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AN EVALUATION OF EFFORTS MADE BY THE GOVERNMENT OF INDIA TO COMBAT THE ADVERSE EFFECTS OF CLIMATE CHANGE

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Abstract

Climate change refers to long-term shifts in temperatures and weather patterns. Intense droughts, water scarcity, rising sea levels, floods, melting of polar ice, catastrophic storms, and declining biodiversity are the consequences of Climate Change. India is the 7th among the most affected nation due to climate change (The Global Climate Risk Index 2021). India reported 280 heatwave days in the year 2022, as per the report of the State of India's Environment. The surface air temperature over India has risen by about 0.7 °C during 1901–2018 which is accompanied by an increase in atmospheric moisture content as per the report ("Assessment of Climate Change over the Indian Region", (MOES). India is a Party to the United Nations Framework Convention on Climate Change (UNFCCC), its Kyoto Protocol (KP), and the Paris Agreement (PA). The Government of India stands committed to combat climate change and its adverse effects through its several programs and schemes including the National Action Plan on Climate Change (NAPCC) which comprises missions in specific areas of solar energy, energy efficiency, water, agriculture, Himalayan ecosystem, sustainable habitat, green India, and strategic knowledge on climate change. In this paper, we will examine the efforts made by GOI and its achievement to combat the adverse effects of climate change.

Keywords: United Nations, Ministry of Earth Sciences, Climate Change, Green House Gases, National Action Plan on Climate Change.

Introduction

Since 19th century human (anthropogenic) activities and (Burning of fossil fuels, deforestation, and land use changes, among other human) activities, have led to a rapid increase of atmospheric CO2 levels from 280 parts per million during 1850 to more than 416 parts per million in February 2020. This has led to increase in the atmospheric concentrations of heat-trapping greenhouse gases that is: carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), and fluorinated gases[1]. Climate change refers to long-term shifts in temperatures and weather patterns. Due to the over-

exploitation of natural resources and emission of GHGs global average temperature has risen by around 1°C. This magnitude and rate of warming is not only due to natural variations; it is due to changes in the lifestyle of people. Economic Development (Industrial and Agricultural practices) have led to emissions of greenhouse gases (GHGs), aerosols, and changes in land use and land cover (LULC) have altered the atmospheric composition and the planetary energy balance is responsible for the present-day climate change. Warming since the 1950s has already contributed to a significant increase in weather and climate extremes globally (e.g., heat waves, droughts, heavy precipitation, and severe cyclones), changes in precipitation and wind patterns (including shifts in the global monsoon systems), warming and acidification of the global oceans, melting of sea ice and glaciers, rising sea levels, and changes in marine and terrestrial ecosystems[2]. India is the 7th among the most affected nation due to climate change (The Global Climate Risk Index 2021). Out of 365 days in a year about 280 heatwave days were reported in the year 2022, as per the report of the State of India's Environment[3].

India is a Party to the United Nations Framework Convention on Climate Change (UNFCCC), its Kyoto Protocol (KP), and the Paris Agreement (PA). As a party to UNFCCC various policies and programs were initiated by GOI schemes including the National Action Plan on Climate Change (NAPCC) which comprises missions in specific areas of solar energy, energy efficiency, water, agriculture, Himalayan ecosystem, sustainable habitat, green India, and strategic knowledge on climate change. The NAPCC provides an overarching framework for all climate actions. Thirty-three States /Union Territories have prepared their State Action Plan on Climate Change (SAPCC) in line with NAPCC taking into account the State's specific issues relating to climate change. These SAPCCs outline sector-specific and cross-sectoral priority actions, including adaptation. to address the problem of climate change in the context of sustainable development[4].

In this paper, we will examine the efforts made by GOI and its achievements to combat with adverse effects of climate change.

Adverse effects of Climate Change in India: Observed and Projected Changes

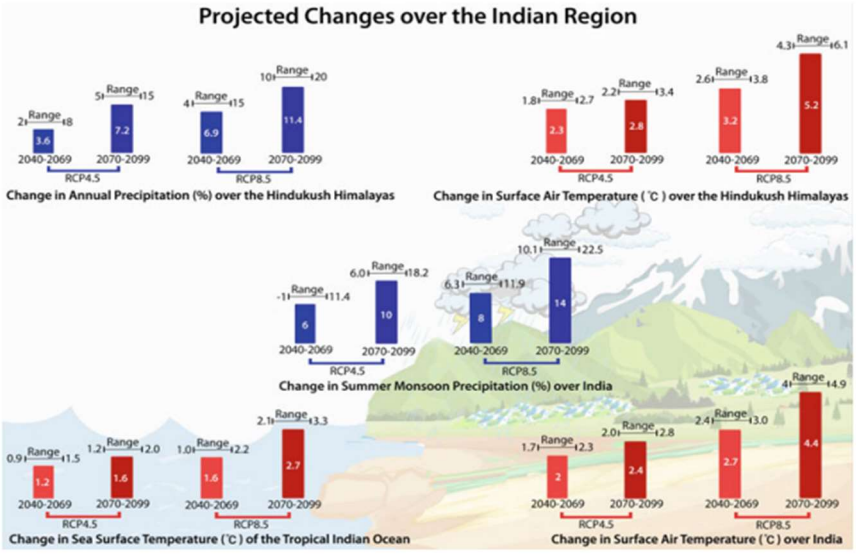

Fig. 1 Best estimate and range in climate model projections of future changes in 1. Surface air temperature over India (°C; bottom right panel), 2. Sea surface temperature of the tropical Indian Ocean (°C; bottom left panel), 3. Surface air temperature over the Hindu Kush Himalayas (°C; top right panel), 4. Summer monsoon precipitation over India (% change; centre panel), 5. Annual precipitation over the Hindu Kush Himalayas (% change; top left panel). All the changes are computed relative to their climatological average over the 30-year period 1976–2005. Projected changes are reported for the middle and end of the 21st century under the RCP4.5 and RCP8.5 scenarios (defined in Box 1).

By the end of the twenty-first century, average temperature over India is projected to rise by approximately 4.4°C relative to the recent past (1976–2005 average) (Fig. 1), under the RCP8.5 scenario (see Box 1).

Box 1: Description of future forcing scenarios

Projections by climate models of the Coupled Model Intercomparison Project Phase 5 (CMIP5) are based on multiple standardized forcing scenarios called Representative Concentration Pathways (RCPs). Each scenario is a time series of emissions and concentrations of the full suite of GHGs, aerosols, and chemically active gases, as well as LULC changes through the twenty-first century, characterized by the resulting Radiative Forcing* in the year 2100 (IPCC 2013). The two most commonly analyzed scenarios in this report are "RCP4.5" (an intermediate stabilization pathway that results in a Radiative Forcing of 4.5 W/m^2 in 2100) and "RCP8.5" (a high concentration pathway resulting in a Radiative Forcing of 8.5 W/m^2 in 2100).

*A measure of an imbalance in the Earth's energy budget owing to natural (e.g., volcanic eruptions) or human-induced (e.g., GHG from fossil fuel combustion) changes.

Temperature Rise Over India:

India's average temperature has risen by around 0.7°C during 1901–2018. This rise in temperature is largely on account of GHG-induced warming, partially offset by forcing due to anthropogenic aerosols and changes in LULC. By the end of the twenty-first century, average temperature over India is projected to rise by approximately 4.4°C relative to the recent past (1976–2005). In the recent 30-year period (1986–2015), temperatures of the warmest day and the coldest night of the year have risen by about 0.63°C and 0.4°C, respectively. By the end of the twenty-first century, these temperatures are projected to rise by approximately 4.7°C and 5.5°C, respectively, relative to the corresponding temperatures in the recent past (1976–2005 average), under the RCP8.5 scenario. By the end of the twenty-first century, the frequencies of occurrence of warm days and warm nights are projected to increase by 55% and 70%, respectively, relative to the reference period 1976-2005, under the RCP8.5 scenario. The frequency of summer (April–June) heat waves over India is projected to be 3 to 4 times higher by the end of the twenty-first century under the RCP8.5 scenario, as compared to the 1976–2005 baseline period. The average duration of heat wave events is also projected to approximately double, but with a substantial spread among

models. In response to the combined rise in surface temperature and humidity, amplification of heat stress is expected across India, particularly over the Indo-Gangetic and Indus river basins.

Indian Ocean Warming

Sea surface temperature (SST) of the tropical Indian Ocean has risen by 1°C on average during 1951–2015, markedly higher than the global average SST warming of 0.7°C, over the same period. Ocean heat content in the upper 700 m (OHC700) of the tropical Indian Ocean has also exhibited an increasing trend over the past six decades (1955–2015), with the past two decades (1998–2015) having witnessed a notably abrupt rise. During the twenty-first century, SST (Fig. 1) and ocean heat content in the tropical Indian Ocean are projected to continue to rise.

Changes in Rainfall

The summer monsoon precipitation (June to September) over India has declined by around 6% from 1951 to 2015, with notable decreases over the Indo-Gangetic Plains and the Western Ghats. There is an emerging consensus, based on multiple datasets and climate model simulations, that the radiative effects of anthropogenic aerosol forcing over the Northern Hemisphere have considerably offset the expected precipitation increase from GHG warming and contributed to the observed decline in summer monsoon precipitation. There has been a shift in the recent period toward more frequent dry spells (27% higher during 1981–2011 relative to 1951–1980) and more intense wet spells during the summer monsoon season. The frequency of localized heavy precipitation occurrences has increased worldwide in response to increased atmospheric moisture content. Over central India, the frequency of daily precipitation extremes with rainfall intensities exceeding 150 mm per day increased by about 75% during 1950–2015. With continued global warming and anticipated reductions in anthropogenic aerosol emissions in the future, CMIP5 models project an increase in the mean (Fig. 1) and variability of monsoon precipitation by the end of the twenty-first century, together with substantial increases in daily precipitation extremes.

Droughts

The overall decrease of seasonal summer monsoon rainfall during the last 6–7 decades has led to an increased propensity for droughts over India. Both the frequency and spatial extent of droughts have increased significantly during 1951–2016. In particular, areas over central India. southwest coast, southern peninsula and north-eastern India have experienced more than 2 droughts per decade, on average, during this period. The area affected by drought has also increased by 1.3% per decade over the same period. Climate model projections indicate a high likelihood of increase in the frequency (>2 events per decade), intensity and area under drought conditions in India by the end of the twenty-first century under the RCP8.5 scenario, resulting from the increased variability of monsoon precipitation and increased water vapour demand in a warmer atmosphere.

Sea Level Rise

Sea levels have risen globally because of the continental ice melt and thermal expansion of ocean water in response to global warming. Sea-level rise in the North Indian Ocean (NIO) occurred at a rate of 1.06–1.75 mm per year during 1874–2004 and has accelerated to 3.3 mm per year in the last two and a half decades (1993–2017), which is comparable to the current rate of global mean sea-level rise. At the end of the twenty-first century, steric sea level in the NIO is projected to rise by approximately 300 mm relative to the average over 1986–2005 under the RCP4.5 scenario, with the corresponding projection for the global mean rise being approximately 180 mm.

Tropical Cyclones

There has been a significant reduction in the annual frequency of tropical cyclones over the NIO basin since the middle of the twentieth century (1951–2018). In contrast, the frequency of very severe cyclonic storms (VSCSs) during the post-monsoon season has increased significantly (+1 event per decade) during the last two decades (2000–2018). However, a clear signal of anthropogenic warming on these trends has not yet emerged. Climate models project a rise in the intensity of tropical cyclones in the NIO basin during the twenty-first century.

Changes in the Himalayas

The Hindu Kush Himalayas (HKH) experienced a temperature rise of about 1.3°C during 1951–2014. Several areas of HKH have experienced a declining trend in snowfall and also retreat of glaciers in recent decades. In contrast, the high-elevation Karakoram Himalayas have experienced higher winter snowfall that has shielded the region from glacier shrinkage. By the end of the twenty-first century, the annual mean surface temperature over HKH is projected to increase by about 5.2°C under the RCP8.5 scenario (Fig. 1). The CMIP5 projections under the RCP8.5 scenario indicate an increase in annual precipitation (Fig. 1), but decrease in snowfall over the HKH region by the end of the twenty-first century, with large spread across models[5]

Programs and Schemes launched by GOI to Combat the adverse effects of Climate Changes and Achievements.

National Action Plan on Climate Change (NAPCC): NAPCC is an action plan launched on 30th June 2008 to deal with climatic changes and achieve sustainable growth.

Eight National Missions were launched under NAPCC for climate change in the following areas

1. National Solar Mission 2. National Mission for Enhanced Energy Efficiency 3. National Mission on Sustainable Habitat 4. National Water Mission 5. National Mission for Sustaining the Himalayan Eco-system 6. National Mission for a Green India 7. National Mission for Sustainable Agriculture 8. National Mission on Strategic Knowledge for Climate Change

The principles of NAPCC are:

- Inclusive and sustainable development, protect the poor.
- Ecological balance along with growth and poverty alleviation.

- cost-effective and efficient strategies through demand-side management
- Develop appropriate technologies for adaptation and mitigation
- Enact regulations and promote innovative market and voluntary mechanisms for sustainable development
- Encourage participation of civil society, LGUs, and public-private partnerships for implementation of NAPCC[6].

Eight Missions of NAPCC

1.National Solar Mission (2008) objective is to make India a global leader in solar energy. Initially, 20 GW solar power target was set to be achieved by 2022, it is scaled up to 100 GW. The revised target of 100 GW is to be achieved in seven years, it comprises 40 GW of grid-connected rooftop projects and 60 GW large and medium land-based solar-power projects. The total investment for commissioning 100 GW of solar power was estimated at Rs 5 lakh crore. Only 36 GW installed capacity was realised by 2020. However Solar tariffs have decreased from Rs 18 per unit—a 2010 figure—to Rs 2.44 per kWh. India stands at seventh position globally with respect to installed capacity (Grid Connected Solar Power), surpassing Australia and Spain[7].

2.National Mission for Enhanced Energy Efficiency (NMEEE)

The National Mission for Enhanced Energy Efficiency (NMEEE) was launched in june 2010 with an outlay of Rs. 74,000 crore, the mission is based on the Electricity Act, 2001 and falls under the Bureau of Energy Efficiency (BEE). Its aims to provide energy efficiency and meet the energy demands of the country. It also intends to achieve total avoided capacity addition of 19,598 MW, fuel savings of around 23 million tonnes per year and greenhouse gas emissions reductions of 98.55 million tonnes per year at its full implementation stage. Its objective is to bring efficiency in the use of energy through regulatory and policy regimes and to promote innovative and sustainable models. Four models were introduced to enhance energy efficiency which are as follows:

Perform, Achieve and Trade (PAT)
Market Transformation for Energy Efficiency (MTEE)
Energy Efficiency Financing Platform (EEFP)
Framework for Energy Efficient Economic Development (FEEED)

Perform, Achieve and Trade (PAT) was launched in 2012. It is the most notable initiative under the NMEEE. During the first cycle of PAT (from 2012–15), eight energy intensive sectors—thermal power plants, iron and steel, cement, fertilizer, aluminium, textile, pulp and paper, chlor-alkali—have been included. There are about 478 designated consumers in these eight sectors, accounting for about 165 million tonnes of oil equivalent of energy consumption annually. The cumulative target for energy saving for Cycle I was 6.68 million tonnes of oil equivalent (MTOE) to be achieved by the end of 2014–15, against which energy saving of 8.67 MTOE have been achieved—about 30 per cent more than the target. It resulted in 5,635 MW of energy saving, which is 1.25 per cent of India's total primary energy supply. This has resulted in emission reduction of

31 million tonnes of CO2, equalling 1.93 per cent of India's total emissions. In PAT Cycle II (2016–19), 621 industries from 11 sectors were given specific energy consumption (SEC) targets, with energy saving of 8.869 MTOE by the assessment year 2018–19. Under PAT, capacity building of over 5000 engineers and operators was conducted and 13,718 energy auditors and managers trained. Additionally, an investment of Rs 25,000 crore went into developing energy efficient technologies. In September 2017, Bureau of Energy Efficiency (BEE) organized training workshops on financing energy efficiency for financial institutions. Energy Efficiency Services Ltd (EESL) were created as a corporate entity to provide market leadership. Number of other initiatives have been taken up, including distribution of energy-efficient appliances, where the government has distributed about 23.39 crore LED lights under the Pradhan Mantri Ujjwala Yojana, to provide free clean cooking gas connections to women below the poverty line. More than 2.8 crore LPG connections have been provided[8].

3.National Mission on Sustainable Habitat

The National Mission on Sustainable Habitat was approved in 2010 with an outlay of Rs 54,200 crore. The objective of the mission is to set sustainable habitat standards which help in addressing climate change concerns along with development strategies. It aims to integrate mitigation and adaptation into the urban planning process with a view to make cities sustainable through improvements in energy efficiency of buildings, management of solid waste and shift to public transport. The Ministry of Housing and Urban Affairs is a nodal agency for the Sustainable Habitat Mission.

National Urban Transport Policy (NUTP) was introduced in 2014 with the prime objective of making urban transportation an important parameter at the planning stage, bringing about a more equitable allocation of road space with people. It has also proposed to increase excise at the national level and the registration cost (city level) of diesel-propelled private vehicles. It suggests formation of transport management associations to facilitate implementation of sustainable transport initiatives.

Corporate Average Fuel Consumption (CAFC) regulations were notified in 2015 with the aim to improve the fuel efficiency of automobiles in the wake of the rising costs of oil. CSE analysis further showed that rules have allowed number of concessions for the car industry to score extra points for certain technologies for compliance with the norm, which can effectively weaken the programme.

The government also revised solid waste management rules after 16 years of its implementation. The revised rules extend to urban and industrial areas, advocate waste segregation at source, and segregation into wet (biodegradable), dry and domestic hazardous wastes. Additionally, it also talks about integration of waste pickers into the formal system.

- To envisage all Indian cities and towns to be sanitized, the government launched the National Policy on Faecal Sludge and Septage Management (NPFSM) in February 2017.
- A total of 197,142 individual toilets in households were built till March 2017 against the target of 127,105.

- Draft National Water Framework Bill came out in 2016 to provide uniform national legal framework to manage water supply, river rejuvenation, integrated river basin management, and storm-water.

The scope and coverage of the mission is very broad but it lacks specification. It is important to note that the previous scheme known as the Jawaharlal Nehru National Urban Renewable Mission (JNNURM) was identified as the main channel for implementation and routing of funds for NMSH. However, since 2015 new initiatives including AMRUT, Smart City initiative, HRIDAY, Swachh Bharat and National Urban Livelihoods Mission etc. have been launched to concentrate on core areas as their objectives overlap with NMSH. For instance, AMRUT, which covers 500 cities, focuses on access to water, water management and storm water while the focus of Swachh Bharat is on sanitation, public hygiene and community participation. The government's position is that the fundamentals of NMSH reflect in the new schemes. But taking into account specific sectoral and wide scope of the new schemes, they have been able to draw wider attention and momentum, while the NMSH have lost its value. According to ministry sources, synchronization among different ministries and convergence of NMSH with aligned missions and schemes appears to be the key issues bringing delay in city development plans for implementation of sustainable habitat guidelines. The guidelines that have been prepared for sustainable habitat, transport and energy efficiency have to be incorporated into the urban planning process, which is still to assume shape[9]

4.National Water Mission

NWM objective is to conserve water, minimize wastage and ensure more equitable distribution both across and within states considering the provisions of National Water Policy and promote efficiency in the use of water by 20 percent through regulatory mechanisms with differential entitlements and pricing. It will ensure that needs of urban and coastal cities are met through recycling of waste water or desalination technologies that allow for the use of ocean water.

Five goals are set to be achieved under NWM

- Create water data base and assess the impact of climate change on water resource
- encourage citizens and state actions for water conservation, augmentation, and preservation
- Address vulnerable and over-exploited areas
- Increase water use efficiency by 20 per cent
- Promote basin level integrated water resources management

Achievements

- 702 new Hydrological Observation Station (HOS) were established till 2016–17 against the target of 800 in 2012–17. This is meant to provide information through 275 flood forecasting sites and help in climate change studies and glacial lake bursts/cloudbursts.
- Establishing 6,376 new groundwater monitoring wells against the target of 9,360.

- Around 668 training sessions were conducted where 56,768 stakeholders were trained till March 2017.
- A total of 1,237 waterbodies were restored till March 2017 as against an ambitious target of 10,000. Around Rs 264.67 crore was released for this.
- Establishment of 24 new and additional forecast stations against the target of 100.
- Till March 2017, 21 baseline studies in irrigation sector were in progress to understand how to increase water efficiency by 20 per cent, mandated in the mission target.
- Work on the SSAP has only begun for the water sector. The initial target was to complete the plan in all 29 states and seven UTs
- A total of 36 additional water quality monitoring stations have been installed against the target of 113.
- The Draft National Water Framework Bill was proposed in 2016 to formulate a national law on water. It envisaged that a national law on water would provide an overarching legal framework with principles for protection, conservation, regulation and management of water. It provides an umbrella framework of the general principles governing the exercise of legislative and executive powers.
- The Model Groundwater (Sustainable Management) Act, 2016 recognizes groundwater as a local resource and recommends the role of local institutions having primary rights and duties over the resource.
- In an attempt to have a national consensus on basic concepts and issues relating to water, the National Water Policy was revised and adopted in 2012.

Still NWM has failed to address the issue of equity as the demand for water among affluent people is more, which has reduced the per capita availability of water for lower sections.

5. National Mission for sustaining the Himalayan Eco-system

The Himalayan ecosystem's mission is to enhance four types of national capacities that are ● Human and knowledge capacities ● Institutional capacities ● Capacities for evidence based policy building and governance ● Continuous self-learning for balancing between forces of Nature and actions of mankind

Important issues to be addressed under mission are: ● Himalayan Glaciers and the associated hydrological consequences ● Biodiversity conservation and protection ● Wildlife conservation and protection ● Traditional knowledge societies and their livelihood and ● Planning for sustaining the Himalayan Ecosystem.

Initiatives undertaken under NMSHE

• Mapping all institutions and civil society organizations (CSOs) working in the field of Himalayan ecosystems both within and outside the Himalayas. This exercise revealed that there are as many as 100 institutions and several hundred CSOs are working in this area. An inventory of these institutions has been prepared.

• Six thematic task forces have been finalized. These are
a) Natural and Geographical Wealth by the Wadia Institute of Himalayan Geology
b) Forest Resources and Plant Biodiversity by GB Pant Institute on Himalayan Environment and Development, Almora.
c) Micro Flora and Fauna, Wildlife and Animal Population by Wildlife Institute of India, Dehradun
d) Traditional Knowledge Systems by JNU
e) Water, Ice, Snow and Glaciers by National Institute of Hydrology, Roorkee
f) Himalayan Agriculture by Indian Council of Agricultural Research (ICAR)
• State climate-change centres have been set up in the seven Himalayan states, namely, Jammu and Kashmir, Himachal Pradesh, Manipur, Mizoram, Tripura, Sikkim and Meghalaya.
• A capacity-building programme titled 'Indo-Swiss Capacity Building Programme on Himalayan Glaciology' was launched by DST in collaboration with the Swiss Agency of Development and Cooperation (SDC), with the main mandate to build capacity in the field of glaciology and related areas in climate change.
• Under the Indo-Swiss bilateral cooperation, a capacity-building programme on adaptation planning and implementation comprising two orientations and three trainings has been developed in consultation with the Himachal Pradesh government.
• A common framework for integrated 'vulnerability, risks and hazard assessment' has also been developed for implementation in the entire Himalayan region and is to be used as a guidance tool for other Himalayan states.
NMSHE at present is facing financial and technical constraints and skilled expert manpower.

6. National Mission for a Green India (2014)

The National Mission for Green India, or the Green India Mission (GIM), was adopted in 2014 with an outlay of Rs 46,000 crore allotted. NGM is launched in response to the adaptation of climate change and mitigation. It refers to Greening which means carbon sequestration and storage (in forests and other ecosystems), hydrological services and biodiversity; as other provisioning services such as fuel, fodder, small timber and non- timber forest products (NTFPs) and forest dependent communities. GIM is being implemented by the Ministry of Environment, Forest and Climate Change (MoEF&CC) within a separate cell.

The objectives of the Mission are:

● Increased forest/tree cover on 5 m ha of forest/non-forest lands and on another 5 m ha (a total of 10 m ha). This will improve ecosystem services including biodiversity, hydrological services and carbon sequestration.
● About 3 million households living in and around the forests to be provided forest-based livelihood income
● Enhance 50 to 60 million tonnes CO2 sequestration in the year 2020.
It has proved to be one of the most slow-moving missions in the NAPCC. At present, the ministry is hugely understaffed and short of experts with respect to the GIM.

The Green India Mission meant to revive forests through afforestation activities has fallen short of its objectives by 30% from 2015-16 to 2020-21. States like West Bengal, J&K, and Himachal Pradesh have not yet become a part of this scheme. Decentralized and participatory governance as envisaged in the mission document seems to be more in principle than reality. The mission looks more like a plantation scheme. Approaches on carbon sequestration and the issue of forest diversion are largely neglected in the mission

7. National Mission for Sustainable Agriculture (NMSA) 2014- aim is to make agriculture more productive, sustainable, remunerative and climate resilient by promoting location specific integrated /composite farming systems; soil and moisture conservation measures; comprehensive soil health management; promoting efficient water management practices and mainstreaming rain-fed technologies.

The key components of the mission are as follows:

Rain-fed Area Development (RAD): RAD is the most important component of the Mission. This element intends to adopt an area-based approach for development and conservation of natural resources along with farming systems.

Farm Water Management (FWM): promote drip & sprinkler technologies, efficient water application & distribution system, secondary storage etc. Thereafter, these activities were takenup under the **Per Drop More Crop (PDMC)** 'component of **Pradhan Mantri Krishi Sinchayee Yojana (PMKSY)** during 2015-16.

Soil Health Management (SHM); Its objective is to promote Integrated Nutrient Management (INM) for improving soil health and its productivity, strengthening of soil and fertilizer testing facilities to improve soil test based recommendations to farmers for improving soil fertility, through judicious use of chemical fertilizers including secondary and micro nutrients in conjunction with organic manures and bio-fertilizers

"Soil Health Card" Scheme: This card will provide information to farmers on the soil nutrient status of their soil and would recommend the appropriate dosage of nutrients to be used for maintaining soil health and fertility.

All these components require integration with ongoing aligned programmes, including MGNREGA, Integrated Watershed Management Programme (IWMP), Accelerated Irrigation Benefit Programme (AIBP), Rashtriya Krishi Vikas Yojana (RKVY), National Food Security Mission (NFSM), Mission for Integrated Development for Horticulture (MIDH), National Mission on Agricultural Extension and Technology (NMAET), National Livestock Mission, and Mission for Integrated Development of Horticulture (MIDH) etc.

Schemes and Programmes

• Programmes such as System of Rice Intensification (SRI) against conventional rice cultivation and coverage of milch animals under the ration balancing programme for addressing mitigation and adaptation.

• The National Initiative on Climate Resilient Agriculture was also launched in 2011 to address both adaptation and mitigation in the agriculture sector.
• Numerous initiatives have been launched, including the Soil Health Card. Neem-coated urea is being promoted to regulate use of the crystalline compound. Parampragat Krishi Vikas Yojana (PKVY) is being implemented to promote organic farming in the country. Pradhan Mantri Krishi Sinchai Yojana (PMKSY) is being implemented to expand cultivated area.
• The National Food Security Act, 2013 aims at ensuring, inter alia, timely and efficient procurement and distribution of food grains, building and maintenance of food stocks, and their efficient storage, movement and delivery to consumers.
• The Global Environment Facility (GEF) has approved Rs 250 crore for the project related to Ministry of Agriculture and Farmers Welfare on the subject 'to obtain revolutionary change on the strategies and methodologies for sustainable agriculture in India' to implement it in various parts of the five states—Uttarakhand, Madhya Pradesh, Rajasthan, Orissa and Mizoram.
• Pradhan Mantri Fasal Bima Yojna (PMFBY) was launched for providing insurance coverage and financial support to farmers in the event of failure of any of the notified crop as a result of natural calamities, pests and diseases.
• Monitoring Information Systems for implementation of RAD component of NMSA is created. MIS is a web-based monitoring devise for applications.
• The National Sub-Mission on Forestry has also been launched under NMSA.

Under NMSA, currently only RAD is given prominence. NMSA is designed extensively for large- and medium-sized farms and land holdings. Even though promotion of soil conservation practices, use of biotechnology and improved seed varieties are important components to help all farmer types. There needs to be a more dedicated approach towards climate change resilience of small and marginal farmers. mission focuses on sustainable agriculture but fails to recognize the importance of adaptation. No dedicated funds are allotted to adaptation and coping mechanisms with respect to agriculture.

8. National Mission on Strategic Knowledge for Climate Change (2010)

NMSKCC seeks to develop a knowledge system that will help the nation in achieving the objective of sustainable development. The Global Technology Watch Group (GTWG) has been set up which aims to keep track of state-of–the-art technologies emerging globally in eight sectors—coal, renewable energy, agriculture, water, sustainable habitat, manufacturing, energy efficiency and forestry. The mission aims to make the suitable technology commercially available by 2030. So far, the focus has been on renewable energy, especially solar, where the focus is on photo-voltaic technologies, solar-thermal technologies, storage for energy management and business models and policy.
• GTWB for six sectors—agriculture, water, sustainable habitat, manufacturing, energy efficiency and forestry—have been recently set up under the DST Technology Information Forecasting and Assessment Council (TIFAC).

• Centres for Excellence have been launched at IIT Bombay (Centre for Excellence on Climate Change) and the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) in Hyderabad (Centre for Plant Research).
• Major research and development projects were launched, including Ocean Acidification and Sea-level Rise under the National Institute of Oceanology (NIO); Regional Climate Modelling and Storm Surges under IIT-Delhi; Extreme Rainfall Studies under the University of Allahabad; and Adaptation in Himachal Pradesh under IRADE.
• Existing centres of excellence in IIT Chennai (Indo-German Centre for Sustainability) and IISc Bangalore (Divecha Centre for Climate Change).
• National Network on Climate Change Impact on Human Health and National Network on Climate Modelling is launched.
• Proposed new programmes: State climate-change cells in all states; institutional and human capacity-building nodal agency to be set up in states.
The formation of GTWGs is an overarching highlight of the initiative. The mission is one of the slowest-moving missions and is currently facing financial and expertise crunch. Also, even though states are recognized as significant drivers of the mission, no significant development is seen on this front. States are still to establish nodal agencies to carry forward the work on the mission. Most of the work on capacity-building initiatives, setting up of climate networks, establishments of data-sharing systems and enhancing research and development activities at the state level is still to be seen[10].

Conclusion

NAPCC was launched in response to combat the adverse effects of climate change, formed ahead of the crucial Copenhagen Summit, it showed India's seriousness in tackling climate change. According to the Economic Survey 2020-21, to achieve India's Nationally Determined Contribution goals, a financial resource of USD 2.5 trillion (INR 11 lakh crores) at 2014-15 prices is needed. Climate finance is necessary to fulfil NDC targets. By 2020, developed nations were to provide USD 100 billion to developing countries which did not happen. Moreover, IFSCA Expert Committee on Sustainable Finance estimated that India needs investments of $10 trillion to make the carbon neutrality story a success by 2070. The Climate Policy Initiative (CPI) reported that India could raise only $44 billion (25% of the total target required each year) in FY 2019-20. The international investment was 13% and 17% in 2019 and 2020 respectively which is less due to the 5% hedging cost in the region. Beside this 8 Missions under NAPCC dealing with subjects as sustainable habitat, water, and agriculture and forestry are multi-sectoral, overlapping and multi-departmental in nature. However, an effort made to combat climate change is appreciable, still much more needs to be done[11].

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