# Adaptation Plan Evaluation Report

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## Introduction

Climate change in India affects multiple facets of the ecosystem, including oceans (Marathe, Terray and Karumuri, 2021)**,** coastal regions (Gupta *et al.*, 2018), water resources (Shiva Shankar, Kumar and Mohan, 2021) and forests(Lele and Krishnaswamy, 2019). Additionally, it significantly impacts agriculture (Kumar *et al.*, 2023), urban areas (Khosla and Bhardwaj, 2019), public health (Rajput *et al.*, 2022), and energy infrastructure (Yarlagadda *et al.*, 2022), creating complex challenges that require coordinated responses. For this report, we will focus on adaptation measures in two key sectors: water resources and public health.

*Water Resources*

Climate change poses a significant threat to water, food security, and the well-being of India’s 1.2 billion people in the 21st century. The country experiences uneven spatial distribution of water resources, with the drier northwest receiving scarce rainfall, while the northeast holds the distinction of being the wettest region on Earth (Goyal and Surampalli, 2018). Agriculture feeds about 17.2% of the global population using only about 9% of the world’s arable land, and more than 56% of the total agricultural area is rainfed (Goyal and Surampalli, 2018)

This heavy dependence on rainfall makes India particularly vulnerable to climate variability. Precipitation patterns are expected to shift significantly, with projections showing an increase in average annual rainfall by 7–18.7% by 2099 compared to the 1961–1990 baseline (Chaturvedi *et al.*, 2012). Similarly, precipitation in several river basins across India could increase by up to 30% by 2040–2069 and 50% by 2070–2099 from the 1971–2005 levels (Mishra and Lilhare, 2016). The A1B (IPCC, 2000) scenario projects higher precipitation, particularly in southern India (Kim and Byun, 2009). In the Brahmaputra basin, premonsoon rainfall is expected to rise by approximately 100 mm by 2071–2100, compared to the 1961–1990 baseline (Ghosh and Dutta, 2012). With India’s agrarian economy being heavily dependent on monsoons and water availability, these projected changes pose serious risks to agricultural productivity and food security, increasing the vulnerability of millions of livelihoods (Goyal and Surampalli, 2018).

Adaptation policy

The National Action Plan on Climate Change [NAPCC] (Prime Ministers Council on Climate Change, 2008) articulates India's adaptation goals addressing climate vulnerabilities across key sectors while promoting sustainable growth. NAPCC identifies eight National Missions, which form the core of the National Action Plan, out of which five missions are focusing on adaptation, which are:

1. National Water Mission: Promotes integrated water resource management to conserve water, minimize wastage, and ensure equitable distribution across regions and states.

2. Mission for Sustaining the Himalayan Ecosystem: Aims to safeguard Himalayan glaciers and ecosystems through sustainable management and a monitoring network.

3. National Mission for a Green India: Focuses on enhancing ecosystem services, including carbon sequestration, through afforestation and reforestation efforts.

4. National Mission for Sustainable Agriculture: Seeks to build climate resilience in agriculture by adopting new technologies, integrating traditional knowledge, and introducing improved credit and insurance systems.

5. National Mission on Strategic Knowledge for Climate Change: Facilitates research, innovation, and global collaboration to address climate challenges and develop effective responses.

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Figure :Institutions involved in the National Action Plan on Climate Change.(Azohani et al,2017).

In addition to NAPCC (Prime Ministers Council on Climate Change, 2008), state-level strategies known as State-Specific Action Plans [SSAPs] (Ministry of Jal Shakti, 2015) have been developed. These SSAPs complement the national missions by addressing region-specific climate risks and adaptation needs, reflecting the diverse environmental challenges across different states. While the NAPCC provides a framework for promoting sustainability and building climate resilience at the national level, the SSAPs tailor these efforts to local contexts, ensuring targeted responses.

Beyond these frameworks, targeted government schemes, such as the Atal Bhujal Yojana (Nandakumaran, 2020), focus on domain-specific adaptation efforts. The scheme aims to enhance groundwater governance through community participation, improved monitoring systems, and sustainable use practices.

## Methods

*Water Resources*

The analysis will evaluate whether the key adaptations implemented under the National Water Mission [NWM] (Prime Ministers Council on Climate Change, 2008), SSAP (Ministry of Jal Shakti, 2015) or other institutions such as the Atal Bhujal Yojana (Nandakumaran, 2020) align with global recommendations outlined by the IPCC recommendations (IPCC, 2021). Additionally, the analysis will explore whether these institutions share a consistent understanding of risk with the IPCC’s framework, The IPCC identifies the disproportionate impacts on vulnerable populations and highlights the critical importance of adaptive water management. The three primary dimensions of water related risks:

1. With every increment of warming, risks related to water scarcity, quality, and extreme events will increase, vulnerable populations and regions with high exposure will be disproportionately affected. (IPCC, 2021, TS.C.4.1)
2. Furthermore, changes in the water cycle, including shifts in precipitation patterns, groundwater recharge, and streamflow, are projected to disrupt freshwater and coastal ecosystems, threatening biodiversity and ecosystem services essential for human and environmental well-being. (IPCC, 2021, TS.C.4.3)
3. At higher warming levels, the risks to water security represent a major barrier to achieving global sustainability goals. (IPCC, 2021, TS.C.4.5)

This comparison will help determine if the institutions’ adaptation strategies are aligned not only in their objectives but also in their risk perceptions and frameworks for action.

Various adaptation options in the water, agriculture, and food sectors are both feasible and come with several co-benefits. Many of these strategies have proven effective in reducing the impacts of climate change, though their effectiveness varies depending on context. (IPCC, 2022, TS.D.5)

1. Adaptation strategies for water and food systems vary across sociocultural, economic, and geographical contexts. Key documented options include rainwater harvesting, soil moisture conservation, crop improvements, agricultural diversification, and community-based adaptation. (IPCC, 2022, TS.D.5.2)
2. Policies supporting resilient water and food systems improve ecosystem services and food security. Effective policies include shifting subsidies, certification, green public procurement, capacity building, and payments for ecosystem services. Involving food producers, water users, and integrating Indigenous and local knowledge are essential for building sustainable systems.(IPCC, 2022, TS.D.5.8)

Adaptation measures under the National Water Mission would be weighed against the IPCC recommendations

The adaptation measures under the National Water Mission (Ministry of Jal Shakti, 2022) will be evaluated against the IPCC recommendations (IPCC, 2022, TS.D.5) to determine their alignment with globally recognized strategies.

The assessments will be summarised in a tabular format as recommended by (Craft and Fisher, 2016)

## Assessment

*Risk perception pertaining to the impact of climate change on water resources*

1. The Government of India acknowledges that climate change may alter the distribution and quality of natural resources, posing a significant threat to the livelihoods of millions. With the Indian economy heavily reliant on climate-sensitive sectors such as agriculture, water, and forestry, the projected climate changes present a substantial challenge (Ministry of Jal Shakti, 2022). This assessment aligns with the IPCC's findings, which highlight the disproportionate impact of water-related risks on regions with high vulnerability and exposure (Intergovernmental Panel On Climate Change (IPCC), 2023, TS.C.4.1).
2. Similarly, the Department of water resources identifies that global warming will likely disrupt the hydrological cycle, exacerbating temporal and spatial variations in precipitation, snowmelt, and water availability (Ministry of Jal Shakti, 2022). These perceptions align with the IPCC's analysis, which emphasizes the intensification of water cycle disruptions, including groundwater recharge, runoff, and streamflow changes, that will negatively impact both ecosystems and human well-being (IPCC, 2023, TS.C.4.3).

*Adaption policy on water resources*

## Findings

Increasing dependence on ground water is depleting the buffering capacity of shallow aquifers (Shah, 2010). Regulations preventing the over utilisation of groundwater are difficult to enforce. (Shah, 2008)