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Global Warming

Melting ice - A hot topic?



Global Warming ... Melting ice - a hot topic ?

The atmosphere carries out the critical function of maintaining life-sustaining conditions on Earth, in the following way: each day, energy from the sun is absorbed by the land, seas, mountains, etc. If all this energy were to be absorbed completely, the earth would gradually become hotter and hotter. But actually, the earth both absorbs and, simultaneously releases it in the form of infra red waves. All this rising heat is not lost to space, but is partly absorbed by some gases present in very small quantities in the atmosphere, called GHGs (Greenhouse gases). Greenhouse gases (for example, carbon dioxide, methane, nitrous oxide, water vapour and ozone), re-emit some of this heat to the earth's surface. An increase in the levels of GHGs could lead to greater warming, which, in turn, could have an impact on the world's climate, leading to the phenomenon known as climate change.

What is climate change?

Climate change refers to a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period. Climate change may be due to natural internal processes or external forcings, or to persistent anthropogenic changes in the composition of the atmosphere or in land use.

Climate is the average weather over a long period of time. The components of the global climate are atmosphere, hydrosphere, cryosphere, biosphere, and the geosphere. These components interplay with one-another to create and maintain climate. Any alteration in any of these components would have a corresponding impact on the climate. The scientific community generally agrees that the globe has warmed over the past 40 years, largely due to anthropogenic causes. Energy use, transit, and land management have sharply increased the atmospheric concentration of common greenhouse gases like carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and chlorofluorocarbons (CFCs), increasing average global temperatures (Article & Web Alert, 2007).

The International Panel on Climate Change (IPCC), an international body projects that the global mean temperature may increase between 1.8°C to 4°C by 2100. The unprecedented increase is expected to have severe impact on the global hydrological system, ecosystems, sea level, crop production and related processes. The impact would be particularly severe in the tropics, which mainly consists of developing countries, including India (Survey of the Environment, 2007).

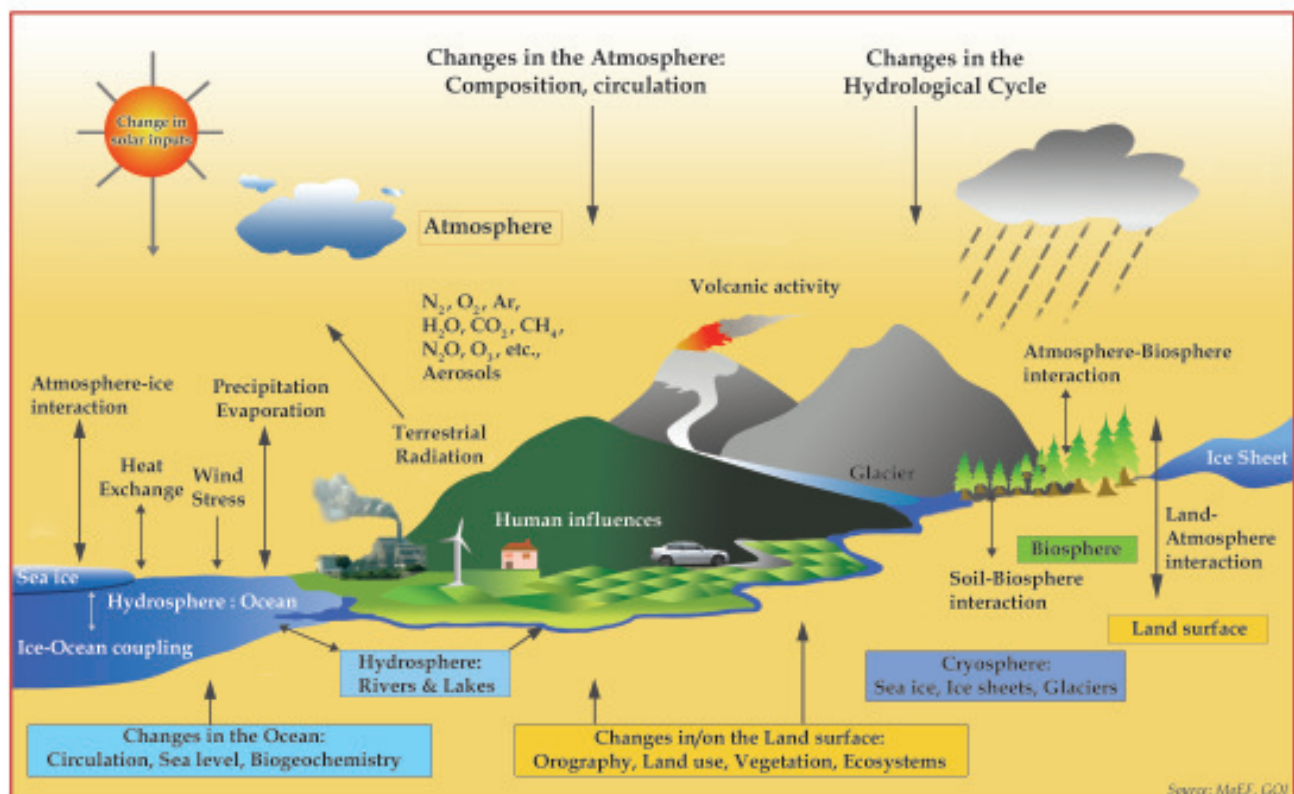
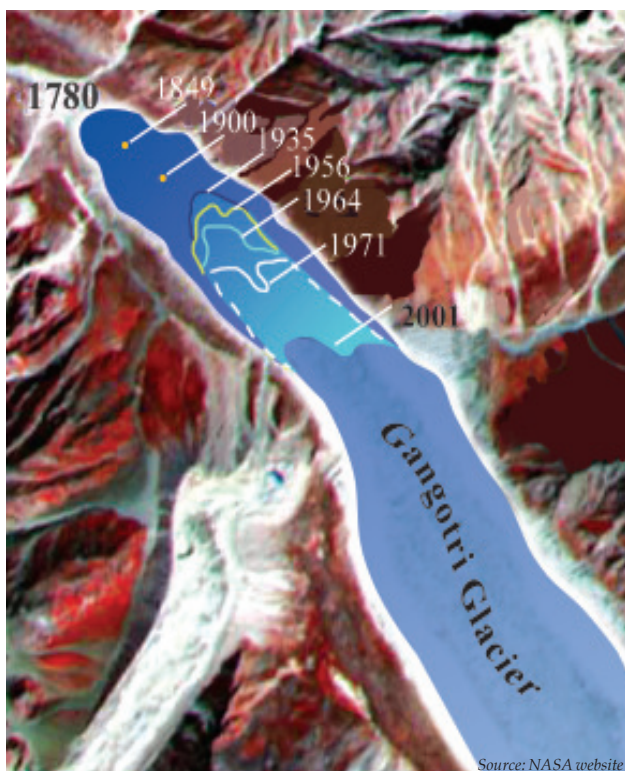


Fig.1. Schematic representation of Climate change

Melting of Gangotri Glacier

The river Ganga originates in the Himalayas, and is fed by several glaciers. The Gangotri is the longest of these, at 26 km in length. Scientists studying this glacier have found that it has been retreating at a rate of 20 m a year compared to about 16 m per year in the past. If the present trend continues, then over the next 25 years, the Ganga could initially swell in volume because of increased melting but then dry out as the water supply in the mountains runs low. This will endanger the lives of about 400 million people who live in the river's plains and depend upon it for their supply of water (Survey of the Environment, 2007).



Impact on Forest Ecosystem

Climate change has the potential to adversely impact natural ecosystems such as forests and socio-economic systems such as food production and fishing. The scientific study reveals that projected climate change is likely to lead to increase water scarcity, increased drought and high rainfall threat to biodiversity, shift in forest types, alter species composition, reduction in food production in dry tropics with increased risk of hunger and flooding due to sea level rise. Climate is probably the most important determinant of vegetation patterns and has significant influence on forest distribution, species dominance, plant productivity and in general ecology of forests. The global warming in the recent decades has already made an impact on forest ecosystems such as a pole-ward and upward shift in ranges of plant,

insect, bird and fish species. Further, plant flowering, bird arrival and dates of breeding and flowering are observed to be occurring earlier than before in the seasons. An assessment of the Impact of climate change shows that large scale mortality of tree species is likely under the changed climatic conditions (Ravindranath 2007). Thus any impact on forest vegetation and biodiversity will have adverse implications for the livelihoods of forest dependent communities (Survey of the Environment, 2007).

Impact on Biodiversity

Ecosystems have a limited capacity to adapt to climate change. Through different years, the inhabitants of this planet have adapted and evolved with the changing climatic conditions of their surroundings. When the rate and extent of climate change exceeds nature's maximum adaptation speed, it may lead to the extinction of several species. Inability to adapt to rapid environmental changes has drastic implications. It is estimated that by 2100 two-thirds of the Earth's remaining species might become extinct (Article & Web Alert, 2007).

Independent of climate change, biodiversity in India is under threat and is projected to decline in the future due to multiple pressures such as increased land-use intensity, forestland conversion, non-sustainable extraction of biomass, over grazing and forest fire. The projected climate change is likely to adversely impact biodiversity since the future climate will not be optimally suited to current forest type and species-mix. The species extinction, already occurring in India, could be accelerated. Many existing species may be subjected to drying of plants due to warming, mortality and poor regeneration. For example, if the montane grasslands of the western ghats are invaded by woody plants, the endemic Nilgiri Tahr may be t h r e a t e n e d .

Similarly upward altitudinal migration of plants in the Himalayas could reduce the alpine meadows and related vegetation, adversely impacting the habitats of several high altitude mammals including wild sheep, goat, antelope and cattle (Survey of the Environment, 2007).



Impact on Agriculture

Global warming is predicted to affect agricultural production. In the tropics and subtropics, with prevailing high temperatures, crops are already growing at a particular threshold where dry land, non-irrigated agriculture dominates. Therefore yields are likely to decrease even with slight changes in temperature.



Agricultural productivity is sensitive to two broad classes of climate – induced effects: direct effects from changes in temperature, precipitation, radiation, or carbon dioxide concentrations, and indirect effects through changes in soils and the distribution and frequency of infestation by pests and diseases. However, much depends not only on the physiological response of the affected plant, but also on the ability of the affected socio-economic systems of production to cope with changes in yield and in the frequency of droughts or floods. The Third Assessment Report (TAR) of the Inter Governmental Panel on Climate Change (IPCC) indicates that India's rice and wheat production will drop significantly because of climate change (Survey of the Environment, 2007). For example in Kullu Valley in the state of Himachal Pradesh apple belt has moved 30 kilometers (northwards) over the last 50 years, and Bajaura (a low point of the valley) was once the starting point for apple, now there is no apple below Raisan, a midpoint of the valley. It is noted that the change in climate, respondents most often began their response by describing the changed pattern of snowfall (Neeray Vedwan, 2006).

Impact on Coastal Environment

The Intergovernmental panel for climate change (IPCC, 2007) and the Stern review committee predicted that the coastal belts are more prone to the devastating impacts of global warming. Assessments show that one metre sea level rise can lead to welfare loss of \$1,259 million in India equivalent to 0.036 percent of GNP. India's coastline is about 7500 km long and is densely populated as well as low-lying. Tropical cyclones

and storm surges are one of the most critical factors affecting loss of human lives in India. There is concern that global warming may affect tropical cyclone characteristics, including intensity, because sea-surface temperature (SST) plays an important role in determining whether tropical disturbances.

Most of India's coastal regions are fertile and under paddy cultivation, which is sensitive to inundation and salinization. Coastal infrastructure, tourist activities and onshore oil exploration are also at risk. Variations in climatic patterns are expected to result in an increase in the frequency and intensity of extreme events such as cyclones. These will greatly affect the population in coastal areas and may cause devastation in low-income rural areas as exemplified by the cyclone that hit Orissa in 1999, killing about 10,000 people. A one-metre rise in sea level is expected to inundate about 1700 km² of agricultural land in Orissa and West Bengal (IPCC, 1992). The coastline of Orissa is also frequently affected by severe climate change initiated cyclones. It is also frequented by other natural calamities like drought and flood. The sea has ingressed to about 1.5 km into Satavaya and 2.5 km into Kanakpur. Satavaya has also lost 56% of its mangrove vegetation. In Tamil Nadu the most vulnerable coastal districts are Nagapattinam, Cuddalore and Kanyakumari.

Coral bleaching in Gulf of Mannar Biosphere Reserve

Corals are losing their attractive colours, these 'rainforest of the ocean', stunningly coloured, are some of the oldest and most biologically diverse ecosystems on earth. Corals are very sensitive to changes in the temperature of the water in which they live - an increase of even a couple of degrees centigrade can spell danger to their survival. The coral get bleached after Zooxanthellae, an algae lives in coral, responsible for its beautiful colours, is either killed or reduced results from an increase in the temperature.



Bleaching over prolonged periods not only causes the spectacular colours to fade, but also weakens the corals, making them more vulnerable to disease. Over the past two decades, there has been a rapid increase in the number of bleaching events (MoEF, 2007). In Gulf of Mannar, T.N, it was reported that coral bleaching has increased from 14.9 % to 15.5% from 2005 to 2006.

Global Initiatives

The Intergovernmental Panel on Climate Change (IPCC) was established in 1988 with an objective of evaluating the scientific evidence on global warming, assessing the environmental and agricultural impacts of climatic change, and formulating responses. In 1992, representatives from 178 nations, Non Governmental Organisations (NGOs) and other interested parties met in Rio de Janeiro, Brazil to discuss global environmental issues. The first United Nations Conference on Environment and Development (UNCED) is widely regarded as the most important international environmental conference to date and is popularly known as the Earth Summit. The Summit resulted in treaties on biodiversity and climate change, and the assembled countries adopted "Agenda 21" – a blueprint to promote sustainable development. The United Nations Framework Convention on Climate Change (UNFCCC) was adopted in 1992, which entered into force in 1994 with the ultimate objective of stabilizing greenhouse gas concentrations in the atmosphere. The convention also led to the establishment of a Conference of the Parties (COP) which functions as the supreme implementing body of the Convention. In 1997, the third COP session held in Kyoto, Japan resulted in the adoption of the Kyoto Protocol to the UNFCCC. The Protocol calls for legally binding commitments to reduce greenhouse gas emissions by 5.2% below 1990 levels by the period 2008-2012. The Kyoto Protocol entered into force on 16th February 2005 following ratification by Russia in 2004 (Article and Web Alert, 2007).

Government Initiatives

India has undertaken numerous response measures that are contributing to the objectives of the United Nations Framework Convention on Climate Change (UNFCCC). India's development plans balance economic development and environmental concerns. The planning process is guided by the principles of sustainable development. Reforms in the energy

and power sector have accelerated economic growth and enhance the efficiency of energy use. These have been complemented by notable initiatives taken by the private sector. In the last few years several measures relating to environmental issues have been introduced. They have targeted increasing significantly, the capacity of renewable energy installations; improving the air quality in major cities (the world's largest fleet of vehicles fuelled by compressed natural gas has been introduced in New Delhi); and enhancing afforestation. Other similar measures have been implemented by committing additional resources and realigning new investments, thus putting economic development on a climate-friendly path (MoEF).

Initiatives taken by Tamil Nadu towards CDM

A. Clean Development Mechanism (CDM)

The CDM is a new and emerging area which would generate additional revenue for the renewable energy projects. Tamil Nadu Energy Development Agency has been designated as State level agency for small scale CDM projects in Tamil Nadu by the Ministry of Environment and Forest. Under United Nations Development Programme assistance, TEDA has prepared Project Design Documents for 3 small scale projects viz., biomass power project use of bio diesel in transport and village energy security plan in hamlets (Energy Policy note, 2007-08).

B. Methane captures in Sewage Treatment Plants in Chennai

The Chennai Metrowater saves about Rs. 4 crore a year by generating sufficient electricity through biogas from sewage sludge in four plants at Koyambedu, Nesapakkam, Kodungaiyur and Perungudi. The water agency would be presented 'carbon credits' for generating electricity from biogas to operate its sewage treatment plants in the city (The Hindu, June 07).



World Environment Day celebrations 2007 at Ramanathapuram

Seminar on Climate Change

The theme of the world Environment Day for the year 2007 is "Melting Ice - a Hot Topic?" In Tamil Nadu the World Environment Day was celebrated on 5th June by the Department of Environment in collaboration with Tamil Nadu Pollution Control Board (TNPCB) and Gulf of Mannar Biosphere Reserve Trust (GoMBRT) at Schwartz Higher Secondary School, Ramanathapuram. Thiru R. Kirlosh Kumar, I.A.S., Collector, Ramnad district inaugurated an exhibition and seminar on climate change and spoke about the impact of climate change and the rise in sea level. Thiru K.S. Neelakantan, I.F.S., Director, Department of Environment, insisted on the importance of conserving the Gulf of Mannar Biosphere Reserve to the school students. Dr. T. Sekar, I.F.S., Member Secretary, TNPCB, expressed concern about the increasing vehicular pollution which leads to increase in CO₂ levels in the atmosphere. In the morning technical session Dr. J.K. Patterson Edward, Director, SDMRI spoke about the impact of climate change on Marine environment. Dr. C. Thomson Jacob, Senior Programme Officer, ENVIS Centre, delivered a lecture on the impacts of global warming in Himachal Pradesh and coastal Orissa and made a video presentation to the students.

Environment day awareness rally

To create an environmental awareness to the public a student's rally was organised at Ramanathapuram on 5th June 2007 and the District Superintendent of Police Thiru. R. Thirugnanam I.P.S., flagged off the awareness rally from Schwartz Matriculation Higher Secondary School and it concluded at Schwartz Higher Secondary School, Ramanathapuram. More than 1000 Eco-club/NGC students of Ramanathapuram district belonging to various schools have participated in the rally.

Environmental Awards - 2007

The Government of Tamil Nadu has constituted three categories of environment awards (3 prizes) and one award for the best research paper to recognize excellence in the different fields of Environmental education and awareness, Environmental protection and Environmental management. This year, the Hon'ble Minister for Housing and slum clearance board Thiru S. Thangavelan, distributed the Environmental awards to the winners. The Hon'ble Minister for Environment Thiru T.P.M. Mohideen Khan, released SoE Video and launched a SoE website on 'State of Environment' of Tamil Nadu and highlighted the environmental initiatives taken by the Government of Tamil Nadu. Thiru K.S. Neelakantan I.F.S., Director, DoE in his introductory speech briefed about the theme of the World Environment Day 2007. Thiru R. Rajagopal, I.A.S., Secretary to Government, Environment and Forests highlighted the role of NGC in creating Environmental awareness among students and released the manual on eco-club/NGC and Student guide. Thiru N. Sundaradevan, I.A.S., Chairman, TNPCB said that



Awareness rally at Ramanathapuram



Hon'ble Ministers visit to exhibition



Hon'ble Minister Thiru T.P.M. Mohideen Khan releasing the SoE Video



Winners of Environmental Awards 2007



Releasing of National Green Corps manual



World environment day celebration at Nagercoil



World environment day celebration at Erode



the awareness of preserving the environment should begin from students, so that the message could be spread to others in an effective manner and launched the environment awareness activities to be undertaken during this financial year by TNPCB. Dr.V.K. Melkani, I.F.S., Director, GoMBRT said that all five prime factors of life saving system should be

Award for Environmental Education and Awareness

1.	Arignar Anna Award	Colombo Syed Mohamed Alim HSS, Dindigul
2.	Sutrusuzhal Sudar Oli Award	Sri Natesan Vidyasala MHSS, Mannivakkam, Chennai
3.	Sutrusuzhal Seyal Veerar Award	Tmt. R. Saraswathi, P.G.Assistant, Gurukulam Girls HSS, Coimbatore

Award for Environmental Protection

1.	Dr. Gurusamy Mudaliar Award	Tmt. Mangalam Balasubramanian, Pammal, Chennai
2.	Sutrusuzhal Kavalar Award	Kavignar G. Ganapthy Subrammanian, Tirunelveli
3.	Sutrusuzhal Seyal Veerar Award	V. Ramasamy, Tirunelveli

Award for Environmental Management

1.	Karma Veerar Kamarajar Award	Dr. K. Ramasamy, Professor, TNAU, Coimbatore
2.	Sutrusuzhal Puravalar Award	Dr. R. Babu Rajendran, Reader, Barathidasan University, Tiruchy
3.	Sutrusuzhal Seyal Veerar Award	Dr. K. Govindarajulu, Associate Professor, CPM College, Coimbatore
1.	The Best Research Paper Award	Dr. G. Manimaran, Associate Professor, V.O.C. College, Tuticorin

protected. Thiru R. Kirlosh Kumar, I.A.S., said that people should come forward to use non-conventional energy sources. The Department of Environment requested all the District Educational Officers and Chief Educational Officers to ensure the celebration of World Environment Day by conducting rallies, competitions, workshops, seminars, cultural programmes etc in schools in the State. In Erode, 750 students participated in the human chain and raised awareness through slogan, street play and by distributing pamphlets.

In Salem, competitions and environment rallies were organized. In Attur, Government Girls Higher Secondary School, Gokulanatha Hindu Mahajan Higher Secondary School, Gangavalli Government Boys Higher Secondary School, St. John's Matriculation Higher Secondary School, Holy Cross Matriculation Higher Secondary School and Jayarani Girls Higher Secondary School conducted environmental awareness programmes on climate change.

In Nagercoil, more than 100 students participated in the awareness rally and tree plantation. A seminar on global warming was organized in Marthandam Girls Higher Secondary School. In Vellore, Thiru K. Kamaraj, DEE, TNPCB flagged off the rally and more than 10 schools participated in the awareness rally. In Karur, a seminar was organised in Annai Lea High School, Sevapur by Inba Seva Sangam. More than 150 students participated and tree saplings were planted.

Further, the All India Radio broadcasted the message delivered by Thiru K.S. Neelakantan, I.F.S., Director, DoE on the importance of preserving Environment and the steps taken by the Government of Tamil Nadu.

Vulnerability to Climate change

India-specific information from the IPCC assessment reports

Chenab

Studies of the catchment area of the Chenab show that the average snow melt and glacier melt contribution to the annual flow is 49.1%. In the dry season a significant proportion of runoff is derived from snow. Climate change may cause increases in temperature which will shorten the winters, increase the rate of snow melt and reduce the amount of snow fall.

Rajasthan

In India, chronically drought-affected areas cover the western parts of Rajasthan and the Kutch region of Gujarat. Drought conditions have also been reported in Bihar and Orissa. Global warming is likely to increase the rise of droughts that occur with El Nino events.

Rann of Kutch

Sea-level rise would submerge salt marshes and mudflats in the Rann of Kutch resulting in decreased habitat for breeding flamingos and lesser floricans.

Mumbai

Low-lying coastal cities such as Mumbai will be at the forefront of impacts caused due to sea level rise, changes in water regimes, Saltwater intrusion, siltation and land loss.

Kerala

Depletion of soil moisture due to climate change could reduce the productivity of forests in Kerala teak productivity is projected to decline from 5.40m³/ha to 5.07m³/ha. Also productivity of moist deciduous forests could decline from 1.8 m³/ha to 1.5 m³/ha.

Tamil Nadu

1. In Chennai, rise in the mean temperature (1.5°C increase). The highest maximum temperature rose upto 34.5 - 36°C in March and 37-39°C in Tamil Nadu.
2. Coral bleaching in Gulf of Mannar. (source: Regn. Meteorological Centre, Chennai and The Hindu, 07)

Northwest India

A study carried out in northwest India revealed that there would be a considerable net reduction in rice yield with rise in surface air temperatures.

Bihar

During 1987-90, visceral leishmaniasis reached epidemic form in Bihar affecting about 110 million people. The incidence of the disease is likely to increase in a warmer climate. Major endemic foci are reported in border areas in India (States of Bihar and West Bengal), Bangladesh and Nepal.

Ganges-Brahmaputra delta

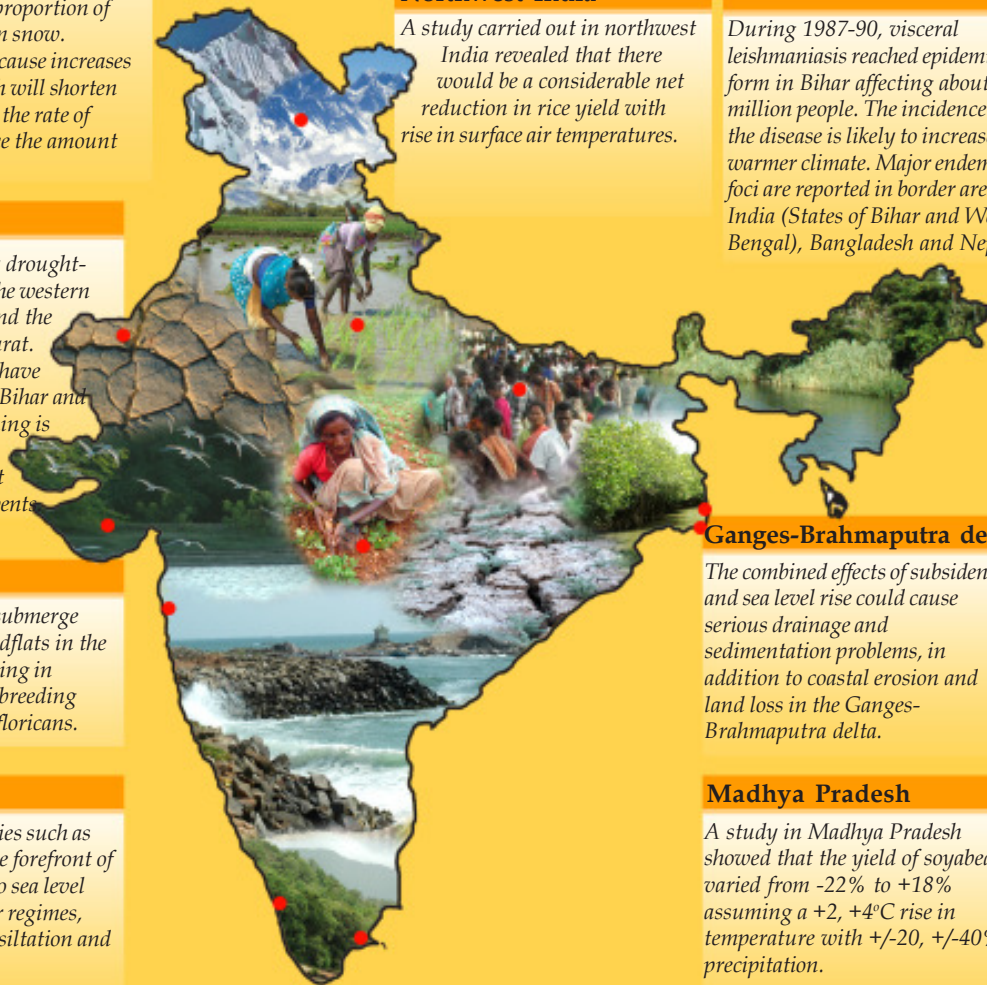
The combined effects of subsidence and sea level rise could cause serious drainage and sedimentation problems, in addition to coastal erosion and land loss in the Ganges-Brahmaputra delta.

Madhya Pradesh

A study in Madhya Pradesh showed that the yield of soyabean varied from -22% to +18% assuming a +2, +4°C rise in temperature with +/-20, +/-40% precipitation.

Sunderbans

There is a serious threat to species living in the Sunderbans due to sea level rise. *Heritiera fomes* (Mangrove) the dominant species area is threatened due to inland movement of saline water.



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