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Impact of climate change on cropping pattern in Vidarbha region

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Abstract
Agriculture is a largest economic sector and plays a very vital role in the socio-economic development of our country, which is now in crises. The farmers of various states particularly in Maharashtra are in distress due to multiple factors that result in suicide in large scale. The suicides of farmers is increasing in numbers throughout the states of Maharashtra, Karnataka, Andhra Pradesh, and Punjab is the most crucial problem and calls for the topmost priority in the agenda of rulers & policy makers. The suicidal trend set in 1991 by the farmers of Andhra Pradesh has spread to Maharashtra in 2000-01 and has been continued even today. Vidarbha is observed as the suicide prone/ danger zone of the state. In Vidarbha region more numbers of farmers have committed suicide to overcome the miseries due to various reasons *viz.* non-production of crops, bad debts, drought, lack of markets, marketing and irrigation facilities exploitation by private money lenders and other social and family causes arising out of the combination of various factors, but no one particular reason could be attributed to this saddest event of the mankind in the Indian history.

Keywords: Vidarbha, private, money

Introduction
Climate change and variability are concerns of human being. The recurrent droughts and floods threaten seriously the livelihood of billions of people who depend on land for most of their needs. The global economy is adversely being influenced very frequently due to extreme events such as droughts and floods, cold and heat waves, forest fires, landslips etc. The natural calamities like earthquakes, tsunamis and volcanic eruptions, though not related to weather disasters, may change chemical composition of the atmosphere. It will, in turn, lead to weather related disasters. Increase in aerosols (atmospheric pollutants) due to emission of greenhouse gases such as Carbon Dioxide due to burning of fossil fuels, chlorofluorocarbons (CFCs), hydro-chlorofluorocarbons (HCFCs), hydro-fluorocarbons (HFCs), per fluorocarbons (PFCs) etc., Ozone depletion and UV-B filtered radiation, eruption of volcanoes, the "human hand" in deforestation in the form of forest fires and loss of wet lands are causal factors for weather extremes. The loss of forest cover, which normally intercepts rainfall and allows it to be absorbed by the soil, causes precipitation to reach across the land eroding top soil and causes floods and droughts.

Weather and climate
Weather is the set of meteorological conditions such as wind, rain, snow, sunshine, temperature, etc. at a particular time and place. By contrast, the term climate describes the overall long-term characteristics of the weather experienced at a place. The ecosystems, agriculture, livelihoods and settlements of a region are very dependent on its climate. The climate, therefore, can be thought of as a long-term summary of weather conditions, taking account of the average conditions as well as the variability of these conditions. The fluctuations that occur from year to year and the statistics of extreme conditions such as severe storms or unusually hot seasons are part of the climatic variability.

Crop responses to expected climate change factors
Climate change scenarios include higher temperatures, changes in precipitation, and higher atmospheric CO_2 concentrations which may effect on yield (Both quality and quantity), growth rates, photosynthesis and transpiration rates, moisture availability, through changes

of water use (irrigation) and agricultural inputs such as herbicides, insecticides and fertilizers etc. Environmental effects such as frequency and intensity of soil drainage (leading to nitrogen leaching), soil erosion, land availability, reduction of crop diversity may also affect agricultural productivity. An atmosphere with higher CO_2 concentration would result in higher net photosynthetic rates (Cure & Acock 1986, Allen *et al*. 1987) [8, 9]. Higher CO_2 concentrations may also reduce transpiration (i.e. water loss) as plants reduce their stomatal apertures.

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.

Agricultural productivity and food security

Food security is both directly and indirectly linked with climate change. Any alteration in the climatic parameters such as temperature and humidity which govern crop growth will have a direct impact on quantity of food produced. Indirect linkage pertains to catastrophic events such as flood and drought which are projected to multiply as a consequence of climate change leading to huge crop loss and leaving large patches of arable land unfit for cultivation and hence threatening food security. The net impact of food security will depend on the exposure to global environmental change and the capacity to cope with and recover from global environmental change. On a global level, increasingly unpredictable weather patterns will lead to fall in agricultural production and higher food prices, leading to food insecurity.

Climate change-mitigation and adaptation in agriculture

1. Assist farmers in coping with current climatic risks by providing value-added weather services to farmers.
2. An Early warning system should be put in place to monitor changes in pest and disease outbreaks. The overall pest control strategy should be based on integrated pest management because it takes care of multiple pests in a given climatic scenario.
3. Participatory and formal plant breeding to develop climate-resilient crop varieties that can tolerate higher temperatures, drought and salinity.
4. Developing short-duration crop varieties that can mature before the peak heat phase set in.
5. Selecting genotype in crops that have a higher per day yield potential to counter yield loss from heat-induced reduction in growing periods.
6. Efficient water use such as frequent but shallow irrigation, drip and sprinkler irrigation for high value crops, irrigation at critical stages.

Agriculture systems in Maharashtra State

Maharashtra faces an increasing risk from climate change which is likely to impact the production of four major crops – Soybean, Cotton, Wheat, and Gram, grown in the State, according to a study by the Institute for Sustainable Communities. The report titled "Climate Change Impacts on Maharashtra Agriculture" examined the week-wise 30-year averages of historical (Covering the years 1989-2018) and predicted (protecting the years 2021-2050) rainfall and temperature data for eight districts across Khandesh, Marathwada, and Vidarbha regions of the state. "The analysis presented in this report maps climate modeling and projections (Both historical and futuristic), with crop phenology (optimal conditions across each of the growing stages for a crop) coupled with community-based participatory assessments (On-ground farmer validation) at a granular 'weekly' scale to weave a comprehensive understanding of the likely impacts of climate change on each of the crops and the farmers," said Romit Sen, Associate Director – Water & Agriculture Program at ISC. "Climate analysis predicts mismatch in rainfall and temperature patterns with crop phrenology across the monsoon (Kharif) and winter (Rabbi) season," The late onset of monsoon and intermittent dry and wet spells has impacted the germination of soybean and cotton. Excess rainfall during the mid-kharif season will increase fungal diseases, weeds, and pests. This is likely to impact the production of pods in soybean and boll formation in cotton. Additionally, water-logged soils and humid conditions will promote rot, leading to a loss of soil nutrients and fertilizers from the soil. The overall impact of excessive rainfall during the fruit formation and maturity stage for both the kharif crops studied-soybean, and cotton will affect the yield and quality of the produce.

Agriculture systems in Vidarbha Region

The districts of Marathwada and Vidarbha witnessing maximum farmer suicides in Maharashtra face higher risk to climate change. A report by the National Bank for Agriculture and Rural Development (NABARD) has recommended the state government to initiate policies and measures to adapt to climate changes that would be detrimental to the agro-sector in 14 districts which are affected by severe drought across Vidarbha and Marathwada. According to the Central Research Institute for Dryland Farming, "The districts in Marathwada and Vidarbha faced very high risk to climate change. Studies warn that if no action is taken, financial implications on account of damages due to climate change would be massive. Mumbai alone can incur financial damages of as much as Rs.2 trillion due to climate change related damages.

Conclusion

The districts of Marathwada and Western Vidarbha in Maharashtra are drought-prone areas. Despite this, crops like sugarcane which consume more water are grown in these regions. The continuation of this practice in the future might cause severe water stress in the regions, which may lead to more frequent droughts. Based on RCP4.5 projections, variability in rainfall and temperature is likely to be more in Marathwada and Vidarbha. This calls for stress-tolerant crop breeds which are resilient to frequent.

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