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Impact of Climate on Agriculture and Non Agriculture Sectors in India

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India is an agriculturally dominant country. Two-thirds of its population is related to agricultural and allied Sectors. Agriculture is a primary source, which produces most of the food grains that we consume. Besides food grains, it also produces raw material for various industries. Agriculture is very importance for fulfil the requirement food, livelihood securities and nutrition for India. Indian agriculture had made a significant Activities in the past, but presently it is facing so many challenges. Stagnating net sown area, plateauing yield levels, deterioration of soil quality, reduction in per capita land availability, decreasing of ground water table, increasing the intensity of pest and diseases etc. and the adverse effect of climate change are the major challenges for Indian agriculture. On the other hand, Day by Day increasing the rate of population is pressurizing the agricultural sector for enhanced food production. The task is very challenging because about 60% of the net cultivated area are under the rainfed condition and exposed to biotic and abiotic stresses arising from climatic variability and climate change. More than 80% of Indian farmers are marginal and small with poor coping capacity. Furthermore, the Indian farmers are heterogeneous and unorganized. Climate change and variability are likely to aggravate the problem of future food security by putting pressure on agriculture and allied sectors and affecting its sustainability.

Under the National Action Plan on Climate Change (NAPCC), the Government of India has launched eight National Missions during the XII Five year plan. The National Mission for Sustainable Agriculture (NMSA) and the Mission on Strategic Knowledge on Climate Change (NMSKCC) are targeted to achieve an agricultural growth rate of 4% per annum and also enable the country to cope with the impacts of a changing climate. Under the NMSKCC, the DST has supported Tamil Nadu Agricultural University (TNAU), Coimbatore; International Crop Research Institute on Semi-Arid Tropics (ICRSAT), Hyderabad and ICAR-Indian Agricultural Research Institute (IARI), New Delhi to undertake research on the impact of climate change on agriculture having less than one hector land, for developing appropriate adaptation strategies including strategic knowledge. The results derived from these studies are summarized in the report.

Impact of Climate Change in Agriculture and Allied Sectors

The research on climate change impact has focussed primarily on the staple food crops, Horticultural crops, dairying and animal husbandry, and fisheries, which together comprise about 60% of the agricultural gross value added (GVA), and these are expected to drive future growth in agriculture. These activities are more exposed to climate risks, from farm to fork, hence, need greater focus of research on climate change impact and their management.

a. Crops

- Increase in ambient CO2 is beneficial since this leads to increased photosynthesis in several crops, especially crops with C3 mechanism of photosynthesis such as wheat and

rice, and decreased evaporative losses. Despite this, the yields of major cereals crops especially like wheat is likely to be reduced due to decrease in crop growth duration, increased respiration, and /or reduction in rainfall/irrigation water supplies due to rise in atmospheric temperature.

- Enhanced frequency and duration of extreme weather events such as flood, drought, cyclone and heat wave; that adversely affect agricultural productivity.
- Reduction in yield in the rainfed areas due to increased crop water demand and changes in rainfall pattern during monsoon season.
- Declined quality of fruits, vegetables, tea, coffee, aromatic, and medicinal plants.
- Alteration of agricultural pests and diseases because of more pathogen and vector development, rapid pathogen transmission and increased host susceptibility.
- Threatened agricultural biodiversity by rainfall uncertainty and temperature increase, sea level rise, and increased frequency and severity of drought, cyclones and floods.
- Contrary to all the above negative impacts, predictions have been made for decreased cold waves and frost events in future due to the atmospheric temperature rise, which would lead to a decreased probability of yield loss associated with frost damage in northern India in crops such as mustard and vegetables.

b. Water

- Increased irrigation demands with increased temperature and higher evapo-transpiration. This may also result in lowering groundwater table at some places.
- Melting of glaciers in the Himalayas may lead to increased water availability in the Ganges, Bhramaputra and their tributaries in the short run but in the long run the availability of water would decrease considerably.
- A significant increase in runoff is projected in the wet season that may lead to increase in frequency and duration of floods and also soil erosion. However, the excess water can be harvested for future use by expanding storage infrastructure. The water balance in different parts of India is predicted to be disturbed and the quality of groundwater along the coastal track will be more affected due to intrusion of sea water.

c. Soil

- Reduced quantity and quality of organic matter content, which is already quite low in Indian soil. Under elevated CO2 concentration, crop residues have higher C:N ratio, which may reduce their rate of decomposition and nutrient supply. Increase of soil temperature will increase N mineralization but its availability may decrease due to increased gaseous losses through processes such as volatilization and denitrification.
- Change in rainfall volume and frequency and wind intensity may alter the severity, frequency and extent of soil erosion.
- Rise in sea level may lead to salt-water ingression in the coastal lands turning them less suitable for conventional agriculture.

d. Livestock

- Climate change has pronounced effect on feed production and nutrition of livestock. Increased temperature results in enhanced lignification of plant tissues and reduced digestibility. Increased water scarcity would also decrease food and fodder production.
- In cooler areas, climate change has major impact on vector-borne diseases of livestock by the expansion of vector population. Changes in rainfall pattern may also influence expansion of vectors during wetter years, leading to large outbreaks of disease.
- Global warming would increase water, shelter, and energy requirement of livestock for meeting projected milk demand.
- Climate change is likely to aggravate the heat stress in dairy animals, adversely affecting their reproductive performance.

e. Fishery

- Increasing sea and river water temperature is likely to affect fish breeding, migration, and harvest.
- Impact of increased temperature and tropical cyclonic activity would affect the capture, production and marketing costs of the marine fish.
- Coral bleaching is likely to increase due to higher sea surface temperature.

f. Insects and diseases

- Extension of geographical range of insect-pests and pathogens
- Changes in population growth rates of pathogens and insect-pests
- Changes in relative abundance and effectiveness of biocontrol agents
- Changes in pathogen/insect-pest × host × environment interactions, and loss of resistance in cultivars containing temperature-sensitive genes
- Emergence of new diseases/pest problems and increased risk of invasion by migrant diseases and pests
- Reduced efficacy of different components of disease and insect-pest management.

Impact of Climate on None Agriculture Sectors

Climate change being one of the most pressing challenges of the 21st century poses significant risks not only to the environment, human health and food security, but also economic development. Climate change can adversely affect both the supply side (the productive potential) and the demand side (the consumption and investment) of the economy.

a. Increased Health Costs

- Climate change can increase the incidence and severity of diseases such as malaria, dengue, cholera, heat stroke, respiratory infections, and mental stress.
- It can also affect the nutrition and well-being of vulnerable groups such as children, women, elderly, and poor. Health costs can reduce disposable income, lower labour productivity, and increase public expenditure.
- According to the WHO, between 2030 and 2050, climate change is expected to cause approximately 2,50,000 additional deaths per year, from malnutrition, malaria, diarrhoea and heat stress.
- If disease-related deaths are valued at lifetime earnings, the loss of economic output will be USD 2.5 Bn and USD 21 Bn in 2050 and 2100 respectively.

b. Damaged Infrastructure

- Climate change can damage physical infrastructure such as roads, bridges, railways, ports, airports, power plants, water supply systems, and buildings due to sea level rise, coastal erosion, landslides, storms, floods, and heat waves.
- Damaged infrastructure can disrupt economic activity, trade, and connectivity and increase maintenance and replacement costs.
- For instance, India spent USD 3 bn of economic damage caused by floods in the last decade which is 10% of the global economic loss.

c. Reduced Industrial Output

- Climate change can increase operational costs and reduce profits in the industrial sector due to factors such as new climate-friendly regulations, reduced utilisation of old stock, relocation of production processes and activities due to climate-related losses.
- India could contribute to 34 million out of 80 million global job losses due to heat stress-associated productivity decline by 2030.

d. Energy Crisis

- According to the the International Energy Agency (IEA), India's primary energy demand will double by 2030.

- Energy and climate share a distinctive relationship such that rising temperatures demand a surge in energy usage to assist the process of mitigating the heat effects.
- Additional power generation could require an incremental capital investment of USD 33 Bn and USD 123 Bn in 2050 and 2100 respectively to meet the higher cooling energy needs of India.

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