

Climate change and its impact on agriculture and food security

Agriculture and food security are among the major casualties of climate change in India. Strategies such as adopting necessary mitigation measures and reducing greenhouse gas emissions along with widespread awareness on this issue, are needed.

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The pace and extent of warming across India is wide spread and undisputed. It has adverse impact on wild life, agriculture, incidence of diseases, local weather, rise in sea level, more heat waves etc. North India will be relatively more affected. Rising population, rapid urbanization, industrialization, deforestation and waste production are putting enormous pressure on our natural resource base and has led to qualitative and quantitative degradation of land, water, air, biodiversity, forests and bio-resources. The problems are compounded by dwindling non-renewable resources, shrinking arable land and farm size, growing regional disparity, depleting natural resource base, increasing biotic and abiotic stresses. About 70% of our soils are deficit in organic carbon and other micro nutrients. Soil toxicity is increasing due to industrial effluents and the use of chemicals and pesticides. Agriculture over the years is losing ground to other professions, which are considered more attractive by the younger generation.

Decrease in agricultural productivity with shrinking of land availability is the biggest challenge to feed increasing population. Fast depleting forest cover is a threat to several species of flora and fauna. In the last 20 years, nearly 12,000 sq. km. of forest has disappeared under the government's programmes and much more illegally. At least 30% land under forest cover is necessary for ecological balance. The challenges before us are daunting. The future approach shall have to be more sustainable so that while we increase productivity, on one side, we do not degrade the environment.

Climate variations

Country is facing unpredictable weather for last few years. Analysis of different meteorological variables available from weather stations in the country shows an upward trend in mean monthly temperature, and downward trend in relative humidity (RH), annual rainfall and number of wet days in a year. The rate of carbon dioxide release into the atmosphere has increased 30 times during the last 3-4 decades.

States like Bihar, Assam and parts of Karnataka are experiencing dry spells, whereas Southern Gujarat, Maharashtra, parts of Bihar, Andhra Pradesh, Ladakh and Western Karnataka were hit by the floods. In 2007 alone, 17 million people had borne the brunt of floods. During the year 2006, the Kashmir Valley witnessed the most severe summer in three decades. Cherapunji, known for highest rainfall, had less rains in 2005. Mumbai, for consequent 3-4 years, had heavy down pour, almost dipping the city. Unusual rainfall (60 cm rainfall in 5 days, August 19-23, 2006) in Barmar district of Rajasthan in 2006, was not recorded in the past 200 years.

Impacts of climate change

Climate change is affecting India in a big way and its impacts are many and serious – erratic monsoon, migration of agricultural zones, spread of tropical diseases, sea level rise, change in availability of fresh water, floods, droughts, heat waves, storms, hurricanes etc. Abrupt climate change could make large areas of the country uninhabitable. Climate change and its impacts on natural resource base, agriculture and allied sectors are discussed below.

There is a direct link between the rise in global temperature and damage to eco-systems. About 130 million hectares (mha) land is undergoing different levels of degradation, namely water erosion (32.8mha), wind erosion (10.8mha), desertification (68.1mha), salinization (7.0mha), water logging (8.5mha) and nutrient depletion (3.2mha). It could have serious repercussions on agricultural productivity, if preventive steps are not taken. Other effects of climate change are more. For instance, rise in sea levels, say about a meter by the next century, may displace millions of people. Sea level rise would lead to ingress of saline water and salination of ground water and surface water in coastal areas. Almost 50 percent of flora and fauna could be affected by global warming. At the present warming rate, 1/4th of earth's species including birds may become extinct by 2050. Rising water temperatures and more intense hurricanes would affect the sea life. Increasing desertification is a serious problem. Arid and semi-arid conditions make India more prone to desertification. Depletion of natural vegetation and cultivation on sand dunes and marginal lands accentuate soil erosion.

Trends indicate that agricultural productivity will decline upto 25 percent which could be as much as 50 percent in rainfed agriculture. Small and marginal farmers with small land holdings will be more vulnerable to climate change. Fickle monsoon and water scarcity has drastically reduced crop yield in Bundelkhand region of Uttar Pradesh in the last 3-4 years. Vagaries of weather and debt have driven several farmers to suicides as they were unable to repay the loan and fulfill social obligation of feeding their families. An unusually warm winter in 2006 battered orchards (Alphonso mangoes' yield was down by 75 percent) along the Konkan coast in Maharashtra.

Snapshots of some calamities in India

- 22 of the 32 states and union territories are disaster prone affecting 24.79 million people every year
- Annual disaster loss is about \$1883.93 million and average damage to crops is about Rs.972 crore,
- Over 16,000 were killed in earthquakes in Kutch and other parts of Gujarat in June 2001
- 28 percent of the country's total cultivable land is drought – prone, 567 percent is earthquake prone, 76 lakh hectares of land are flooded every year and over 1,300 live are lost to floods every year.

(Sources: Reuters, IPCC, WWF, WFP, Greenpeace).

Heat stress during summer months has been found to affect animal productivity both of male (draught capacity) and female (milk production). Season affects fertility in most of the animal species. Exotic animals are more vulnerable to heat stress. Increased disease incidence, poor performance in terms of growth, milk production, reproductive efficiency are reflections of poor acceptability of cross-breeding programmes.

Climate change will have an adverse impact on food security. Food cost will increase as food availability (cereals, livestock products, fish) will decrease. Disadvantaged regions and socially and economically backward people will be affected more. Food security would be further exacerbated by loss of cultivable land and nursery areas for fisheries, by inundation and coastal erosion in low lying areas. Predictions based on modeling studies indicate that substantial losses are likely in rain-fed wheat in South and South – East Asia. A 0.5 degree celsius rise in winter temperature would reduce wheat yield by 0.45 tonne per hectare. Bundelkhand region in India is the worst sufferer of climate change. There has been acute drought and distress including starvation deaths for last 3-4 years. 25 percent people did not have two-square meals and only 5 percent had nutritionally balanced food.

Mitigation Strategies

There is a need for global consensus to contain global warming. Targets to cut emissions by 5 percent below their 1990 levels by 2012 and 15 to 30 percent by 2020 established by Kyoto protocol, should be enforced. Climate change over last few decades has endangered food security. Impacts are diversified and need to be addressed through public – private partnerships between communities and local government and states. The central government's role is to facilitate the total programme as a nodal agency.

There are two fold approaches to mitigate the climate stress – firstly by reducing greenhouse gas emissions, the main culprit of climate change and secondly, by adopting necessary measures to mitigate adverse impacts of climate change.

Water harvesting and conservation is a national priority. Water should be used judiciously. Drip irrigation and water sprinkler approach, mulching and bed plantation, construction of tanks and check-dams are conventional approaches for water harvesting and conservation. Its impact is visible in Alwar region of Rajasthan, wherein barren lands were converted into lush fields. Dried up rivers got rejuvenated by making 'Johads', a small earthen check dams.

Plants in the forest area are natural carbon sinks. A programme for massive tree plantation and banning the grazing of animals will help in the regeneration of the forests and slow down the process of desertification.

With unpredictable weather, farmers will have to change crop management practices, grow tougher plant varieties and be prepared for constant change in the way they operate. Traditional farming system methods with introduction of new varieties (drought/ heat resistant), new farm management practices, change in land use, watershed management, micro-credit and agri-insurance are measures to ameliorate climate stress in future. One adaptive measure with changed climate to sustain wheat productivity would be introduction of longer duration and one week early planting varieties. Building capacities by designing climate proof investments, resource mobilization, promoting insurance and agri-business are other majors to protect against risk of production loss due to calamities like floods, droughts, pests and diseases.

Prediction of monsoon particularly in rainfed areas is important for planning when and what crops to plant. Concerted efforts should be made to improve both short and long-term weather based forecasts to alert farmers of drought, excess rains, pest and disease incidence.

Diet changes may be a key potential factor in reducing methane emission from animals. Suitable plant breeding methods may find animal feed and fodder that reduces emissions.

Clean technologies for generating energy can lead to sustainable growth in future. We should shift to well designed vehicles with less pollution. Bio-gas generation from dung rather than using dung as a fuel should be promoted. Use of animals like horse and mule for transport purposes in hill region and bullocks for agricultural operations and for transport of goods save huge amount of carbon dioxide emissions. According to a study in Garhwal region of Uttarakhand, at least 14.5 lakh kg carbon dioxide emission is reduced by using horse and mule for transport purposes.

Conserving energy at home and on transport is also important by making use of renewable energy sources like solar energy. Using CNG in place of petrol and diesel in vehicles would not only clean up the air but also bring revenue worth crores of rupees earned through carbon trade, particularly in metro cities.

Simple things like creating awareness about adverse impact of climate change may reduce the level of greenhouse gas emissions. Clean Development Mechanism (CDM) and carbon trading may also help in reducing greenhouse gas emission. If people become sensitive to environment and awareness is created on importance of the clean environment and judicious use of resources, the level of greenhouse gas emissions could decline. Inclusion of courses on environmental studies in school curricula is a good beginning. Providing pertinent literature in local language help in building awareness.

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