CHAPTER - 20

IMPACT OF CLIMATE CHANGE

20.1. AGRICULTURE AND FOOD SECURITY

- Climate Change can affect crop yield as well as the types of crops that can be grown in certain areas, by impacting agricultural inputs such as water for irrigation, amounts of solar radiation that affect plant growth, as well as the prevalence of pests.
- Rise in temperatures caused by increasing green house gases is likely to affect crops differently from region to region. For example, moderate warming (increase of 1 to 3°C in mean temperature) is expected to benefit crop yields in temperate regions, while in lower latitudes especially seasonally dry tropics, even moderate temperature increases (1 to 2°C) are likely to have negative impacts for major cereal crops. Warming of more than 3°C is expected to have negative effect on production in all regions.
- The Third Assessment Report of the IPCC, 2001 concluded that climate change would hit the poorest countries severely in terms of reducing the agricultural products.
- The Report claimed that crop yield would be reduced in most tropical and sub-tropical regions due to decreased water availability, and new or changed insect/pest incidence.
- In South Asia losses of many regional staples, such as rice, millet and maize could top 10 per cent by 2030.
- As a result of thawing of snow, the amount of arable land in high-latitude region is likely to increase by reduction of the amount of frozen lands.
- At the same time arable land along the coast lines are bound to be reduced as a result of rising sea level.
- Erosion, submergence of shorelines, salinity of the water table due to the increased sea levels, could mainly affect agriculture through inundation of low lying lands.
- In a recent study, the International Commission for Snow and Ice (ICSE) reported that Himalayan glaciers – that are the principal dry-season water sources of Asia's biggest rivers - Ganges, Indus, Brahmaputra, Yangtze, Mekong, Salween and Yellow – are shrinking quicker than anywhere else and that if current trends continue they could disappear altogether by 2035.
- If agricultural production in the low-income developing countries of Asia and Africa is adversely affected by climate change, the livelihoods of large numbers of the rural poor will be put at risk and their vulnerability to food insecurity will be manifold.

Do you know?

A conifer usually has a conical appearance and has an excurrent stem; i.e., its main stem is thickest at the base and gradually tapers toward the apex, with lateral branches in an acropetal succession.

20.1.1. Impacts on Indian agriculture

- A large part of the arable land in India is rain-fed, the productivity of agriculture depends on the rainfall and its pattern.
- Agriculture will be adversely affected not only by an increase or decrease in the overall amounts of rainfall but also by shifts in the timing of the rainfall.
- Any change in rainfall patterns poses a serious threat to agriculture, and therefore to the economy and food security.

- Summer rainfall accounts for almost 70 per cent of the total annual rainfall over India and is crucial to Indian agriculture.
- However, studies predict decline in summer rainfall by the 2050s.
- Semi arid regions of western India are expected to receive higher than normal rainfall as temperatures soar, while central India will experience a decrease of between 10 and 20 per cent in winter rainfall by the 2050s.
- Relatively small climate changes can cause large water resources problems particularly in arid and semi arid regions such as northwest India.
- Productivity of most crops may decrease due to increase in temperature and decrease in water availability, especially in Indo-Gangetic plains.
- This apart, there would be a decline in the productivity of rabi as compared to kharif season crops.
- Rising temperature would increase fertilizer requirement for the same production targets and result in higher GHG emissions, ammonia volatilization and cost of crop production.
- Increased frequencies of droughts, floods, storms and cyclones are likely to increase agricultural production variability.

Do you know?

The sloth bear, also known as the labiated bear, is a nocturnal insectivorous species of bear found wild within the Indian subcontinent. They feed on termites, honeybee colonies and fruits

20.2. WATER STRESS AND WATER INSECURITY

- Lack of access to water is a perturbing issue, particularly in developing countries.
- Climate change is expected to exacerbate current stresses on water resources.
- By 2020, between 75 and 250 million people are projected to be exposed to increased water stress due to climate change.
- Spreading water scarcity is contributing to food insecurity and heightened competitions for water both within and between countries.
- As the world population expands and the consumption of water spirals upwards, water problems are bound to intensify.
- Increase in temperature due to climate change has been widespread over the globe.
- Warming has resulted in decline in mountain glaciers and snow cover in both hemispheres and this is projected to accelerate throughout the 21st century.
- This will in turn lead to reducing water availability, hydropower potential, and would change the seasonal flow of rivers in regions supplied by melt water from major mountain ranges (e.g. Hindu-Kush, Himalaya, Andes).
- By 2050s freshwater availability in Central, South, East and South-East Asia, particularly in large river basins, is projected to decrease.
- A warmer climate will accelerate the hydrologic cycle, altering rainfall, magnitude and timing of run-off.
- Available research suggests a significant future increase in heavy rainfall events in many regions, while in some regions the mean rainfall is projected to decrease.
- The frequency of severe floods in large river basins has increased during the 20th century.
- Increasing floods poses challenges to society, physical infrastructure and water quality.
- Rising temperatures will further affect the physical, chemical and biological properties of fresh water lakes and rivers, with predominantly adverse impacts on many individual fresh water species, community composition and water quality.
- In coastal areas, sea level rise will exacerbate water resource constraints due to increased salinisation of groundwater supplies.

20.2.1. Impacts on water situation in India

- Water resources will come under increasing pressure in the Indian subcontinent due to the changing climate.
- The Himalayan glaciers are a source of fresh water for perennial rivers, in particular the Indus, Ganga, and Brahmaputra river systems.
- In recent decades, the Himalayan region seems to have undergone substantial changes as a result of extensive land use (e.g. deforestation, agricultural practices and urbanization), leading to frequent hydrological disasters, enhanced sedimentation and pollution of lakes.

- There is evidence that some Himalayan glaciers have retreated significantly since the 19th century.
- Available records suggest that the Gangotri glacier is retreating about 28 m per year.
- Glacial melt is expected to increase under changed climate conditions, which would lead to increased summer flows in some river systems for a few decades, followed by a reduction in flow as the glaciers disappear.
- As a result of increase in temperature significant changes in rainfall pattern have been observed during the 20th century in India.
- A serious environmental problem has also been witnessed in the Indo-Gangetic Plain Region (IGPR) in the past whereby different rivers (including Kosi, Ganga, Ghaghara, Son, Indus and its tributaries and Yamuna) changed their course a number of times.
- The recent devastating floods in Nepal and Bihar due to change of course of River Kosi is a case in point.
- Available study suggests that food production has to be increased to the tune of 300 mt by 2020 in order to feed India's ever-growing population, which is likely to reach 1.30 billion by the year 2020.
- The total foodgrain production has to be increased by 50 per cent by 2020 to meet the requirement.
- It is feared that the fast increasing demand for food in the next two or three decades could be quite grim particularly in view of the serious problem of soil degradation and climate change.
- The rise in population will increase the demand for water leading to faster withdrawal of water and this in turn would reduce the recharging time of the water tables.
- As a result, availability of water is bound to reach critical levels sooner or later. During the past four decades, there has been a phenomenal increase in the growth of groundwater abstraction structures.
- Growing demand of water in agriculture, industrial and domestic sectors, has brought problems of overexploitation of the groundwater resource to the fore.
- The falling groundwater levels in various parts of the country have threatened the sustainability of the groundwater resources.
- At present, available statistics on water demand shows that the agriculture sector is the largest consumer of water in India.
- About 83% of the available water is used for agriculture alone. If used judiciously, the demand may come down to about 68% by the year 2050, though agriculture will still remain the largest consumer.
- In order to meet this demand, augmentation of the existing water resources by development of additional sources of water or conservation of the existing resources and their efficient use will be needed.
- It is evident that the impact of global warming threats are many and alarming.
- Water security in terms of quantity and quality pose problems for both developed and developing countries.
- However, the consequences of future climatic change may be felt more severely in developing countries such as India, whose economy is largely dependent on agriculture and is already under stress due to current population increase and associated demands for energy, freshwater and food.

Do you know?

Indian Flying Fox are the fruit eating bats. This species is found in roosts in large colonies of hundreds to thousands of individuals on large trees in rural and urban areas, close to agricultural fields, ponds and by the side of roads.

20.3. RISE IN SEA LEVELS

- Sea level rise is both due to thermal expansion as well as melting of ice sheets.
- Satellite observations available since the early 1990s show that since 1993, sea level has been rising at a rate per year, significantly higher than the average during the previous half-century.
- IPCC predicts that sea levels could rise rapidly with accelerated ice sheet disintegration.
- Global temperature increases of 3–4°C could result in 330 million people being permanently or temporarily displaced through flooding.
- Warming seas will also fuel more intense tropical storms.

20.3.1. Impacts on Coastal States in India

- The coastal states of Maharashtra, Goa and Gujarat face a grave risk from the sea level rise, which could flood land (including agricultural land) and cause damage to coastal infrastructure and other property.
- Goa will be the worst hit, losing a large percentage of its total land area, including many of its famous beaches and tourist infrastructure.
- Mumbai's northern suburbs like Versova beach and other populated areas along tidal mud flats and creeks are also vulnerable to land loss and increased flooding due to sea level rise.
- Flooding will displace a large number of people from the coasts putting a greater pressure on the civic amenities and rapid urbanisation.
- Sea water percolation due to inundations can diminish freshwater supplies making water scarcer.
- The states along the coasts like Orissa will experience worse cyclones. Many species living along the coastline are also threatened.
- The coral reefs that India has in its biosphere reserves are also saline sensitive and thus the rising sea level threatens their existence too, not only the coral reefs but the phytoplankton, the fish stocks and the human lives that are dependent on it are also in grave danger.
- People living in the Ganges Delta share the flood risks associated with rising sea levels.

20.4. ECOSYSTEMS AND BIO-DIVERSITY

- Climate Change has the potential to cause immense biodiversity loss, affecting both individual species and their ecosystems that support economic growth and human well being.
- The projected extinctions of flora and fauna in the future will be human driven i.e. due to adverse impact of human activities.
- According to International World Wildlife Fund (WWF) species from the tropics to the poles are at risk.
- Many species may be unable to move to new areas quickly enough to survive changes that rising temperatures will bring to their historic habitats.
- WWF asserted that one-fifth of the world's most vulnerable natural areas may be facing a "catastrophic" loss of species.
- It have catastrophic impact on the marine ecosystems. They will be affected not only by an increase in sea temperature and changes in ocean circulation, but also by ocean acidification, as the concentration of dissolved carbon dioxide (carbonic acid) rises.
- This is expected to negatively affect shell forming organisms, corals and their dependent ecosystems.

Do you know?

Grizzled giant squirrel is distributed in the patches of riparian forest along the Kaveri River and in the hill forests in the Tamil Nadu and Kerala states of southern India. IUCN Status - near threatened

20.5. IMPACTS ON INDIA'S BIODIVERSITY

- India is a land of mega-biodiversity, encompassing features from glaciers to deserts. However, climate change is posing grave threat to its ecosystems.
- Mountain ecosystems are hot spots of biodiversity. However, temperature increases and human activities are causing fragmentation and degradation of mountain biodiversity.
- The Himalayan Ecosystem is considered as the lifeline not only to India but also to our neighbouring countries such as China, Pakistan, Nepal, owing to the perennial rivers that arise out of the melting glaciers.
- It is home to the largest amount of glaciers after the North and the South Poles. However, climate change is threatening this life giver drastically.
- It is also predicted that there will be an increase in the phenomenon of Glacial Lake Outburst Floods (GLOFs) in the eastern and the central Himalayas, causing catastrophic flooding downstream, with serious damage to 'life, property, forests, farms, and infrastructure'.
- The melting glaciers of the Himalayas have a serious impact given the fact that they give rise to the perennial rivers that further flourishes the agriculture.
- The Himalayan rivers are closely interlinked with the Indo-Gangetic Ecosystem, which is primarily an agricultural ecosystem, nearly 65-70% of Indians having agriculture as their primary occupation.
- The National Environment Policy, 2006 states that the Indian Desert Ecosystems (arid and semi-arid region)

occupies 127.3 mha (38.8%) of the country's geographical area and spreads over 10 states.

- The Indian desert fauna is extremely rich in species diversity of mammals and winter migratory birds.
- Recent studies have shown that deserts have shown signs of expansion, thus leading to a process called desertification.
- The climate patterns have altered the natural attributes of a desert region; for example the floods in the desert district of Barmer in Rajasthan in 2006.
- Coastal and Marine Ecosystem is one of the assets of India.
- The mangrove forests (wetlands) of the rivers and the coasts acts as carbon sink as well as a habitat for a unique and diverse species of plants and animals.
- The wetlands act as a natural barrier to flooding (that may be caused by the rising sea levels) and cyclones.
- The most explicit event in the perspective of climate change affecting the marine ecosystem is the example of coral bleaching.
- In the Peninsular India, even the rivers of the Peninsula are dependent on the monsoons, thus the Peninsular Ecosystem is basically a monsoon dependent ecosystem.
- India is heavily dependent on the monsoon to meet its agricultural and water needs, and also for protecting and propagating its rich biodiversity. Climate change is linked with the changing patterns observed in the monsoons of India.

Do you know?

Narcotic substances that are used for smoking purposes are called "fumitories," and those that are used for chewing purposes are called "masticatories."

20.6. CLIMATE CHANGE AND HEALTH

- Climate change poses a host of threats to the survival of mankind.
- Each year, about 800,000 people die from causes attributable to air pollution, 1.8 million from diarrhoea resulting from lack of access to clean water supply, sanitation, and poor hygiene, 3.5 million from malnutrition and approximately 60,000 in natural disasters.
- A warmer and more variable climate would result in higher levels of some air pollutants, increased transmission of diseases through unclean water and through contaminated food.
- Climate change has a direct impact on human health.
- For example, the warmer the climate the likelihood of its impact on human health becomes worse.
- It is anticipated that there will be an increase in the number of deaths due to greater frequency and severity of heat waves and other extreme weather events.
- Climate change and the resulting higher global temperatures are causing increasing frequency of floods and droughts leading to the risk of disease infections.
- Lack of freshwater during droughts and contamination of freshwater supplies during floods compromise hygiene, thus increasing rates of diarrhoeal disease.
- Endemic morbidity and mortality due to diarrhoeal disease primarily associated with floods and droughts are expected to rise in East, South and South-East Asia due to projected changes in hydrological cycle.
- Flooding also creates opportunities for breeding of disease carrying insects such as mosquitoes.
- Areas affected by frequent floods and drought conditions also witness large scale migration of populations to relatively stable regions leading to overcrowding and unhygienic conditions resulting in transmission of diseases like Japanese encephalitis and malaria.
- Climate change is a major factor in the spread of infectious diseases. Diseases, confined to one specific geographic region spread to other areas.
- The World Health Organization (WHO) in their studies have indicated that due to rising temperatures, malaria cases are now being reported for the first time from countries like Nepal and Bhutan.
- It has also been predicted that an additional 220-400 million people could be exposed to malaria- a disease that claims around 1 million lives annually.
- Dengue fever is already in evidence at higher levels of elevation in Latin America and parts of East Asia.
- Studies suggest that climate change may swell the population at risk of malaria in Africa by 90 million by 2030, and the global population at risk of dengue by 2 billion by 2080s.

- Rising temperatures and changing patterns of rainfall are projected to decrease crop yields in many developing countries, stressing food supplies. This will ultimately translate into wider prevalence of malnutrition/ under-nutrition. In some African countries, yields from rain-fed agriculture could be reduced by up to 50 per cent by 2020.
- Emission of the Green House Gases have been responsible for the depletion of ozone layer, which protects the Earth from the harmful direct rays of the sun. Depletion of stratospheric ozone results in higher exposure to the ultra violet rays of the sun, leading to an increase in the incidents of skin cancer. It could also lead to an increase in the number of people suffering from eye diseases such as cataract. It is also thought to cause suppression of the immune system.
- The projections by WHO and IPCC suggest that the negative effects of climate change on health are greater.
- In addition, the negative effects are concentrated on poor populations that already have compromised health prospects, thus widening the inequality gap between the most and the least privileged.
- The balance of positive and negative health impacts will vary from one location to another, and will alter over time as temperatures continue to rise.

Do you know?

Saponins are a group of water-soluble glucosides that yield soap froth in water, form emulsions with oils and fats, and are capable of absorbing large amounts of gases such as carbon dioxide. Soap nut tree yields saponins.

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