Climate Change, Risk, Adaptation and Mitigation

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Abstract: Climate change is a pressing global issue that poses significant risks to the environment, human health, and economies. The increase in greenhouse gas emissions from human activities has led to rising global temperatures, sea level rise, severe weather events, changes in ecosystems and wildlife habitats, and negative impacts on human health and well-being. In order to address the impacts of climate change, it is essential for individuals, communities, governments, and businesses to engage in both adaptation and mitigation efforts. Adaptation involves taking proactive measures to reduce vulnerability and build resilience in response to changing climate conditions. This can include implementing infrastructure improvements, developing early warning systems for natural disasters, protecting biodiversity hotspots, and promoting sustainable agriculture practices. Mitigation efforts focus on reducing greenhouse gas emissions through actions such as transitioning to renewable energy sources, improving energy efficiency in buildings and transportation systems, conserving forests that act as carbon sinks, and promoting sustainable land use practices. By reducing emissions at the source of production or consumption we can help slow down the rate of warming globally. It is crucial for policymakers at all levels of government to prioritize investments in climate change adaptation strategies while also working towards ambitious targets for reducing greenhouse gas emissions. Additionally, individual actions such as reducing personal carbon footprints by driving less frequently or consuming less meat can also contribute positively towards mitigating climate change. Overall, addressing climate change requires a coordinated effort from all sectors of society, with a focus on building adaptive capacity, and pursuing mitigation strategies that will lead us towards a more sustainable future.

Keywords: Climate Change and earth observation, Needs for adaptation, mitigation and resilience, Current Progress in Adaptation and Gaps, Climate Change Mitigation Options in Energy sector, The forest sector to mitigate climate change, Sustainable forest management, Adaptation & Mitigation in Agriculture sector, sustainable agriculture, Adaptation & Mitigation in Water resources, Adaptation and mitigation strategy for coastal zones, Climate change adaptation and mitigation: Future direction.

INTRODUCTION

Climate change is a complex crisis with effects felt globally at all levels, and is primarily driven by anthropogenic activities. Recent changes in climate are widespread, rapid, and intensifying, and unprecedented in thousands of years. The IPCC reported that the earth's average surface temperature during the 20th century increased approximately 0.6ºC. While this may seem like a small change, global temperature are generally quite stable. The difference between today's global temperature and the average global temperature of the last ice age is only about 5ºC.However, over the last century we have witnessed a decrease of nearly 10 percentage snow cover and a 10-15% decrease in spring and summer sea-ice in the northern hemisphere. Other observed change that have been linked to climate include longer growing seasons, increases in rainfall and rainfall intensity in the northern hemisphere, and shifts in when ice freezes and break up on rivers and lakes. The IPCC has projected that global average surface temperatures could increase 1.4 to 5.8ºC by 2100. Daily maximum and minimum temperatures will increase as well as the number of hot days, with less cold and foresty days. The global average precipitation and evaporation is also expected to increase by about one to nine percent. The intensity of extreme weather events is also likely to increase, with greater extremes of both flooding and drought.

OBJECTIVES

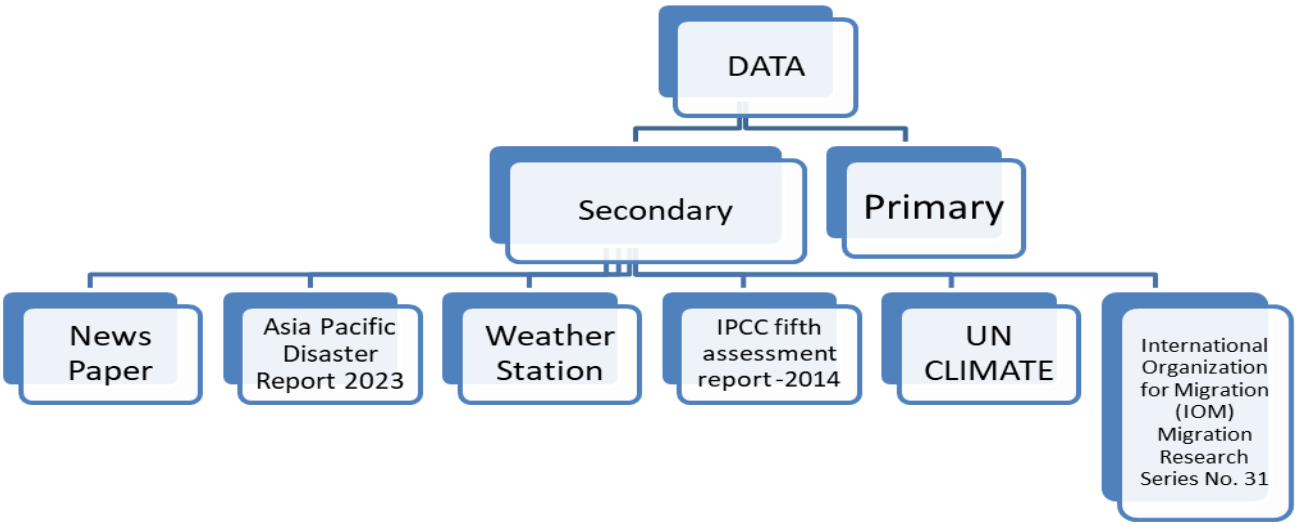
To present study focused on the following major objectives –

a) To discuss the Needs for adaptation, mitigation and resilience, Current Progress in Adaptation and Gaps.

b) To disscuss the sustainable forest management & sustainable agriculture

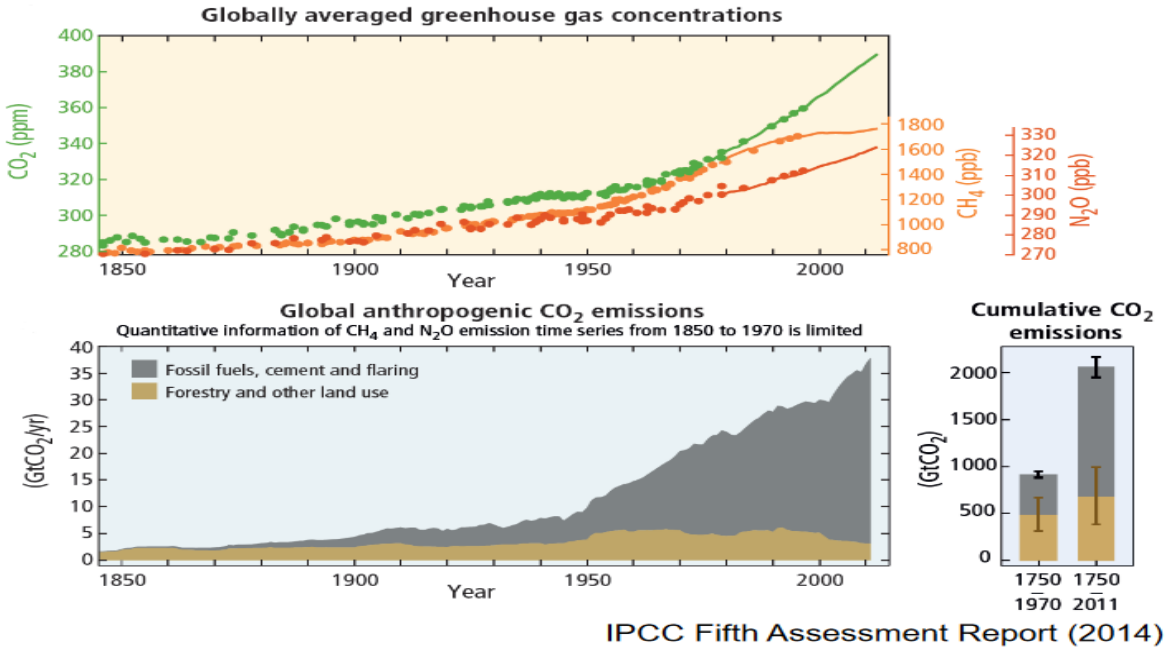
METHODOLOGY

The required data for the present study has been divided into two parts a) primary data and b) Secondary data. It has been taken fulfill from secondary source. Secondary data has been acquired from News paper, different type journals, Asia Pacific Disaster Report 2023, Weather Station, IPCC fifth assessment report -2014, UN CLIMATE, International Organization for Migration (IOM) Migration Research Series No. 31.

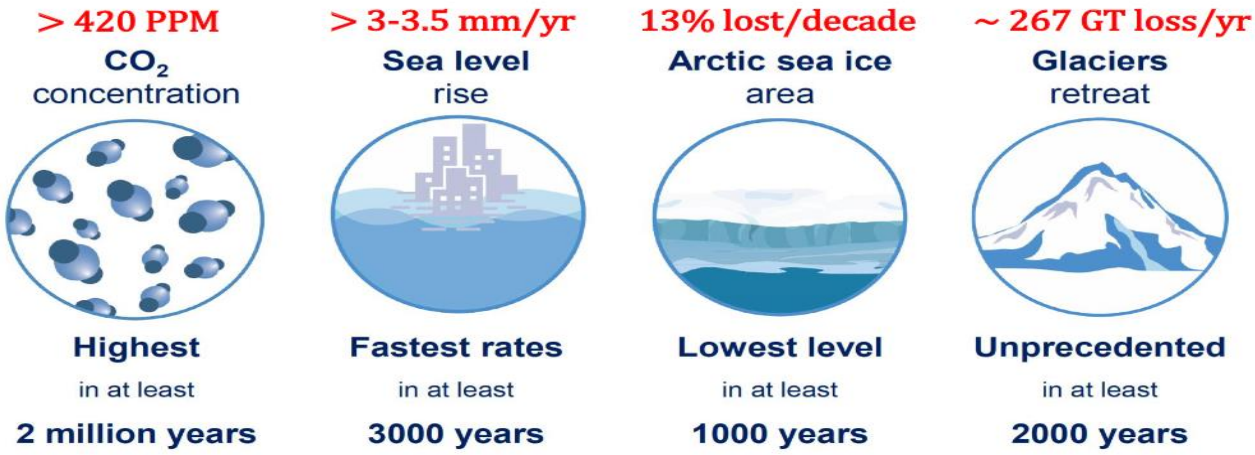


CLIMATE CHANGE AND EARTH OBSERVATION SATELLITE

- WMO, IMD, IPCC assessment report, UN Climate information is the backbone of climate science. Hence, it is fundamental to develop the right programs and activities and to guide policy development using space technology.
- This informations not only plays key role to monitor and observe climate change but also to mitigate, build resilience and assess for the impacts of climate change.
- Earth observation is crucial to understand patterns of sea- level rise, surface temperature changes, rainfall variability, or even the cooling effects of increased stratospheric aerosols.



MAJOR CAUSE AND INDICATORS OF CLIMATE CHANGE



- Earth observation satellite helps in detection and scientific understanding of long term changes in climate and the functioning of the Earth System (e.g. water, carbon, energy cycles).
- Monitoring and impact on natural resources (e.g. water resources and quality, land cover).
- A fleet of earth observation satellite is contributing to our understanding of climate change and related science.
- Global level missions like GCOS (Global Climate Observation System) and forums like CEOS supporting new initiatives to combat climate change.

NEEDS FOR ADAPTATION, MITIGATION AND RESILIENCE:

Fig: Clean energy

Fig: Sustainable transport

Earth is a need for combinations of short-term and long-term policies to mitigate projected climate damages. Proper adaptation strategy shall help minimize impact of climate change. Nature-based adaptation solutions that focus predominantly on rejuvenating forest resources have multiple benefits: conservation of water resources, soil conservation, sustainable development of forest communities, improving food security by providing alternative food choices and sustaining wild flora and fauna. Earth is a need to move from reactive adaptation practices to proactive techniques that reduce greenhouse gas emissions and limit future warming. The adaptation efforts implemented are often constrained by finance, lack of adequate knowledge on climate change among vulnerable populations, ineffective policies and lapses in implementation. Community-level adaptation strategies such as increasing awareness and access to climate education and technology would strengthen resilience against long-term impacts. Remote sensing, Gis, and Science helps in nearly all levels of adaptation and mitigation efforts. Earth is a need to act

immediately to limit warming within 1.5 deg. The future depends on the actions taken today. Proper action on adaptation, mitigation, and sustainable development pathways shall lead to inclusive well being of the society.

CURRENT PROGRESS IN ADAPTATION AND GAPS

Growing public and political awareness of climate impacts and risks has resulted in countries including adaptation in their climate policies and planning processes. Most observed adaptation responses are fragmented, incremental, sector-specific and unequally distributed across regions. Despite progress, adaptation gaps exist across sectors and regions, with the largest adaptation gaps among lower income groups. Cultivar improvements, on-farm water management and storage, soil moisture conservation, irrigation, agro-forestry, community-based adaptation, sustainable land management approaches, use of agro-ecological principles and practices are some of effective adaptation options. Ecosystem-based adaptation approaches such as urban greening, restoration of wetlands and upstream forest ecosystems have been effective in reducing flood risks and urban heat.

CLIMATE CHANGE MITIGATION OPTIONS IN ENERGY SECTOR

Several mitigation options, notably solar energy, wind energy, urban green infrastructure, energy efficiency, improved forest and crop/grassland management, and reduced food waste and loss are becoming increasingly cost effective. From 2010 to 2019 there have been sustained decreases in the unit costs of solar energy (85%), wind energy (55%), and lithium-ion batteries (85%).

THE FOREST SECTOR TO MITIGATE CLIMATE CHANGE

1. Significant interventions are required to reduce climate change impacts on forest ecosystems.
2. Interventions such as urban forestry, sustainable forestry and management of protected areas with due consideration to the conservation of biodiversity, soil and water would reduce the impacts on the forest ecosystem and mitigate climate change by increasing carbon sequestration.
3. There is a need to establish a fast and effective fire-response system that considers local knowledge to reduce the impact of forest fires.
4. Migration pathways for the safe movement of animals, and proper measures must be placed to reduce human-animal conflicts.
5. Need a combination of reactive and active adaptation strategies to conserve forest resources,
6. Several adaptation strategies that include water management, soil conservation, crop diversification and construction practices for the indigenous communities living in protected areas to reduce the impacts on forests and conserve resources.
7. Policy maker and Niti ayog can play key role in planning, monitoring, and management of such activities of climate change mitigation initiatives.

Sustainable Forest Management (SFM) is the practice of managing forest resources in a way that meets the needs of the present without compromising the ability of future generations to meet their own needs. It balances ecological, economic, and socio-cultural goals and constraints to ensure that forests continue to provide a wide range of goods and services. Here are some key principles of SFM:

1.Maintenance of Ecosystem Biodiversity: Ensuring that forest management practices do not diminish the biodiversity within forest ecosystems.

2.Protection of Ecologically Important Areas: Identifying and safeguarding forest areas that are critical for maintaining ecosystem health.

3.Sustainable Harvest Levels: Regulating the amount and rate of timber and non-timber resource extraction to prevent overexploitation.

4.Regeneration Capacity: Promoting natural forest regeneration and, where necessary, aiding it through planting and other management techniques.

5.Forest Vitality: Keeping forests healthy and vigorous, which includes protecting them from diseases, pests, and fire.

6.Socio-Economic Benefits: Providing a stable source of income and employment for local communities, as well as respecting the rights and values of indigenous peoples and other forest-dependent communities.

7.Legal Framework Compliance: Adhering to local, national, and international laws and regulations concerning forest management.

SFM is a dynamic concept that adapts to changing environmental conditions and scientific understanding. It is implemented through various certification systems, like the Programme for the Endorsement of Forest Certification (PEFC), which helps consumers identify products sourced from sustainably managed forests.

ADAPTATION AND MITIGATION IN AGRICULTURE SECTOR

1. Since agriculture has a high sensitivity to temperatures and precipitation and a strong dependence of the population on it, it is one of the sectors most impacted by climate change.
2. The significant climatic impacts on agriculture are linked to three climatic factors: increasing temperature, dry and wet extremes in rainfall distribution, and rising sea levels.
3. To improve food production in the changing climate it is necessary to adapt to the planting and harvesting time and cultivate new crops with modern irrigation techniques.
4. To ensure food security and sustainable livelihood of the rural population, there is a need to frame policies that could support the small and marginal farmers.
5. Remote sensing and GIS could help in identifying areas that are suitable for different crops in a changing climate.

Sustainable agriculture offers a multitude of benefits across environmental, economic, and social aspects:

1. Environmental Conservation: It promotes biodiversity, reduces reliance on nonrenewable energy, minimizes chemical use, and conserves water, contributing to the overall health of the ecosystem.

2. Economic Viability: By optimizing resource use and reducing input costs, sustainable agriculture can increase farm profitability and ensure long-term economic sustainability for farmers.

3. Social Equity: Sustainable practices can enhance the quality of life for farm families and communities by providing more stable farm incomes and fostering social equality.

4. Soil Health: Crop rotations, cover crops, and reduced tillage help maintain and improve soil fertility, structure, and biodiversity.

5. Climate Change Mitigation: Sustainable agriculture plays a role in reducing greenhouse gas emissions and sequestering carbon, helping to mitigate climate change.

6. Food Security: By focusing on long-term productivity and resilience, sustainable agriculture supports food security for current and future generations. These benefits demonstrate how sustainable agriculture is crucial for a balanced approach to farming that respects the environment while supporting human needs.

ADAPTATION AND MITIGATION IN WATER RESOURCES

1. Water security consists of water for drinking, sanitation and hygiene, food production, economic activities, ecosystems, and cultural purposes.
2. Water security risks are associated with water-related hazards such as drought, floods, poor water quality, water contamination, and related health issues.
3. Satellite image helps with the mapping of surface as well as groundwater conditions and their dynamics.
4. Adaptation strategies such as watershed management, construction of small check dams, construction of ponds, preservation of aquifers, wastewater treatment plants, waste management guidelines, etc. are required.

ADAPTATION AND MITIGATION STRATEGY FOR COASTAL ZONES

1. The adaptation strategies should be region-specific and address the specific climatic driver that causes the impact.
2. Early warning systems to reduce the impacts by cyclones.
3. Conservation of mangroves to mitigate the impacts of storm surges and improve livelihood of coastal population
4. Strategy to prevent algal growth by reducing marine pollution, prevent the overuse of pesticides, etc.

5. Measures to protect the coastal wetlands and maintenance of coastal water quality.
6. Effective measures are required to reduce marine pollution by ships/container vessels, restrict removal of beach sediments.
7. Salt-tolerant crops could reduce the impacts on agriculture due to seawater ingress in the coastal areas.
8. Check dams, bunds and recharge reservoirs can be constructed to prevent salinity ingress.

CLIMATE CHANGE ADAPTATION CHALLENGES

1. Proper planning and implementation of adaptation measures need observations, projections, and historical data.
2. Commonly, observational datasets used for the adaptation process include gauge station data and remote sensed data of hydrological components, atmosphere, land, and ocean observations.
3. Strengthen climate-relevant observational networks to understand climate change impacts at appropriate spatial and temporal resolutions to plan and implement adaptive measures.
4. Since high-resolution climate projections are essential for proactive adaptation planning, high-resolution climate modeling efforts need to be strengthened in the coming decades. Climate data information can be enhanced further by focusing on three significant aspects:
5. Exploiting the big data from space-based observations and innovative solutions like machine learning and cloud and edge computing.
6. Ensuring open access to all existing data, including historical data.
7. Data gaps need to be filled through long-term funding of in situ observational systems & innovative ways of providing interdisciplinary data and information for local adaptation and decision-making.

CONCLUSION

Climate change calls for new approaches to sustainable development that take into account complex interactions between climate, social, and ecological systems.

- Climate-resilient pathways that combine adaptation and mitigation to realize the goal of sustainable development is the need of the hour.
- We need to consider sustainable development as the ultimate goal, and mitigation as a way to keep climate change moderate rather than extreme.
- Sustainable development should be inclusive of creating capacities for implementing and sustaining appropriate risk management.
- Responses to be at a multi-scale perspective that takes the socioeconomic, cultural, biophysical, and institutional context into account.
- The effects of climate change will make sustainable development objectives such as food and livelihood security, poverty reduction, health, and access to clean water more difficult to achieve.
- Need to focus more on scientific adaptation to changes as a response strategy to anticipate and cope with impacts that cannot be avoided under different scenarios of climate change.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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