CMFRI

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Impact of Climate Change on Indian Marine Fisheries

Lecture Notes

Part 1

Compiled and Edited by

E. Vivekanandan and J. Jayasankar

Central Marine Fisheries Research Institute (CMFRI),
(*Indian Council of Agricultural Research*)
P.B. No. 1603, Cochin - 682 018, Kerala

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केंद्रीय समुद्री मात्स्यिकी अनुसंधान संस्थान
CENTRAL MARINE FISHERIES RESEARCH INSTITUTE

IMPACT OF WEATHER EXTREMES ON INDIAN FOOD GRAIN PRODUCTION

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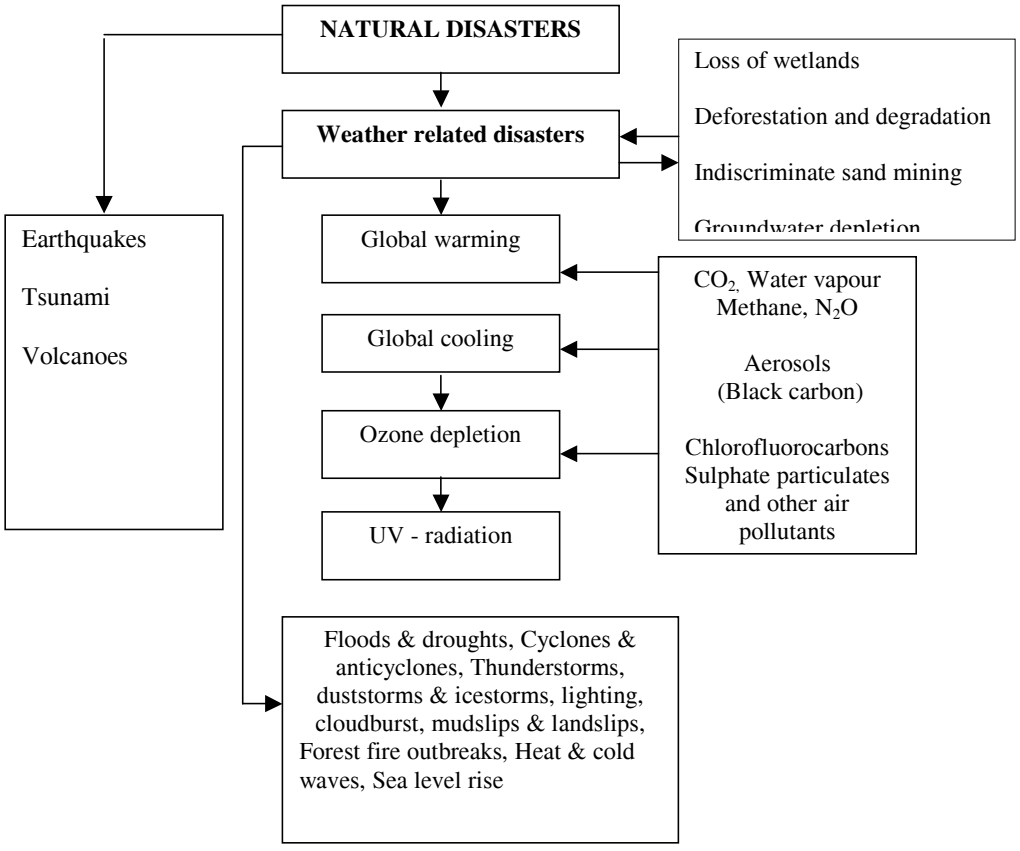
GSLHV Prasada Rao
Department of Agricultural Meteorology, College of Horticulture
Kerala Agricultural University, Vellanikkara

Introduction

Climate change and variability are recent concerns of humankind. The recurrent drought and desertification threaten seriously the livelihood of over 1.2 billion people who depend on land for most of their needs. The global economy has adversely been influenced due to droughts and floods, cold and heat waves, forest fires, landslips and mudslips, icestorms, duststorms, hailstorms, thunder clouds associated with lightning and sea level rise (Fig. 1).

Fig. 1. Natural and weather related disasters



Extreme events

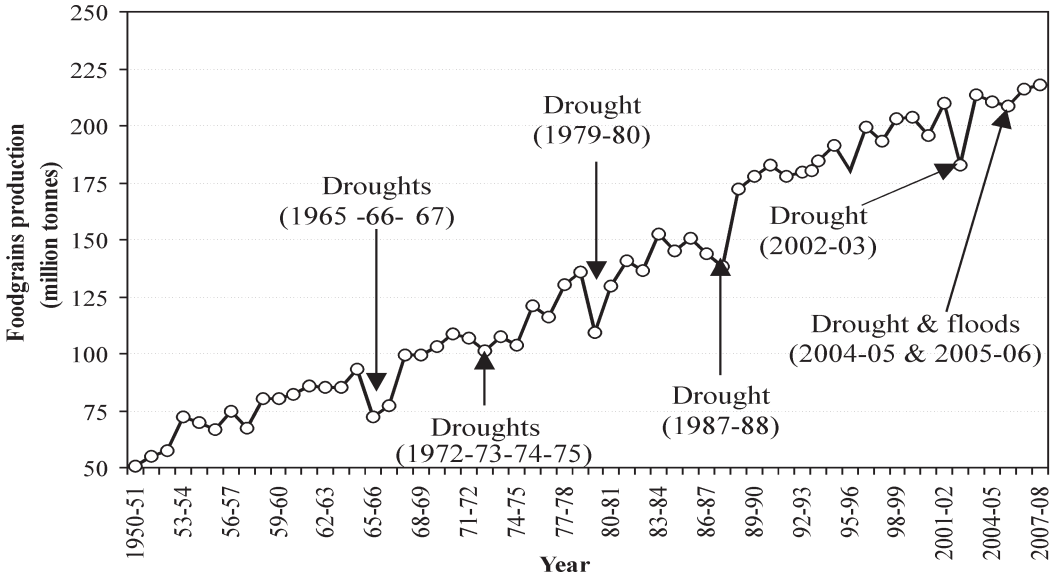
The year 1998 was the warmest and declared as the weather-related disaster year, which caused hurricane havoc in Central America and floods in China, India and Bangladesh. Canada and New England in the U.S suffered heavily due to icestorm in January while Turkey, Argentina and Paraguay with floods in June 1998. In contrast, huge crop losses were noticed in Maharashtra (India) due to unseasonal and poor distribution of rainfall during 1997-98. The 1997/1998 El Nino event, the strongest of the last century affected 110 million people and the cost on global economy was nearly US$ 100 billion. A string of 16 consecutive months saw record high global mean temperature in 1997-98. Statistics compiled from insurance companies for 1950-1999 showed that major natural catastrophes, which were weather related, caused estimated economic losses of US$960 billion. Most of the losses were recorded in recent years since 1995 onwards as the top ten warmest years occurred during the decade.

The year 2005 was another historic second worst warmest year on record for hurricanes. The hurricane Katrina over New Orleans (USA) in August; the hurricane Rita in Texas, central and western Cuba and southern Florida and typhoon over Hainan Province in South China and Vietnam during the last week of September, while early October over Mexican's Gulf coast; heavy downpour over Mumbai on 26th July, 2005 (Single-day the highest record rainfall of 944 mm) and 3rd September, 2005 over Bangalore; severe tropical storms in Andhra Pradesh in September; and floods in Kerala, Karnataka, Maharashtra, Gujarat, Orissa and Himachal Pradesh during the southwest monsoon (June-September) in 2005 in India devastated cropped area to a large extent in addition to losses of thousands of human lives. In contrast, it was declared as a famine year in 24 sub-Sahara African countries due to drought and attack of locusts in 2005. Similarly, Australia experienced a severe drought in 2002 and heavy crop damage was noticed. Again in 2006, occurrence of droughts and floods devastated rice and other crops in Andhra Pradesh and 40% cereal production was affected in Karnataka due to drought. Similar was the case during monsoon 2007, causing floods across several continents (Hurricane Dean in August slammed into Mexico) including India and Bangladesh. Torrential downpour in June, 2007 over Kerala, Karnataka, Andhra Pradesh and Maharashtra while in July and August over Gujarat, West Bengal, Orissa, Bihar, Uttar Pradesh and Assam, led to floods. Heavy rains again in September in Andhra Pradesh, Karnataka and Kerala led to floods and thus the year 2007 was the flood year in India. A huge crop loss was noticed in several states of the country due to floods in *kharif*, 2007. A major food shortage is expected in majority of African countries due to heavy floods, which devastated several crops in the region. Mali, a west African country more often plagued by droughts, received unprecedented rains during 2007. Similar was the case in Algeria, Uganda, Sudan, Ethiopia and Kenya.

Grain production

The Indian economy is mostly agrarian-based and depends on onset of monsoon and its further behaviour. The year 2002 was a classical example to show how Indian food grain production depends on rainfall of July and it was declared as the all-India drought, as the rainfall deficiency was 19% against the long period average of the country and 29% of area was affected due to drought. The *kharif* food grain production was adversely affected by a whopping fall of 19.1%. Similar was the case during all-India drought in 1979 and 1987. Occurrence of droughts and floods during southwest monsoon across the country affects food grain production to a greater extent as evident from Fig. 2.

Fig. 2 Impact of droughts on foodgrain production in India



It is one of the reasons that the food grain production is not in tune with plan estimates and the food grain production is likely to touch only a maximum of 260 million tonnes by 2020 at the present rate though it is projected as 400 million tonnes to declare India as one of the developed countries (Fig. 3).

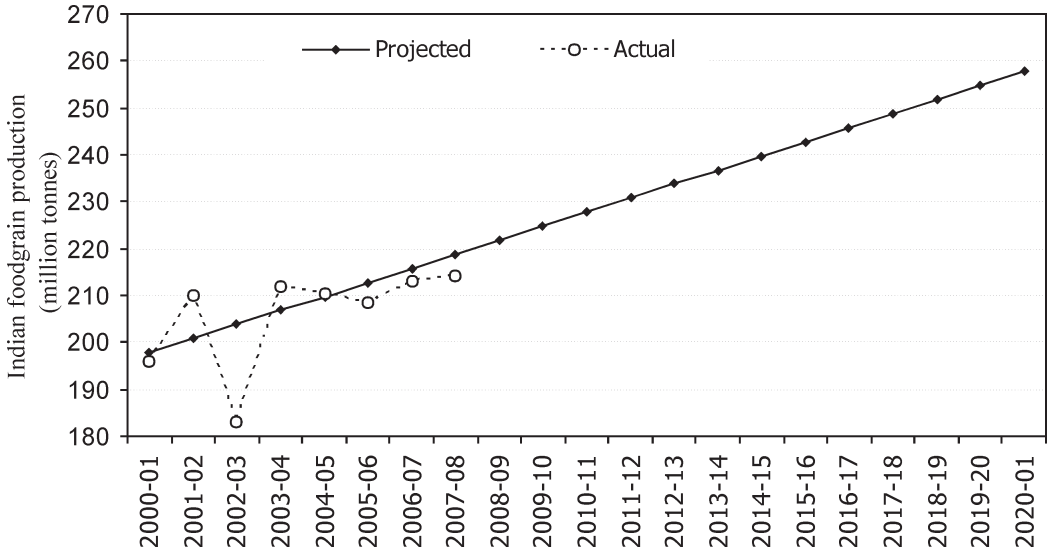


Fig. 3 Actual and projected Indian foodgrains production from 2000 - 01 to 2020 - 21

Increase in aerosols (atmospheric pollutants) due to emission of greenhouse gases including black carbon and chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs), ozone depletion and UV-B filtered radiation, eruption of volcanoes, the "human hand" in deforestation in the form of forest fires and loss of wetlands in the process of imbalanced development are causal factors for weather extremes. The loss of forest cover and wetlands, which normally intercept rainfall and allow it to be absorbed by the soil, causes precipitation to reach across the land, eroding top soil, causing floods and droughts. Paradoxically, the lack of trees also exacerbates drought in dry years by drying out soil quickly.

The IPCC (2006) projected the rate of warming for the 21st century to be between 0.8 and 4.4°C at various stabilized CO_2 levels in the atmosphere and it is most likely to be 3°C by end of this century. It could cost global economy nearly $7 trillion by 2050, equivalent to a 20% fall in growth if no action is taken on greenhouse gas emissions. If action is taken, it will cost only $350 billion due to climate change that has already taken place, just 1% of the global GDP. The winter 2007 was the warmest and recorded 0.85°C above average of 12°C and the previous highest was 0.71°C, which occurred in 2002 in Northern Hemisphere. The entire European Union recorded warm winter, more than 2°C above average. New York experienced the highest temperature of 21.7°C in January, 2007 and the second highest was recorded as 17.2°C in 1950. Floods and excess rains were also noticed due to hurricanes and tropical storms worldwide in 2007. The European Union suffered to a large extent due to heat wave in summer 2003.

The increase in all-India mean temperatures is almost solely contributed by increase in maximum temperature (0.6°C/100years) with minimum temperature remaining practically trendless. Consequently, there is a general increase in diurnal range of temperature. In rainfall, there was a decrease since last 50 years. A marked increase in rainfall and temperature is projected in India during the current century. The maximum expected increase in rainfall is likely to be 10-30% over central India. Temperatures are likely to increase by 3 - 4°C towards end of the Century. It is more pronounced over northern parts of India. The mean sea level rise is likely to be slightly less than 1mm/ year along the Indian coast. Greater number of high surges and increased occurrences of cyclones in post-monsoon period along with increased maximum wind speed are also expected as per Ministry of Environment and Forests (MoEF), Govt. of India and Department of Environment, Food and Rural Affairs (DEFRA), U.K. This phenomenon of climate change threatens the area of land availability for farming. As per the United Nations Report of FAO, India stands to lose 125 million tonnes, equivalent to 18% of its rainfed cereal production from climate change by 2015. China's rainfed cereal production potential of 360 million tonnes is expected to increase by 15% during the same period**.** It would also cause a worldwide drop in cereal crops, put 400 million more people at risk of hunger, and put up to 3 billon people at risk of flooding and without access to freshwater supplies. The crop production losses due to climate change may also drastically increase the number of undernourished people, severely hindering progress in combating poverty and food security. The severest impact is likely to be in sub-Saharan African countries, which are the least able to adapt to climate change or to compensate for it through increase in food imports. In 2004 and 2005, 24 sub-Saharan African countries faced food emergencies, caused by a lethal combination of locusts and drought. In addition, adverse hot and dry weather in United States and drought conditions in parts of the European Union lowered cereal output during 2005 when compared to that of 2004. The simulation models indicate that the global warming leads to reduction in rice and wheat production in northern India.

The future

The extreme weather events like droughts and floods, cold and heat waves are likely to increase in the ensuing decades. The human and crop losses are likely to be heavy. The global economy will be adversely affected as mentioned in the latest report of IPCC. If sea level increases as projected, the coastal areas which are thickly populated will be in peril and for the existing population, the safe drinking water will be a great problem. The whole climate change is associated with increasing greenhouse gases and human-induced aerosols and the imbalance between them may lead to uncertainty even in year-to-year monsoon

behaviour over India. Therefore, there should be a determined effort to make industrialisation environment-friendly by reducing greenhouse gases pumping into atmosphere. Awareness programmes on climate change and its effects in various sectors viz., agriculture, health, infrastructure, water, forestry, fisheries, land and ocean biodiversity and sea level and the role played by human beings in climate change need to be taken up on priority. In the process, life style of people also should be changed so as not to harm earth-atmosphere continuum by pumping greenhouse gases and CFCs into atmosphere. From agriculture point of view, effects of extreme weather events on crops are to be documented so that it will be handy to planners in such reoccurrence events for mitigating the ill effects. Also, there is a need to guide planners on projected future crop scenarios based on climate change events, which will be more realistic at field level as models always overestimate the impacts. Finally, we have to foresee these extreme events and prepare ahead to combat them so that the losses can be minimised. Therefore, strategies on mitigation and adaptation against climate change are to be chalked out on war footing in every sector.

Suggested Readings

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