Effect of Climate Change on Agriculture

Suresh Wankhede
Assistant Professor
Thakur Institute of Management Studies, Career Development and Research, Mumbai (MS), India
E-mail:sureshw1702@gmail.com

Atul Tiwari
Assistant Professor
Thakur Institute of Management Studies, Career Development and Research, Mumbai (MS), India
E-mail:tiwarig2008@gmail.com

Kiran Dubey
Librarian
Thakur Institute of Management Studies, Career Development and Research, Mumbai (MS), India
Eemail: dubeyk95@gmail.com

***Abstract*— Climate change is a severe impact on the availability of various resources available on the earth especially water, food, animals which sustains life on this planet. Changes in the biosphere, biodiversity and natural resources are adversely affecting human health and quality of life. Throughout the 21st century, India is projected to experience warming above global level. Today India begins to experience more seasonal variation in the temperature with more warming in the winters than the summers. Longevity of heat waves across India has extended in recent years with warmer night temperatures and hotter days, and this trend is expected to continue. The average temperature change is predicted to be 2.33°C-4.78°C with a doubling in CO2concentrations. These heat waves will lead to increased variability in summer monsoon precipitation, which will result in drastic effects on the agriculture sector in India. Climate models forecast a ongoing rise in carbon dioxide (CO2) concentration and temperature across the sphere. Present models are not very accurate in predicting future changes of local weather conditions such as rain, temperature, sunshine and wind, in combination with locally adapted plant varieties, cropping methods, and soil conditions which can maximize food production as long as plant diseases can be controlled.**

Keywords*: *Agriculture productivity; Climate change; Rainfall;

I. INTRODUCTION

Climate changes and agriculture are interrelated processes both take place on global scale. Climate changes affects agriculture in different ways, including changes in average temperatures, rainfall, and climate extremes (e.g., heat waves); changes in pests and diseases; changes in atmospheric carbon dioxide and ground-level ozone concentrations; changes in the nutritional quality of some foods[1]; and changes in sea level.[2] Agriculture production is directly dependent on climate change and weather. Changes in temperature, precipitation and CO2 concentration are expected to drastically impact on crops growth. Generally impact of climate change is worldwide - food production is considered to be low to moderate with successful adaptation and adequate irrigation [2]. Global agricultural production could be increased due to the doubling of CO2 fertilization effect. Agriculture will also be impacted due to climate changes imposed on water resources. India experience variation in seasonal temperature like 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 had 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.

II. IMPACT OF CLIMATE CHANGE ON CROP PRODUCTIVITY

Climate is fundamental to crop growth. Moisture stimulates seeds to germinate, the time to emergence being temperature-dependent. The rate of growth of roots, stem and leaves depends on the rate of photosynthesis, which in turn depends on light, temperature, moisture and carbon dioxide (CO2), as discussed in detail in the following sections. Temperature and day length also determine when plants produce leaves, stems and flowers, and consequently the filling of grain or the expansion of fruit.

The yield of grain crops depends on grain number and grain weight at harvest, which in turn depends on biomass at anthesis and the availability of moisture post-anthesis. Present paper explores that how lights, temperature, moisture and other climatic factors determine use of land, crop emergence, growth of saleable product [3]. In the next few decades, CO2 will increase global yields by roughly 1.8% per decade. Warming trends may possible to reduce global yields roughly 1.5% per decade without effective adaptation, with a plausible range from roughly 0% to 4%. The upper end of this range is half of the expected 8% rate of gain from technological and management improvements over the next few decades. There are various factors which globally effect on yields, including higher O3 and greater rainfall intensity, are not considered in most current assessments.

III. ROLE OF GREENHOUSE GASES

Climate scientists agree that the root cause of current global warming trend is human development that is "greenhouse effect"1 – global warming that result when the atmosphere traps heat radiating from Earth toward space.

There are certain gases in the atmosphere which blocks heat from escaping. Long - lasting gases which stay semi-permanently in the atmosphere and do not respond physically or chemically to the changes in the temperature described as "forcing" climate change. Various Gases like water vapor, Carbon dioxide, Methane, Nitrous oxide etc. respond physically or chemically to the changes in temperature

Gases that contribute to the greenhouse effect include:

- Water vapor- is the common rich greenhouse gas, prominently; it acts as a feedback to the climate. Water vapor increases as the Earth's atmosphere warms, but so does the possibility of clouds and precipitation, making these some of the most important feedback mechanisms to the greenhouse effect
- Carbon dioxide (CO2)- A minor but very important component of the atmosphere, carbon dioxide is released through natural processes such as respiration and volcano eruptions and through human activities such as deforestation, land use changes, and burning fossil fuels. Human being had increased atmospheric CO2 concentration by 70% since the Industrial Revolution. This is the most important long-lived "forcing" of climate change.
- Methane- is a hydrocarbon gas which is produced by natural sources and through human activities, including the decomposition of wastes in landfills, agriculture, especially rice cultivation, as well as ruminant digestion and manure management associated with domestic livestock. Methane is more active greenhouse gas than carbon dioxide on the basis of molecule-for-molecule, but also one which is much less abundant in the atmosphere.
- Nitrous oxide- is a powerful greenhouse gas which is produced by soil cultivation practices, especially the use of commercial and organic fertilizers, fossil fuel combustion, nitric acid production, and biomass burning.
- Chlorofluorocarbons (CFCs)- is synthetic compounds exclusively of industrial origin used in a number of applications, but now largely regulated in production and release to the atmosphere by international agreement for their ability to contribute to destruction of the ozone layer. They are also greenhouse gases [4].

IV. SOIL EROSION

The major environmental issue is soil erosion since it leads to the water pollution. Soil erosion is seriously impairing the crop activity especially on the sloping landscape. Soil erodes faster when erosion is severe, the loss of 1 inch per acre of topsoil represents approximately 167 tons per acre and approximately 30 years is required to develop 1 inch of soil with properties of typical topsoil.

Even limited soil erosion can be harmful to productivity in other soils. Soils with little rooting depth potential, slowly permeable subsoil, and fragile soils structure, or those that are shallow to bedrock or coarse sands and gravels, definitely are adversely affected by erosion. Without management no one can compensate the lack of suitable soil material. One should understand the effect of soil characteristics and erosion on soil productivity effects of soil erosion on productivity can be measured by changes in three soil profile properties such as - topsoil thickness, rooting depth which relates to plant-available water capacity, and depth to maximum clay content in the soil profile [5].

V. SOIL AND NUTRIENTS

A fertile soil is not necessarily a productive soil, Soil fertility is vital to a productive soil the majority of organic matter; approximately 50 percent of plant-available phosphorus (P), potassium (K) is concentrated in the topsoil (A-horizon). Losing topsoil to erosion contributes loss of inherent soil fertility levels of nitrogen, P, K, and thus to a decline in potential crop yield by addition of manure and fertilizer can supply the needed crop nutrients and help offset some loss of inherent fertility caused by soil erosion. We can increase the productivity of eroded soils by added inputs only if favorable subsoil material is present. Due to this productivity lost by excessive soil erosion which cannot be restored with additional inputs when soils have subsoil material with unfavorable physical and chemical properties for plant root growth. In soils that have fragile subsoils, limited rooting depth, coarse sand and gravel, or high densities, there is little or no ability to recover yield losses with increased inputs.

Loss of yield is disturbing, preventing soil erosion means preserving inherent soil fertility and minimizing fertilizer and management inputs. To understanding the impact of erosion on soil productivity means knowing the characteristics of your soils. Information about soil profile characteristics is available in every county soil survey report. Soil water balance is important for the water management and water use strategy.

Climate change will make the temperature and rainfalls fluctuate, consequently, influencing soil evaporation and plant transpiration. IPCC AR4 (Intergovernmental Panel on Climate Change Fourth Assessment Report) [80] projected that mean annual precipitation will increase in the tropical regions and at high northern latitudes, and decrease in the subtropics. Meanwhile, precipitation may increase in one season, while it may decrease in another one.

Over most parts of the globe, the mean annual runoff will increase; however, there are still some significant areas where runoff will decrease such as Middle-East Europe, northern Africa, Central America, Southern Africa, major parts of southern and western Australia, and various areas of South America. All of these may influence the regional soil water balance under various climatic conditions [6] Soil and water balance is reliable evidence to calculate crop water requirements and water use efficiency. The climate change impacts on irrigation requirements based on daily water balance with the FAO (Food and Agriculture Organization)

VI. CLIMATE CHANGE IMPACTS ON FOOD SECURITY

FAO defined that the present situation of food problems and agriculture can be survive when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food

preferences for an active and healthy life. This definition involves four aspects of food security specifically - food availability, food stability, food access and food utilization. However, the existing study is focused on the climate change impact on availability of foods, scarcely referring to the impacts of potential increase in climate variability, frequency and intensity of extreme events on food stability.

The FAO mentioned that biotechnology can be an approach to improve food security and reduce the environmental pressure. Meanwhile, various modified crop varieties, resisting drought, water logging, salinity and extreme climate, can expand the crop planting areas such as in the degraded soils, consequently, to increase food availability in the future.

Climate change will affect the food quality because of the increasing temperature and decreasing crop growth period. Droogers analyzed the climate change impacts on food security with the HadCM3, SWAP and water-salinity basin model to simulate the evapotranspiration (ET) and available water in field scale thus to decide the relationship between the irrigation depth, crop area and food quality. To increase total grain production, we need to extend the crop area or else, it would decrease the food security. Alcamoa et al. Evaluated present and future climate scenario impacts on food security and water availability in 2020 and 2070s and provided some measures to enlarge potential crop production such as diversifying crops and expanding the rain fed and irrigated agriculture areas.

VII CONCLUSION

Global climate change is not a new phenomenon. The effect of climate change poses many threats; one of the important consequences is bringing about changes in the quality and quantity water resources and crop productivity. It can be concluded that the Indian region is highly sensitive to climate change. Agriculture sector is the most prone sector as it will have 1.2 billion people depend on it. India has set target to share equally greenhouse gas emission by 2050. Today its global need of synchronized efforts to strengthen the research on impact of climate changes on agriculture forest land and animals of this universe.

REFERENCES

[1] https://19january2017snapshot.epa.gov/climate-impacts/climate-impacts-agriculture-and-food-supply_.html

[2] https://www.omicsonline.org/open-access/climate-change-and-its-impact-on-agricultural-productivity-in-india-2332-2594.1000109.php?aid=25286

[3] https://www.eolss.net/sample-chapters/C10/E1-05A-02-00.pdf

[4] https://climate.nasa.gov/causes/

[5] https://crops.extension.iastate.edu/soil-erosion-effect-soil-productivity

[6] https://www.sciencedirect.com/science/article/pii/S1002007109002810

[7] Gautam HR, Sharma HL (2012) Environmental degradation, climate change and effect on agriculture. J Kurukshetra 60: 3-5