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The Resilience Dividend: Aligning Adaptation, Growth and Equity in India

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Abstract

India's climate risk is compounding faster than the institutions built to manage it. The Belem Adaptation Indicators agreed at COP30, alongside India's Third National Communication, supply the reporting architecture for resilience. What they do not supply is finance or sectoral coherence. This commentary examines the economics of that shortfall, placing agriculture at the centre of the analysis: the sector employs close to half the workforce and absorbs the largest share of climate-related loss. Its argument cuts against the grain of how budgets are written. Adaptation is not a welfare cost to be contained but a capital investment with a measurable return, and the global evidence puts that return at between two and ten rupees for every rupee committed. Treating it accordingly, by classifying adaptation as productive capital expenditure, financing climate-smart agriculture at scale, and targeting the districts where climatic exposure and poverty coincide, would let India shape the Global Goal on Adaptation rather than merely report against it.

Keywords: Compound Climate Risk, Adaptation Economics, Risk Hotspots, Belem Adaptation Indicators, Climate-Smart Agriculture, Adaptation Finance, Equity

The Adaptation Imperative

India's average temperature rose by roughly 0.89 degrees Celsius over 2015-2024 relative to the early decades of the twentieth century, and models project a further 1.2 to 1.3 degrees by mid-century under a middle-of-the-road emissions pathway [1]. The second figure carries more weight than it appears to. It is additional warming, stacked on change already realised, and it arrives alongside shifts that behave less like trends than like shocks. Marine heatwave days in the surrounding seas are projected to climb from about twenty a year to nearly two hundred by mid-century. The Hindu Kush Himalaya are warming at 0.28 degrees a decade. Peak pre-monsoon cyclone intensity in the Arabian Sea rose by 40 per cent between 1982 and 2019.

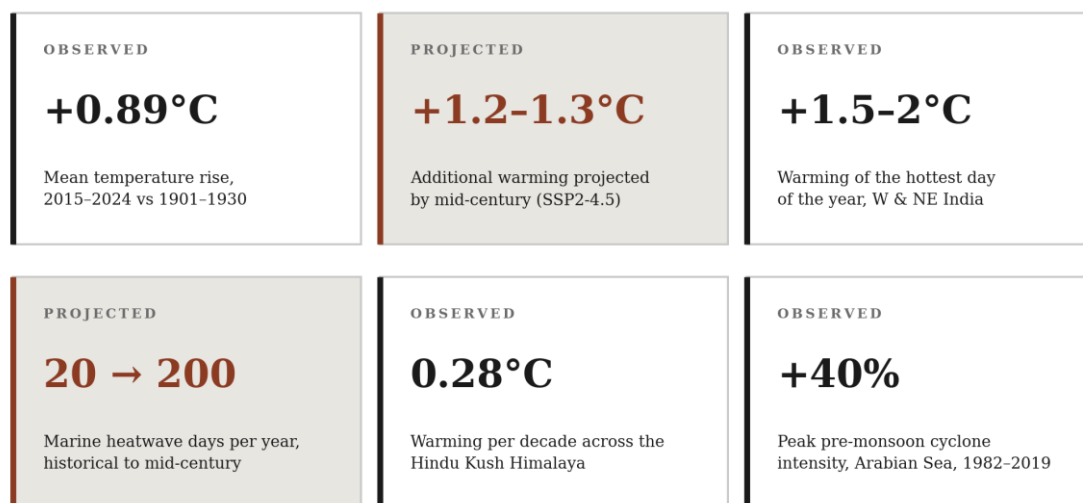
For an economy in which the monsoon still sets the terms of rural demand, these are macroeconomic variables rather than environmental ones. Recent years have delivered them in combination: heatwaves across the Indo-Gangetic plains, glacial lake outburst floods in the Himalaya, extended dry spells through central India. Agriculture absorbs the largest share of the resulting loss, and it does so through households with the thinnest buffers.

The policy architecture is largely in place. The Third National Communication and the Initial Adaptation Communication to the UNFCCC both name agriculture, water and coastal zones as priorities. At COP30 in Belem, parties adopted 59 voluntary indicators under the Global Goal on Adaptation, now referred to as the Belem Adaptation Indicators, together with a commitment to triple adaptation finance by 2035. India thus has a domestic plan and an international yardstick against which to report.

What it lacks is a financing pathway that matches either. Responsibility remains dispersed across ministries, and adaptation still enters the Budget as relief rather than as investment. That gap, and the economic logic for closing it, is the subject of this commentary.

Figure 1: India's climate signal, post-AR6

Observed change and mid-century projections. Warming figures are additional warming under SSP2-4.5 relative to 1995–2014, over and above change already observed.



Source: Dhara et al (2025), PLOS Climate 4(11): e0000724.

Figure 1: Observed Change and Mid-Century Projections for India. Warming Projections are Additional to Change Already Recorded

What Adaptation will Cost

The headline financing number deserves care, because it is frequently misquoted. The Reserve Bank of India's Report on Currency and Finance 2022-23 put India's green financing requirement at a minimum of 2.5 per cent of GDP annually to 2030, in order to close the infrastructure gap that climate events are opening up. The report states plainly that this estimate does not incorporate what mitigation and adaptation will separately demand. It is therefore a floor beneath the adaptation question rather than an answer to it. Read as a floor, and applied to current GDP, the annual requirement falls somewhere in the range of 8 to 14 lakh crore rupees, with agriculture and rural livelihoods representing the largest sectoral claim, ahead of water, urban resilience and health.

The cost of not spending is likewise on record. The same RBI assessment finds that unchecked climate change could cost India between 3 and 10 per cent of GDP annually by the end of the century, working through productivity decline, distress migration and the recurring fiscal shock of disaster response. Those are not losses that arrive on a single date. They accumulate quietly, in a fifth of a harvest here and a delayed sowing there, until they show up in aggregate demand.

The international context offers no reassurance. UNEP's Adaptation Gap Report 2023 finds adaptation costs across developing countries running five to ten times above current public flows [2]. For India, closing that distance is a question of macroeconomic management as much as environmental policy.

Agriculture: Where the Exposure Concentrates

More than 85 per cent of Indian farms are small or marginal, most depend on the monsoon, and a growing number draw on groundwater that is already over-extracted. Heat stress reduces wheat yields by an estimated 4 to 5 per cent for every degree of warming. Erratic rainfall disrupts rice and pulses. Coastal cultivation faces salinisation as sea levels rise, and Himalayan agro-ecosystems are losing crop diversity as climatic zones shift upslope faster than farming systems can follow.

Exposure alone would be manageable. What makes it dangerous is where it lands. The districts with the highest agricultural dependence in NITI Aayog's National Multidimensional Poverty Index (2023) overlap substantially with the climate-risk hotspots mapped by the Department of Science and Technology [3]. Across Bihar, Odisha, Jharkhand and eastern Uttar Pradesh, low adaptive capacity and high poverty incidence occupy the same territory. Vulnerability there is not additive but compounding: the household least able to absorb a bad season is also the one most likely to face one.

Against this, public expenditure reviews suggest that under 10 per cent of agricultural spending explicitly targets climate resilience. The shortfall widens each year, and it is food security and rural incomes that absorb the difference.

The Return on Adaptation

The case for spending rests on evidence that adaptation pays, and pays well. The Global Commission on Adaptation (2019) found benefit-cost ratios for resilience investment ranging from 2:1 to 10:1, and in some cases higher, calculating that 1.8 trillion dollars invested globally between 2020 and 2030 across five areas would generate 7.1 trillion dollars in net benefits [4]. The Commission described the mechanism as a triple dividend: losses avoided, economic gains induced through higher productivity and reduced risk, and social and environmental co-benefits that conventional accounting tends to omit.

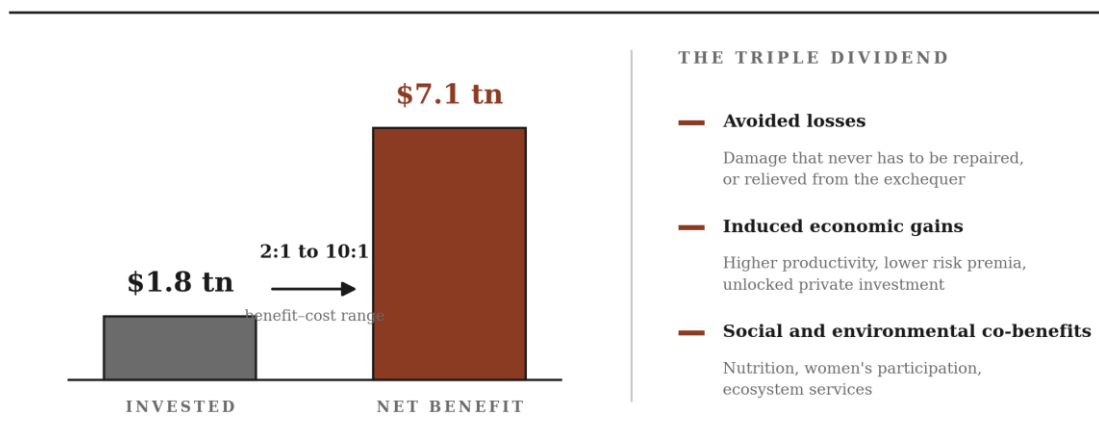
For India the social return is likely to be higher still, because the same rupee does two jobs. Improved irrigation, crop diversification and soil-moisture conservation stabilise output, in doing so they stabilise household consumption, reduce the relief outlays that follow each disaster, and lower the income volatility that keeps smallholders outside formal credit markets. Modelling by ICRIER (2022) suggests that every 100 rupees invested in climate-smart agriculture and irrigation returns 180 to 220 rupees in net social terms, chiefly through avoided poverty and employment stability [5].

A WRI meta-analysis of integrated climate-smart agriculture and water-management projects points in the same direction, reporting household income gains of 18 to 30 per cent, reductions in crop-loss volatility of 25 to 40 per cent, and measurable improvements in nutrition and women's participation. The recurring finding across this literature is that the benefits which are hardest to monetise are often the largest.

This has a direct implication for how adaptation is budgeted. Cost-benefit analysis should be embedded in adaptation budgeting as standard practice, using social discount rates that reflect long-horizon welfare gains rather than the short-term fiscal prudence that systematically undervalues them.

Figure 2: Why adaptation is capital expenditure, not relief

Global returns to adaptation investment, 2020–2030



For India the social return runs higher still, because the rupee that stabilises a harvest also stabilises a household — lifting incomes, cutting post-disaster relief outlays, and reducing the volatility that keeps smallholders out of formal credit.

Source: Global Commission on Adaptation (2019), *Adapt Now: A Global Call for Leadership on Climate Resilience*. Figures are global net benefits across five investment areas; benefit-cost ratios vary by sector and context.

Figure 2: Returns to Adaptation Investment and the Triple Dividend

What Scaling Would Look Like

Four pathways matter most, and none of them is technically novel. The constraint is delivery, not invention.

- **Climate-Smart Agriculture:** Precision farming, micro-irrigation, alternate wetting and drying, and stress-tolerant varieties raise yields while cutting emissions. The National Mission on Sustainable Agriculture has reached several million farmers, but coverage at that scale is a pilot in a country of 140 million holdings. Scaling requires climate-smart practice to be written into state agricultural budgets and, critically, into the credit lines that determine what farmers can actually finance.
- **Water and Soil:** Over half of cultivated land is rain-fed. Watershed development, on-farm water harvesting and restoration of soil organic carbon can raise productivity by 15 to 25 per cent. Aligning these with Atal Bhujal Yojana and Pradhan Mantri Krishi Sinchai Yojana would prevent adaptation and water-sustainability objectives from being pursued through separate and occasionally competing schemes.
- **Risk Financing:** Climate-indexed insurance combined with satellite-based yield estimation can absorb shocks that would otherwise become debt. Pradhan Mantri Fasal Bima Yojana already covers a large share of cultivators, yet delayed payouts and limited awareness blunt its effect. A payout that arrives after the next sowing decision has

been made provides income support but not resilience. Embedding risk-reduction metrics into the scheme would improve both impact and actuarial sustainability.

- **Knowledge Systems:** Adaptation depends on information reaching the person making the decision. District agrometeorological services under Gramin Krishi Mausam Sewa should be extended towards genuinely forecast-based advisories, supported by climate-risk dashboards usable at panchayat and state level.

Who Adapts, and Who is Left Out

Adaptation is also a question of distribution. Women make up close to half of India's agricultural labour force while holding limited access to land, credit and extension services, which means the people doing much of the farming are frequently outside the systems designed to help farmers adapt. Joint land-titling, women's cooperatives and targeted training address the constraint directly, and the returns to doing so run well beyond the households concerned.

Scheduled Tribes, forest dwellers and informal workers bear a comparable burden with even thinner formal protection. Embedding equity indicators in adaptation projects is what keeps resilience gains from concentrating among those already best placed to capture them. As UNEP (2023) observes, adaptation designed around social equity produces co-benefits in health, education and community stability that can exceed the directly economic returns [2].

Financing and Governing the Gap

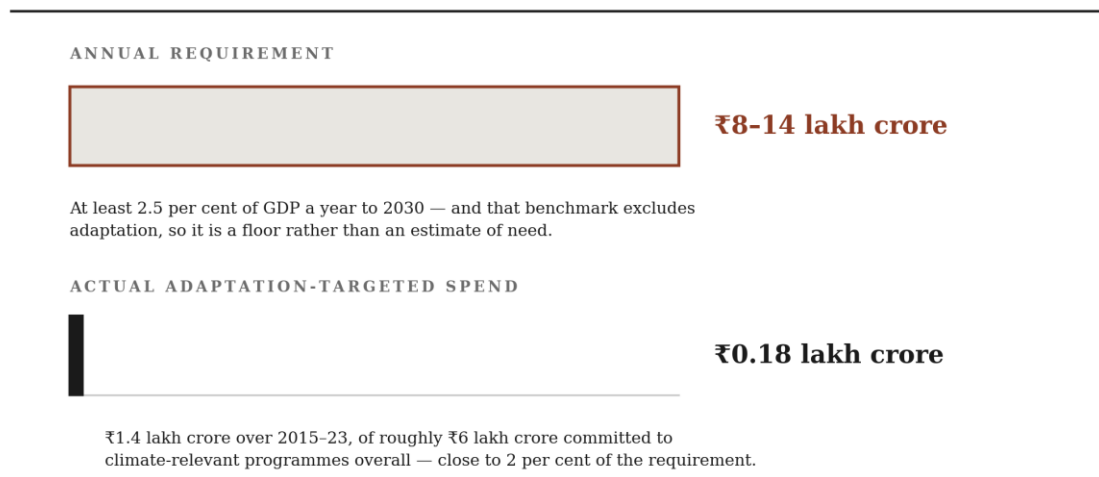
India's adaptation finance draws on domestic budgets, international climate funds and private capital, but tracking across the three is inconsistent enough that the total is not reliably known. The RBI has urged the creation of a national adaptation finance taxonomy, and the sequencing matters: flows that cannot be identified cannot be scaled, monitored or defended in a Budget discussion.

The available picture is sobering. Between 2015 and 2023, central and state governments committed roughly 6 lakh crore rupees to climate-relevant programmes, of which about 1.4 lakh crore was specifically directed at adaptation. Green-bond issuance has passed 20 billion dollars, but adaptation-linked projects account for under 15 per cent of it, since adaptation generates diffuse social returns rather than the contractible revenue streams bond markets prefer. Access to the Green Climate Fund and the Adaptation Fund remains limited by the complexity of project approval.

Adaptation bonds, structured along the lines of sustainability-linked instruments, could draw in domestic institutional investors. The GGA commitment to triple adaptation finance by 2035 supplies an external benchmark, and aligning national budgets to that trajectory would strengthen both credibility and negotiating leverage.

Figure 3: The adaptation financing gap

Annual requirement against annual adaptation-targeted public spending



Private capital is not closing the gap either.

Cumulative green-bond issuance has crossed \$20 billion, but adaptation-linked projects account for under 15 per cent of it. Access to the Green Climate Fund and Adaptation Fund remains constrained by project-approval complexity.

Sources: RBI, Report on Currency and Finance 2022-23; author's compilation of central and state budgetary allocations.

Figure 3: Annual Adaptation Requirement Against Adaptation-Targeted Public Spending

Fragmentation compounds the financing problem. Agriculture, Rural Development, Water Resources and Environment operate overlapping schemes with limited coordination between them. A National Adaptation Council under the MoEFCC could supply vertical and horizontal integration, while State Adaptation Task Forces align climate-risk mapping with actual budget allocation, supported by public dashboards tracking finance, outcomes and beneficiaries. Mainstreaming adaptation indicators into NITI Aayog's SDG Index and the RBI's financial-stability assessments would connect environmental and macroeconomic policymaking, which at present largely proceed in parallel.

The Global Goal on Adaptation and India's Opening

The GGA framework calls for measurable progress in adaptive capacity, resilience outcomes and vulnerability reduction. India's adaptation communications already speak to these pillars. Converting intent into outcomes requires national indicators tied to sectoral plans: crop-yield stability, irrigation efficiency, reduced disaster losses. Adopting a National Adaptation Goal with explicit hotspot prioritisation and time-bound metrics would let India demonstrate what operationalising the GGA looks like in a large developing economy, which is a more valuable contribution than compliance.

GGA focus area	India's stated priority	Where the leverage lies
Adaptive capacity	Governance, institutional planning and climate knowledge systems	Fold the Belem indicators into existing planning and monitoring cycles rather than running a parallel reporting exercise
Resilience outcomes	Sectoral resilience across agriculture, water, coasts and health	Map crop-yield stability, water storage and health metrics onto GGA indicators so one dataset serves both
Vulnerability reduction	Targeted action in hotspot regions and among vulnerable groups	Disaggregate outcomes by district, gender and social group; national averages will conceal the districts that matter
Means of implementation	Domestic budgets, international finance and private capital	Build the adaptation finance taxonomy first; flows cannot be scaled until they can be identified
Hotspot-focused action	Heat-prone plains, Himalayan zones, drought and flood regions	Make hotspot prioritisation a budgeting rule in state adaptation plans, not an annexure to them

Table 1: Mapping the Global Goal on Adaptation onto India's Priorities

Policy Directions

- Establish a National Adaptation Goal anchored in agricultural and rural resilience and consistent with GGA benchmarks.
- Scale investment in climate-smart agriculture through blended finance combining public grants, credit guarantees and private equity.
- Create an adaptation finance tracker within the RBI to monitor flows and impacts across sectors.
- Reclassify adaptation as productive capital expenditure in Union and state budgets, so that it competes for funds on the same terms as other infrastructure.
- Invest in data and early-warning systems that connect meteorological forecasts to crop-insurance and market decisions.
- Build equity and inclusion into adaptation design rather than appending them, ensuring gender and community participation from the point of project formulation.

Conclusion

Indian adaptation policy has reached the point where the binding constraint is no longer knowledge or intent but budgetary classification. As long as adaptation is treated as expenditure to be minimised, it will lose every contest against spending that produces a visible asset. Treated as capital formation, it competes on its returns, and those returns are strong. Agriculture, which is simultaneously the country's largest source of livelihoods and its deepest reservoir of vulnerability, must anchor that shift.

Aligning national planning with the Global Goal on Adaptation while reclassifying adaptation spending as investment would give India a growth model that protects its farmers, its food systems and its fiscal position at the same time. The returns are economic, social and moral in roughly equal measure. Adaptation is not the cost of survival, it is the foundation of prosperity that lasts.

Author

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Editor's Summary

This commentary sets out the economics of climate adaptation in India and argues that the decisive obstacle is now fiscal classification rather than knowledge or intent. Drawing on the Reserve Bank of India's 2023 assessment and on international benefit-cost evidence, it makes the case that adaptation spending, particularly in agriculture, water and rural livelihoods, should be budgeted as productive investment rather than contained as welfare cost. It traces the consequences of that reclassification for hotspot targeting, risk financing and gender equity, and situates India's priorities within the Global Goal on Adaptation framework agreed at COP30. Its conclusion is that resilience, once integrated into development planning, is a driver of inclusive growth rather than a charge against it.

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