IRRIGATION AND ECONOMIC DEVELOPMENT

Edited by

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CHAPTER 43

IMPACT OF CLIMATE CHANGES ON IRRIGATION

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Introduction

One of the most important challenges are facing people is to provide an equitable standard of living for present and future generations. We should need sufficient food, water, energy, safe shelter and a healthy an environment. But, global environmental issues such as land degradation, loss of biodiversity, stratospheric ozone depletion along with human-induced climate change, threatens our ability to meet the basic human needs. The Third Assessment Report (TAR) of the Intergovernmental Panel on Climate Change (IPCC) repeats that the climate is changing in ways that cannot be accounted for by natural variability and that 'global warming' is happening. Global mean temperatures have risen (0.6oC in the last century), with the last decade being the warmest on record. Climate change will, in many parts of the world, adversely affect socio-economic sectors, including water resources, agriculture, forestry, fisheries and human settlements, ecological systems and human health, especially in developing countries due to their limitations.

Agriculture in India is said to be a gamble on the monsoon. It is dominated mainly by nature, especially by rainfall. Nature plays havoc on agricultural production either by insufficient rain, causing drought conditions, or by unwanted rain, floods, cyclones etc., causing widespread damage and destruction. Vulnerability to climate change is closely related to poverty, as the poor have less financial and technical resources. They are heavily dependent on climate-sensitive sectors such as agriculture and forestry; they often live on marginal land and their economic structures are breakable. This is true for a developing country like India where agriculture remains the backbone of the economy, contributing nearly 27% of the total Gross Domestic Product (GDP) and employing nearly two-thirds of the country's population. Agriculture exports account for 13 to 18% of total annual exports of the country. However, given that 62% of the cropped area is still dependent on rainfall, Indian agriculture continues to be primarily dependent on the weather.

Climate change will have an economic impact on agriculture, including changes in farm profitability, prices, supply, demand and trade. The magnitude and environmental distribution of such climate-induced changes may affect our ability to expand the food production as required to feed the population. Climate change could thus have far reaching effects on the forms of trade among nations, development and food security.

Impact of Climate changes on Agricultural Productivity

The problem of agricultural productivity in India is the outcome of cumulative and complex problems affecting various activities in agriculture and as such poor productivity cannot be attributed to one cause alone.Agriculture is sensitive to short-term changes in weather and to seasonal, annual and long term variations in climate. Crop yield is the finale of a varied range of factors. Parameters like soil, seed, pest and diseases, fertilizers and agronomic practices exert significant influence on crop yield. The growing population, along with human-induced climate change and environmental problems is increasingly proving to be a limiting factor for enhancing farm productivity and ensuring food security for the rural poor.

Agricultural productivity can be affected by climate change in two ways: first, directly, due to changes in temperature, rainfall and/or CO2 levels and second, indirectly, through changes in soil, distribution and frequency of plague by pests, insects, diseases or weeds. Acute water shortage conditions, combined with thermal stress, could adversely affect wheat and, more severely, rice productivity in India even under the positive effects of elevated CO2 in the future.

Causes for Climate Change

There are many "natural" and "anthropogenic" (human-induced) factors that contribute to climate change. Climate change has always happened on Earth, which is clearly seen in the biological record; it is the rapid rate and the magnitude of climate change occurring now that is of great concern worldwide. Greenhouse gases in the atmosphere absorb heat radiation. Human activity has increased greenhouse gases in the atmosphere since the Industrial Revolution, leading to more heat retention and an increase in surface temperatures. Atmospheric moisture alter climate by irregularing and absorbing solar and ultraviolet radiation and they may also change the microphysical and chemical properties of clouds. Finally, land-use change, such as deforestation have led to changes in the amount of sunlight reflected from the ground back into space.

Formation of El-Nino and La-Nina

During normal conditions in the Pacific ocean, trade winds blow west along the equator, taking warm water from South America towards Asia. To replace that warm water, cold water rises from the depths — a process called upwelling. El Nino and La Nina are two opposing climate patterns that break these normal conditions. Scientists call these phenomena the El Nino-Southern Oscillation (ENSO) cycle. El Nino and La Nina can both have global impacts on weather, wildfires, ecosystems, and economies. Episodes of El Nino and La Nina typically last nine to 12 months, but can sometimes last for years. El Nino and La Nina events occur every two to seven years, on average, but they don't occur on a regular schedule. Generally, El Nino occurs more frequently than La Nina.

El Nino also has a strong effect on marine life off the Pacific coast. During normal conditions, upwelling brings water from the depths to the surface; this water is cold and nutrient rich. During El Nino, upwelling weakens or stops altogether. Without the nutrients from the deep, there are fewer phytoplankton off the coast. This affects fish that eat phytoplankton and, in turn, affects everything that eats fish. The warmer waters can also bring tropical species, like yellowtail and albacore tuna, into areas that are normally too cold.

La Nina

La Nina means Little Girl in Spanish. La Nina is also sometimes called El Viejo, anti-El Nino, or simply "a cold event." La Nina has the opposite effect of El Nino. During La Nina events, trade winds are even stronger than usual, pushing more warm water toward Asia. Off the west coast of the Americas, upwelling increases, bringing cold, nutrient-rich water to the surface.These cold waters in the Pacific push the jet stream northward. This tends to lead to drought in the southern U.S. and heavy rains and flooding in the Pacific Northwest and Canada. During a La Nina year, winter temperatures are warmer than normal in the South and cooler than normal in the North. La Nina can also lead to a more severe hurricane season.

Impact of Climate Change on Irrigation in Indian Agriculture

In India nearly 60 per cent of land area is used for agriculture, nearly half of that artificially irrigated. Historically, the introduction of irrigation technologies has operated the country's 'Green Revolution' and helped boost crop yield. But, it comes at the cost of heavy consumption of freshwater and groundwater resources.

Irrigation is the replacement or supplementation of rainwater with another source of water. The main idea behind irrigation system is that our fields and plants are maintained with the minimum amount of water required. Irrigation has its importance for every crop and at all the places. It is difficult to raise the agricultural productivity without proper application of water. Irrigation is a necessary element of every combinations of inputs. The application of fertilizers, insecticides and pesticides is also associated with irrigation water. Without the adequate quantity of water the fertilizers cannot give good results.

The Centre for Atmospheric Sciences at the Indian Institute of Technology in Delhi used computer simulations and sophisticated global climate models to analyse the effects of irrigation on the climate in India. There are, however, competing processes by which irrigation could affect local rainfall. When more water is available on the ground, there is more evaporation, which means more moisture in the air and more rainfall locally. This is called recycling.

Conclusion

The agricultural sector is one of the most vulnerable to climate change because it depends heavily on temperature and rainfall. Irrigation is of particular importance in Indian agriculture. Though the big efforts are made to irrigate all the cultivable land but still 42 per cent of the cultivable area got the regular facilities of irrigation whereas on the other areas, the irrigation is either not regular or this depends on rainfall.However, the more capitalised farmers are better able to invest in irrigation facilities and making them potentially less affected by the effects of climate change. Thus, one should encourage the expansion of credit policies to the implementation of irrigation technology, especially for low capitalised formers.

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He has published 15 books, 34 research papers and reviews in national and international journals of repute. His academic contributions involve membership and chairmanship of Board of Studies of various institutes. He was also recipient of "Best teacher award", "Best NSS Programme Officers Award", "Senior Economists award" and "Eminent Academician award". Besides he served as NAAC Coordinator, IQAC Coordinator and Dean of Academics and Research in the college.

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