

Climate Change Impact on Agriculture

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*“Climate variability and extreme conditions are a key driver behind the recent rise in global hunger and one of the leading causes of severe food crisis,”
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THE rapid growth of human civilisation is colliding with approaching limits to the supply of key natural resources. Due to climate change, the planet's life-support systems are running down, posing a threat to humanity's ability to produce even the amount of food produced today because agriculture is very sensitive to weather and climate. It also relies heavily on land, water, and other natural resources that are affected by climate change. Climate change has already affected the quantity of food produced globally, even though it is small compared to the significant increase in global food production. A study of global vegetable and legume production concluded that if Greenhouse Gases (GHGs) emissions continue on their current trajectory, food production could decline by 35 per cent by 2100 due to water scarcity, increased salinity, and topsoil depletion.

Wheat is the most important staple crop in temperate zones and is in increasing demand in countries undergoing urbanisation and industrialisation. It is one of the crops most susceptible to the effects of climate change. Studies reveal that each degree increase in nighttime temperature corresponds with a linear decrease in wheat production. The rise in mean temperature of 2 degrees Celsius to 3 degrees Celsius will reduce wheat crops in North India, resulting in a loss of 6 to 7 million tons of wheat annually. A large global review of the impact of climate change on crop yields between 1980 and 2010 showed that worldwide wheat production fell by 5.5 per cent due to climate-related factors.

Corn (maize) is the most produced crop globally, with 1.1 billion tons, followed by wheat and rice. It originated as a tropical grass and can tolerate exposure to adverse temperatures. But as temperatures continue to increase, corn appears to be the most vulnerable to heat stress. Its yields start to decrease at a range of temperatures the Earth is already experiencing regularly in summer months. Every day during the growing season — roughly from the beginning of March to the end of August — when temperatures rise above a threshold of 84 degrees F (Fahrenheit), corn yields drop by 0.7 per cent. As temperatures grow hotter than 84 degrees F, the yield declines drop further with every degree added.

Corn is the primary US feed grain, accounting for over 95 per cent of total feed grain production and use. The US is also the largest exporter of corn in the world. Indeed, nothing dominates the American landscape like corn. If temperatures in the US continue to rise as much as is now projected as global warming, by the end of the century, corn yields could fall by as much as a third from heat stress alone, with the impact of worsening droughts and the disruption of precipitation patterns taking a larger toll still. The risk is also dangerously real for the other corn exporters — Brazil, Argentina and the Ukraine. These countries are facing simultaneous crop failure. The impact on crop yields will aggravate the plight of the world's poorest and sharpen the rich/poor divide. Though soybeans have a higher threshold for heat stress than corn (86 degrees F or 30 degrees C), it has been established that higher concentrations of CO₂ level can result in soybeans deactivating genes that are crucial to the production of chemicals to defend themselves against the insects. Hence, soybeans grown in an atmosphere with high concentrations of CO₂ appear to be helpless against herbivores.

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A researcher at the International Rice Institute in the Philippines, Shaobing Peng, showed that the yields of rice declined by 10 per cent with every one degree C increase in nighttime temperatures during the dry part of the growing season, even though there were no significant drops in yield associated with increasing maximum temperatures during the daytime. Crop diseases and pests are also increasing with global warming. One of the leaders of an Asian international agricultural research group, Promod K Agarwal, said, “Warmer conditions and longer dry seasons linked to climate change could prove to be the perfect catalyst for outbreaks of pests and diseases”. Moreover, warmer temperatures and changing precipitation can affect when plants bloom and pollinators, such as bees and butterflies, come out. Pollination could decrease if mismatches occur between when plants flower and when pollinators emerge. When plants absorb large amounts of ground-level ozone, they experience reduced photosynthesis, slower growth and higher sensitivity to diseases.

Temperature is probably the most important environmental factor influencing insect behaviour, distribution, development, survival and reproduction. It has been estimated that with 20 degrees C temperature increase, insects might experience one to five additional life cycles per season. According to crop scientists, the increase in the ‘pest population’ could have a substantial economic impact through increased seed and insecticide costs, decreased yields and the downstream effects of changes in crop yields.

The major climate factor which influences crop growth is rainfall. The global water cycle gets radically intensified and accelerated by global warming. While the warmer oceans allow significantly more water vapour to evaporate into the sky, the warmer air also holds more water vapour. Scientifically, it has been established that an extra 4 per cent of water vapour in the atmosphere above the oceans significantly affects the hydrological cycle. Since storms often reach up to 2,000 kilometres, they gather water vapour from large sky areas and funnel it into regions where storm conditions trigger a downpour.

By analogy, if we put a drain into a bathtub filled with water, the water rushing down the drain does not come just from the part of the tub directly over the drain; it comes from the whole tub. In the same way, the great basins of water vapour in the sky are funnelled to the ‘drains’ opened above the land by rainstorms and snowstorms. The downpours are more intense when the basins are filled with more water vapour than in the past. The bigger downpours lead to bigger floods. The floods rush across the land, eroding the soil. And less water seeps down through the soil to recharge the underground aquifers. According to a recent analysis done by the Central Ground Water Board (CGWB), the groundwater level in some parts of the country is declining, while 89 per cent of the groundwater extracted is used in the irrigation sector of the country, and 85 per cent of rural domestic water requirements are also fulfilled by groundwater.

When temperatures rise, the warmer air holds more moisture and can intensify precipitation. Extreme precipitation can damage crops, resulting in decreased

yields. A rise in the sea level can submerge crops. Hot weather also leads to faster evaporation, drought, and water shortage. Presently, around 42.4 per cent of India is drought affected. Climate change also causes desertification by altering atmospheric circulation patterns and drying land and vegetation. The same extra heat that evaporates more water vapour from the oceans also speeds up the evaporation of soil moisture — leading to longer, deeper, and more widespread droughts. As more extended refilling of the atmospheric ‘basins’ of moisture still takes a lot of time, many areas of the world are experiencing more extended periods without rain between precipitation events, leading to more widespread and even deeper droughts. Once it is devoid of vegetation, the surface begins to absorb more heat. When the soil moisture is gone, the ground is baked, local temperatures rise, and the topsoil becomes more vulnerable to wind erosions. Topsoil regenerates naturally but at an amazingly slow rate of about 2.5 centimetres every 500 years. Many studies indicate that half of India’s geographical areas are degraded and suffer from soil erosion; each inch of lost topsoil diminishes grain yield by 5 per cent; apart from quantity, climate change can severely affect food quality.

The parching and desiccation of the world’s most highly productive agricultural breadbasket portend a future food crisis that could have humanitarian and political consequences too horrific to imagine. The consequences for food production and water availability are already extremely harsh. In 2012, mainly because of the climate-related events that reduced crop yields, the world experienced a one-month price increase for food, with additional record price hikes predicted for 2013.

More than 65 per cent of the US suffered from drought conditions in 2012. In addition to the impacts on industrial agriculture in North America, Russia, Ukraine, Australia, and Argentina, subsistence agriculture has been hit hard in many tropical and subtropical countries by considerable alternations in the timing, duration, and magnitudes of precipitations pattern due to global warming disruption of the hydrological cycle.

Climate change encompasses global warming, which is caused by the presence of invisible greenhouse gases in the atmosphere. Those gases do not stay where they are generated. They have not heard of passports and don’t know political boundaries. They are just blown by the winds and moved by the general circulation of the planet. In the words of Paul Hawken, “At present, we are stealing the future, selling it in the present, and calling it gross domestic product.”

Indeed, the planet is a unit so no single nation can solve the problem of climate change alone. All countries must sincerely work together to clean it up, be good trustees of the Earth for future generations and make it a better place for our grandchildren and great-grandchildren. If we want to save ourselves, we shall adopt — as Albert Einstein said in 1945 in a slightly different context — a new way of thinking. It is not impossibly hard to do.

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