



Public Expenditure and Climate Adaptation in India: Evaluating Resilience Outcomes and Financing Challenges

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Abstract

Adaptation to climate has been adopted as the foundation of the climate policy in India due to the high susceptibility of the country to the consequences of climate change, despite the relatively low levels of emissions per person. The paper aims to evaluate the impact of India's threefold increase in public spending on climate adaptation from FY16 to FY22 (3.7% to 5.6% of GDP) and assess its effectiveness in enhancing resilience by measuring outcomes such as improved infrastructure resilience and community preparedness. The paper relies on independent research conducted by the Climate Policy Initiative and the Indian Institute for Human Settlement, as well as official government documents and an audit by the Comptroller and Auditor General of environmental spending, to demonstrate the significant improvement in India's climate adaptation efforts. However, the actual spending represents only 1% of the estimated INR 29 trillion needed for climate adaptation in 2020. The monitored adaptation funding of about INR 370 billion every year falls significantly short of the estimated INR 29 trillion needed in 2020, leading to inadequate preparedness for climate-related challenges. At the state level, evidence shows genuinely realised outcomes in individual cases, e.g., Odisha's irrigation modernisation programme, but such measurement is the exception rather than the rule. In conclusion, it is determined that the primary constraints on the effectiveness of adaptation in India, such as the absence of standardised outcome tracking, insufficient sub-national institutional capacity, and heavy reliance on domestic public budgets for financing, could be addressed through measures like implementing standardised tracking mechanisms, enhancing institutional capacity at sub-national levels, and exploring alternative financing sources.

Keywords: Public expenditure, adaptation to climate, climate finance, SAPCC, adaptation gap, resilience, India.

1. Introduction

Climate change is not a far-off menace merely in scientific forecasts; it is already informing economic outcomes, lives and governments globally. Even over the past thirty years, much of the debate around climate was centred on mitigation or the attempt to reduce greenhouse gas emissions at the point of origin. Already, more and more there is an awareness that it is more or less already embedded within the system that we will face a significant amount of climate change despite the vigour with which we will cut back on our emissions in the future. This has raised climate adaptation to the top of the national agenda, and this rise is no longer more evident than in India.

According to the Intergovernmental Panel on Climate Change, adaptation is the mechanism of changing or adapting to the current or anticipated climate and its consequences to reduce the negative impact or use positive opportunities (IPCC, 2022). Adaptation, as outlined in Article 7 of the Paris Agreement, aims to enhance the ability to adapt, build resilience, and reduce vulnerability to climate change, all in

support of sustainable development (UNFCCC, 2015). The parties at CoP28 in Dubai took on a Framework on the Global Goal on Adaptation, which encompasses water, food security, health, infrastructure, poverty eradication, livelihoods and the protection of cultural heritage, and explicitly links the adaptation action to the Sustainable Development Goals (UNFCCC, 2023).

Adaptation provides local and immediate benefits, unlike mitigation, which offers diffuse advantages realized over extended periods. Adaptation, as the Economic Survey of India itself describes, is beneficial in the short run, as it minimises losses, stabilises incomes, entrenches development and protects investments (Government of India, 2026). This difference is relevant in the ways that adaptation should be assessed, since the payoff should be concrete and short-run; it, at least in theory, can be more readily quantified, in comparison to the more abstract, global reward of emissions reduction.

The stand of India in this debate is a bit peculiar. Despite its low greenhouse gas emissions of 2.9 tonnes per capita (much

lower than the world average of 6.7 tonnes per capita), India faces high vulnerability to climate change with frequent droughts, floods, heatwaves, and a densely populated coastline at risk of sea-level rise (Govt of India 2026). It was this asymmetry of high exposure to the impact of the problem and low historical contribution that has driven India to adopt an adaptation-based climate policy that is nearly entirely funded by domestic resources. India has a much higher share of its adaptation finance being tracked domestically (Government of India, 2026), a value significantly lower in comparison to the rest of the world, where most of the international adaptation finance to developing countries amounts to USD 26 billion annually compared to an estimated value of USD 310-365 billion annually in 2035 (UNEP, 2025).

There have been increased expenditure by the public on relying activities related to adaptation in India. The domestic expenditure on adaptation and resilience, according to the Economic Survey 2025-26, increased by 3.7 per cent of GDP in FY16 to 5.6 per cent of GDP in FY22. Individually, the Union Environment Minister informed the CoP30 assembly in Belém that the proportion of adaptation-relevant spending in India, in terms of GDP, rose by 150 per cent between 2016-17 and 2022-23 (Ministry of Environment, Forest and Climate Change, 2025). The two characters are heading towards one thing: an increase in adaptation spending of an impressive magnitude in the last ten years.

What is not clear, though, is whether this increase in spending has been accompanied by an equivalent increase in effectiveness. It is one thing to spend more and another thing to spend well, and the independent research institutes within India themselves have pointed to a consistent lack of fit between what is being spent and what is in fact needed to construct resilience at scale. This paper explores the gap between the expenditure on climate adaptation in India and the actual outcomes achieved. Its question is: how successfully has India so far spent public money aimed at climate adaptation to translate financial resource allocation into tangible resilience metrics? In response, the paper utilises official government data, independent studies of climate-finance tracking, a state-level statutory audit report, and case-level Indian state evidence to ensure not only to determine the amount that India is spending on adaptation, but also the actual outputs thereof.

The paper is organized as follows: Section 2 will be a literature review based on existing literature on adaptation finance and how it has worked in India. Section 3 sets out the methodology and analytical framework used. In Section 4, the findings are given, including trends in expenditure, institutional delivery mechanisms, case evidence at the state level, and the gap in financing. Section 5 expounds on what the implications of these findings are for the wider effectiveness question, and Section 6 wraps up with recommendations and closing remarks.

2. Literature Review

The climate adaptation expenditure literature on India may be summarized into three overarching strands: official government expenditure reporting, autonomy in finance-tracking studies and critique of academic and audit-based evaluation.

The official record refers to the annual Economic Survey released by the Ministry of Finance. In the 2025-26 edition, a whole chapter is devoted to environment and climate change, lamenting the development of an adaptation strategy in India,

since being launched in 2008 under the name National Action Plan on Climate Change (NAPCC), which included eight national missions, such as solar energy, energy efficiency, water, the Himalayan ecosystem, sustainable habitats, green India, sustainable agriculture and strategic knowledge, to State Action Plans on Climate Change (SAPCCs) which followed. The Survey records a significant change in these state plans: the post-2020 generation is billed as adaptation-centred, is integrated with the state planning department, state finance department and is focused on outcome management compared to the 201015 generation, which was broadly aligned with NAPCC missions but loosely linked to state budgets and featured mitigation-dominated projects (Government of India, 2026). This self-reported development is informative, and as an official document produced by the ministry, it describes the spending; of course, it is quite predisposed towards development appearance rather than shortfall.

Such corrective services are provided by independent research on finance tracking. India Landscape of Green Finance: Since 2019-20, the Climate Policy Initiative has been tracking the flow of finance for adaptation and mitigation in India. Its last release concludes that tracked adaptation finance was roughly USD 15 billion in 2021-22, increasing almost threefold since 2019-20, but at that point, it is almost exclusively government-budget funded, with the involvement of private capital described as insignificant (Climate Policy Initiative, 2024). This confirms the own figure proposed by the Economic Survey that approximately 98 per cent of the adaptation financing in India is domestically financed, but renders it as a sign of market failure, rather than a marker of Indian self-reliance, that merely shows that private investors are not venturing into the field of adaptation on a large scale.

In its Climate Finance in India 2023 report, the Indian Institute of Human Settlement puts tracked adaptation finance against its own, independent estimate of adaptation cost. Based on the Department of Economic Affairs, it estimates that in 2020, the adaptation costs of India are INR 29 trillion and increase to INR 86 trillion at 2012 constant prices, compared to actual flows of current of only INR 370 billion annually tracked adaptation finance, with the report stating that in actual terms, it is akin to a drop in the ocean (Srinivasan *et al.*, 2023). That report observes that private-sector investment in adaptation is also minimal as several structural impediments exist, and that many Indian states do not have the institutional resources to plan, invest, adopt and entrench climate action in the framework of their own development programmes.

Further, more institutional layers of critique are provided by academic and audit-based literature. One of the earliest to record the poor implementation history of the early SAPCCs, Dubash and Jogesh (2014), of the Centre for Policy Research, contended that the state plans were often drawn up with the aid of external consultants, and failed to feature in the reality of state budgeting. More recent institutional analyses, like the 2025 discussion note on climate governance in India by CSEP, suggest a more robust independent audit of climate spending, with the Comptroller and Auditor General International Centre for Environment Audit and Sustainable Development in Jaipur having been identified as an untapped capacity in this context (Centre for Social and Economic Progress, 2025). In a CAG review of the Ministry of Environment and Forests, which was already old when the current practices of adaptation-finance started, over 93 per cent of centrally-funded afforestation projects had not met

their intended purpose, funds allocated to infrastructure to control pollution were not spent after years in some situations, and project delays of more than a decade were not unusual (Comptroller and Auditor General of India, 2011). Although this audit is a precursor to the SAPCC 2.0 framework, it creates a timing basis for the claim of better delivery that must be tested by the long institutional ground.

Taken together, this collection of literature suggests a gap in evaluating the effectiveness of climate adaptation spending in India. Official reports indicate growth in expenditure and characterize institutional reform in very positive terms. Single finance-follow-up reports vindicate this cost pattern, but demonstrate it to be a minor share of apparent requirement. Critical audit-based literature highlights long-standing challenges in implementation capacity and fund utilization, which appear to have been addressed only partially by recent reforms. What is notably missing in the literature is a systematic evaluation of whether the funds spent have effectively reduced vulnerability and built measurable resilience, rather than just accounting for inputs and outputs.

3. Research Methodology

The type of evaluation chosen in this paper, the desk-based and secondary-source evaluation method, also fits the scope of a short research paper. Since this study did not involve primary data collection, such as conducting surveys at the district level to assess the outcomes of adaptation projects, the analysis will enhance its reliability by utilizing four categories of published materials: official government reports (such as the Economic Survey 2025-26 and related ministerial statements), independent studies tracking climate finance (like the Climate Policy Initiative Climate Finance in India series and the Indian Institute of Human Settlements Climate Finance in India series), audit findings (from a Comptroller and Auditor General performance report), and academic or institutional critiques (including discussion papers and journal articles on adaptation finance and SAPCC implementation).

To organize this material for a comprehensive evaluation of effectiveness, the paper uses a framework provided by UNFCCC guidelines on adaptation. It divides the analysis into four key components of effective climate adaptation: risk assessment, strategic planning, implementing adaptation measures, and ensuring effective monitoring, reporting, and verification. The framework is also helpful since it distinguishes the existence of a plan (strategising), the existence of a scheme (implementation), and evidence that the scheme in question actually worked (monitoring and verification) - a distinction that is often unclear in official reporting, where the disbursement of funds or the release of a scheme is sometimes described as evidence of success in itself.

Based on this, the paper also differentiates three types of evidence that were witnessed within the reviewed sources: inputs (money allocated or spent), outputs (activities completed (hectares planted, projects sanctioned, infrastructure built) and outcomes (verified changes in vulnerability or resilience, such as income or productivity gains). This input-output-outcome contrast is used across the Findings section to evaluate the extent to which the evidence available can in fact be said to substantiate claims of effectiveness as to the extent to which the activity is recorded. A significant limitation of this approach is its heavy reliance on secondary sources, primarily government-funded, with a lack of independent field-level verification for the specific case studies discussed in this paper. Any significant

limitations are explicitly highlighted in the discussion of the findings.

4. Results and Analysis

i). Expenditure Trends: Allocation of Domestic Funds-

The allocation of domestic funds towards adaptation and resilience-related expenses in India rose from 3.7% of GDP in FY 2016 to 5.6% of GDP in FY 2022, as reported in the Economic Survey 2025-26, indicating a significant six-year growth period. This is supported, but not precisely balanced, by an alternate number given by the Union Environment Minister at CoP30 in November 2025, who reported that the adaptation-relevant spending in India grew by 150 per cent between the two periods 2016-17 and 2022-23 (Ministry of Environment, Forest and Climate Change, 2025). It's important to note that these two figures are not directly comparable; an increase from 3.7% to 5.6% represents approximately a 51% rise, not 150%. This discrepancy suggests potential differences in baselines, definitions of adaptation-relevant expenses, or time frames used in the calculations. It is a small yet indicative example of a larger issue: even within official governmental communications, there is no uniformity in how adaptation expenditure is reported, thus making it harder to verify independently.

India has also raised sovereign green bonds, totalling INR 72,697 crore since FY23, although its annual issuance decreased in FY26 compared to FY25, on the financing-instrument side (Government of India, 2026). Indore, Ahmedabad, Vadodara, and Ghaziabad are the only urban local bodies to issue municipal green bonds, but the sums raised are small, with an average amount of between INR 100 and 244 crores per issue. Greenium, or the yield premium that green bonds tend to attract over traditional bonds, has been said to be intermittent in India, at a spread between zero and six basis points, compared to a more steady two-to-five-basis-point order in markets like France (Government of India, 2026). This indicates a less developed and illiquid market compared to established sovereign green bond markets.

ii). Institutional Architecture: Evolution of India's Institutional Response Framework-

India's institutional response framework has evolved through three main phases. The National Action Plan on Climate Change, initiated in 2008, introduced eight national missions, with a focus on adaptation in areas such as water, sustainable agriculture, and the Himalayan ecosystem. This national framework has been succeeded by individual state plans on Climate Change, which are the State Action Plans, which have been prepared since approximately 2010. The Economic Survey indicated that the initial set of these plans (201015) was generally in tune with the mission structure of NAPCC but poorly connected to state budgets, with standalone projects being predominant and less likely to be followed up. The recent iteration (as of 2020) is aligned with state planning and finance departments, integrated with key social-sector initiatives in water, agriculture, and urban development. It emphasizes outcome-based monitoring over solely reporting activities (Government of India, 2026).

Such change, provided that it is authentic, should be a significant change in the manner of the provision of adaptation. Nevertheless, the existing evidence to respond to this paper cannot determine whether or not outcome-oriented monitoring has in practice been applied on a large scale, versus being mentioned as a goal. The independent evaluation of the Indian Institute of Human Settlement suggests a more

modest approach, observing that the institutional capacity to plan, invest, undertake and mainstream climate action into the development programmes and investments of many Indian states is wanting (Srinivasan *et al.*, 2023) - a fact that does not auger well with the claims of a fully-fledged, capacity-integrated SAPCC structure.

iii). State-Level Case Evidence: Examples of Program Outcomes-

Very few programmes at the state-level provide definitive, measurable outcome evidence, but these seem to be the exceptions rather than the rule. The Integrated Irrigation Project of Odisha under Climate Resilient Agriculture has modernised 538 minor irrigation systems in 15 districts serving the region, with a reported 28.8 per cent rise in water productivity, a 67.8 per cent rise in agricultural production and a 27 per cent rise in household incomes (Government of India, 2026). This is among the few exceptions to the official record in having a definite before-and-after outcome of productivity or income actually reported, as opposed to merely an output measure, e.g., area covered or funds disbursed.

In comparison, the majority of the other examples listed in support of KERA in Kerala, a spring- mapping and catchment-protection project in Meghalaya, the MISHTI mangrove restoration programme, as well as city-level interventions like the heat insurance scheme in Ahmedabad and the community cooling stations in Jodhpur are detailed nearly entirely in terms of scale and coverage: number of hectares planted, number of households covered, number of person-days of employment generated, difference in temperature in one cooling station. They are valid and are regularly significant fruits, yet inadequate to show a proven decrease in vulnerability or increase in resilience throughout the populace that these schemes are intended to enhance. The imbalance between the outcome-level reporting in Odisha and the output-level reporting in other places indicates that the adaptation programmes in India have a high degree of discrepancy in the rigour with which they monitor their own results, and that outcome assessment, unlike reporting of activities, is the new rule.

iv). The Financing Gap: Discrepancy Between Required and Tracked Spending-

The most outstanding discovery of this paper is the magnitude of the difference between the requirement of financing adaptation and the tracked spending that has actually been done. The Indian Institute of Human Settlement estimates that India needs to spend INR 29 trillion by 2020 and INR 86 trillion by 2030 on adaptation, which was initially estimated by the Department of Economic Affairs. In contrast, in 2020 only INR 370 billion per year will be tracked green finance towards adaptation (Srinivasan *et al.*, 2023) which equals about one per cent of the estimated requirement that is required in 2020. Even with growth since then, even the more recent tracking by the Climate Policy Initiative, with an adaptation finance amount of about USD 15 billion, or about INR 1,250 billion, by 2021-22 (Climate Policy Initiative, 2024), is just a small portion of what independent estimates indicate is needed.

This is not a gap that is exclusive to India. According to the 2025 UNEP Adaptation Gap Report, the total annual contribution of the developing countries will be USD 310-365 billion by 2035, compared to the current annual global adaptation finance flows of around USD 26 billion only

(UNEP, 2025), a figure that the Union Environment Minister quoted directly at CoP30 when he also warned of the continuing worsening of the global adaptation finance gap (Ministry of Environment, Forest and Climate Change, 2025). What is unique to the Indian context is that, unlike most developing economies, it is not largely a developing economy in wait for international funding to plug this gap; instead, it is almost solely domestic public budgets, already under a fiscal constraint of deficit, that bear this load (Srinivasan *et al.*, 2023).

v). Structural Constraints: Barriers to Public and Private Adaptation Funds-

The sources we have looked through share several structural barriers. The official list of barriers to public and private adaptation funds includes, according to the Union Environment Minister, slow and cumbersome steps that must be followed to access multilateral climate funds, high transaction costs, limited institutional capacity, the lack of clear revenue streams for adaptation projects (as opposed to Mitigation projects, which can raise tariff or carbon-credit revenue), and insufficient risk-sharing instruments (Ministry of Environment, Forest and Climate Change, 2025). Individual studies support all of these arguments and introduce another one: there is little or no flow of private capital to adaptation at anything that is noteworthy, as the Indian Institute of Human Settlements overstates it as negligible and further cites a host of structural obstacles (Srinivasan *et al.*, 2023).

These concerns are given weight by a longer pattern of institutions. A 2010-11 Comptroller and Auditor General performance audit of the Ministry of Environment and Forests revealed that over 93 per cent of centrally funded afforestation projects approved under a national scheme did not achieve their targeted objectives and that implementing agencies often did not revert to receive further tranches of funding, a fact that begs the question of misuse of funds (Comptroller and Auditor General of India, 2011). In a single instance, pollution-control funds were lying unused, with a wait of over seven years, and in another instance, a delay of more than twelve years in a wastewater treatment project was discovered by the same audit. Although this audit is older than India's current structure of adaptation finance by an order of ten years, and cannot be interpreted as factual evidence about spending under the SAPCC regime, nonetheless it confirms that the failure to implement this effort was historically an important limitation to what India could spend on the environment. Indicatively, no such adaptation-specific CAG performance audit can be found publicly available during the post-2015 time frame, itself an observation: autonomous, systematic audit coverage of adaptation spending, specifically, does not seem yet to exist on the scale that the afforestation era audit used to cover forestry expenditure.

5. Discussion

The evidence examined in this paper suggests an ambivalent picture, which cannot be easily judged as an achievement or failure. India has increased its expenditure on adaptation, expanded its institutional structure, and the Odisha irrigation modernisation programme has demonstrated positive results from government spending on adaptation. However, the amount of such spending is still a minor fraction of what independent studies suggest is necessary. Private capital has shown little interest in adaptation investment, and the

monitoring indicators needed to assess the effectiveness of the schemes are often not recorded.

This suggests that the effectiveness of adaptation in India is not limited by the absence of political commitment in this context. The Economic Survey and statements from the Union Environment Minister at CoP30 indicate that the government has prioritized adaptation in both rhetoric and financial policies. The main constraints include: a significant financing gap that even doubling or tripling current expenditure may not address effectively; persistent institutional capacity gaps at the state level, not fully resolved by the SAPCC 2.0 reforms; and a lack of standardized outcome monitoring, making it difficult for researchers, auditors, and the government to determine if schemes enhance resilience or just utilize the budget.

The latter point should be highlighted since it has an impact on how future expenditure has to be assessed and directed. There is no semantic difference between an output (a canal built, a mangrove planted, a bond issued) and an outcome (a household income made less vulnerable to drought, a coastal community made measurably less exposed to storm surge). It determines if public funds are fulfilling their intended purpose. However, the Odisha case study is at the moment unique in that it is one of only a few places where this differentiation is even mentioned in the current data. To evaluate the efficiency of India's adaptation program in the future, bridging the measurement gap may be more critical than increasing spending.

6. Recommendations

India should establish standardized outcome indicators for state-level adaptation plans, following the framework used by developed countries, to monitor and compare resilience outcomes across states over time. Second, the current environmental audit capacity of the Comptroller and Auditor General with the International Centre for Environment, audit and sustainable development must be enhanced to undertake a specific performance audit on adaptation-specific spending in relation to the NAPCC and SAPCC frameworks, similar to the scrutiny that afforestation spending has been subjected to. Third, with the complete lack (almost) of private capital in adaptation finance, targeted de-risking facilities (blended finance facilities, guarantees, clearer forms of revenue for adaptation infrastructure) should be given top priority, but carefully enough designed not to create contingent fiscal liabilities of their own. Fourth, an attempt to harmonize discrepancies that emerge among various official data on adaptation expenditure (including the difference between the GDP share trend in the Economic Survey and the 150 per cent increase quoted by the Minister) would give increased credibility to self-reporting by India and allow independent assessment, of the type undertaken in this paper, to be implemented with much less confidence.

7. Conclusion & Policy Implications

Over the last decade, climate adaptation has become crucial to India's climate policy, reflecting the country's vulnerability to climate risks despite low per-capita greenhouse gas emissions. India has significantly increased public expenditure on adaptation and strengthened institutional frameworks, notably through the National Action Plan on Climate Change (NAPCC) and State Action Plans on Climate Change (SAPCCs). This increase in adaptation funding from FY2016 to FY2022 showcases a strong policy commitment. Nevertheless, important limitations remain. Firstly, although

expenditure has grown, it still falls drastically short of the estimated financial requirements needed to build adequate climate resilience. Current funding is only a fraction of what is necessary. Secondly, adaptation finance heavily relies on public budgets, with negligible private-sector involvement attributed to uncertain returns and inadequate risk-sharing mechanisms. Most crucially, there is a persistent gap between spending and actual outcomes. While some programs, like Odisha's irrigation modernization initiative, demonstrate positive results, many interventions are only assessed in terms of financial inputs and outputs, lacking clear evidence of reduced vulnerability.

The study concludes that India's key challenge is not just to secure more resources but to establish institutions capable of verifying the effectiveness of adaptation investments. Without robust outcome-based assessments, it's difficult to gauge the efficiency and sustainability of adaptation expenditures.

Policy implications from this study include:

- i). **Standardized Monitoring Framework:** India should adopt a nationwide framework to monitor adaptation outcomes, moving beyond simple input and output reporting to include indicators that measure resilience, vulnerability reduction, and risk mitigation. This would enhance comparability across states and support evidence-driven policies.
- ii). **Strengthened Evaluation Mechanisms:** It is vital to bolster independent evaluations of adaptation expenditures. The Comptroller and Auditor General and environmental auditing bodies should conduct performance audits focusing on both financial compliance and the efficacy of funded initiatives.
- iii). **Enhanced Institutional Capacity:** Although SAPCC 2.0 has improved planning frameworks, many states still struggle with project implementation and evaluation. Increasing technical support and governance capabilities at the state and local levels is essential for translating financial input into effective adaptation outcomes.
- iv). **Mobilization of Private Capital:** To address the adaptation finance gap, there must be an increase in private investment alongside public funding. Innovative financing solutions, such as blended finance, climate risk guarantees, and public-private partnerships, could attract investment and minimize risks for private stakeholders, although they must be carefully structured.
- v). **Improved Reporting Transparency:** Accurate and consistent reporting of adaptation finance is essential. Varied methodologies across official reports can undermine credibility and hinder evaluations. Establishing a harmonized accounting framework for climate finance would foster transparency and enhance policy synchronization.

In conclusion, while India's adaptation strategy has advanced to a more rigorous and finance-oriented framework, success will depend on not only the quantity of resources but also the mechanisms to measure and validate adaptation outcomes. Building an effective outcome-based monitoring system is as crucial as securing additional funding to ensure India's climate resilience in the future.

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