks. Adjustments will be necessary in order to counter balance any negative impacts of climate change.

It has been estimated by National Research Centre for Weed Science, Jabalpur that the potential losses due to weeds in different field crops would be around 180 million tonnes valued Rs 1,05,000 crores annually. In addition to the direct effect on crop yield, weeds result in considerable reduction in the efficiency of inputs used and food quality. Studies suggest that proper weed management techniques if adopted can result in an additional production of 103 million tonnes of food grains,15million tones of pulses,10 million tonnes of oilseeds, and 52 million tonnes of commercial crops per annum, which in few cases are even equivalent to the existing annual production. There is tremendous scope to increase agricultural productivity by adopting improved weed management technologies that have been developed in the country. Substantial quantities of food stuffs, be it food grains, pulses, fruits or vegetables are lost every year due to poor post harvest handling, transportation and storage. The losses are maximum in fruits (25-45%), followed by vegetables (20-25%), and food grains (10%). According to an estimates, Rs. 58000 crores worth of agricultural food items of which Rs 10000crores worth of food grains get wasted every year.

VI. Conclusions: India's population was 36.11crores, which has grown rapidly and as per census of 2001, has increased to 102.87crors, an increase by 2.09%. India is positioned to emerge as most populous country in near future. Increase in population along with increase in per capita income will lead to the increase in demand for food items. Size of land holding plays a great role in production and productivity. Average size of land holdings now in the country is 1.33ha which in 1971 was 2.28ha. It is

expected that average size of holding would be 0.68 ha in 2020 and 0.32 ha in 2030. Increase in fragmentation of land is inhibiting productivity and production. of Indian agriculture in big way. It is worth mentioning that the great strides have been made since independence and from 50.82 million tonnes of total food grain production in 1950-51, the country is now producing about 230 million tonnes of food grains (2007-08), an increase by over four and half times. However food production has shrunken over the last decade. Population is increasing by 2 percent every year and projected to reach 130crors by 2020 and may require 300mt of food grains to feed the population .Land area is shrinking at a faster rate due to urbanization, industrialization, development of new economic zones, new roads and railway tracks and so on. We have to produce more and more from less land to feed the ever increasing population. In present day agriculture, climate change, soil degradation, depletion of ground water level, untimely supply of canal water, electric supply ,escalation of cost of production, labour problem, sharp increase in fertilizer costs etc are the major constraints being faced by the Indian farmers. There is continuous demand to increase food grain production without adequate technological break through to achieve the same. The further increase in food grain production has to come through managing available resources, particularly land and water and adoption of new technology in a more efficient way.

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