# Climate Action Strategy for a Better and Resilient Future

## Action for Climate and Environment – ACE Strategy (2026-30)

***Building Resilience through Integrated Climate Pathways, Community Empowerment, and Biodiversity Restoration***

## 1. Context

Climate change has emerged as one of the most complex and urgent challenges of our time. India, ranked 9th in the long-term Global Climate Risk Index 2026 (1995–2024), continues to face escalating impacts, including extreme heatwaves, erratic monsoons, intensified cyclones, rising sea levels, widespread soil degradation, and biodiversity loss. In response, Dr. Reddy's Foundation (DRF) launched the Action for Climate and Environment (ACE) program in 2020, integrating climate action into its core mandate.

The initial five-year phase of ACE laid a strong foundation by building awareness, piloting and executing the interventions in Agriculture & Water, Afforestation & Biodiversity and Coastal Ecosystems, and scaling the impact through establishing partnerships. However, evolving scientific evidence, recent extreme events (such as the floods and heatwaves that affected millions between 2020-25), and India's updated national priorities—including the Disaster Management (Amendment) Act 2025, enhanced coastal vulnerability assessments, and commitments under the Kunming-Montreal Global Biodiversity Framework—necessitate a sharpened strategic focus for the next five years (2026–2030).

Notably, the Agriculture & Water component, which served as a primary strategic focus in the first five years, has been carved out into a separate strategy on regenerative agriculture, acknowledging its critical importance for enhancing farm livelihoods and transforming the agriculture sector as a whole. This revised strategy shifts emphasis to three interconnected thrust areas critical for building resilience and achieving co-benefits in mitigation and adaptation: *Afforestation and Biodiversity; Coastal Ecosystems; and Disaster Risk Reduction (DRR).*

This document presents the strategy for the Action for Climate and Environment (ACE) Program over the next five years (2026-30). The first section offers an overview of India's current climate landscape, highlighting persistent and emerging challenges alongside opportunities, to set the context for ACE's renewed direction. The second section outlines ACE's guiding principles, strategic priorities, and the three core thrust areas that will drive implementation.

### 1.1. Navigating India's Climate Future

For India to successfully respond to climate change, it calls for navigating multifaceted, interconnected challenges: transitioning from fossil fuels, addressing emissions from land use, addressing water insecurity and soil degradation, protecting ecosystems from pre-existing hazards and new emerging climate risks, managing rapid urbanization, and

reducing socio-economic disparities, gender barriers, and exclusion of local communities and non-state actors. Specific vulnerabilities underscore the need for focused action; over 80% of regions experiencing rising extreme events requiring proactive disaster risk reduction (DRR); coastal zones threatened by sea-level rise, erosion, and cyclone surges impacting 250–350 million people; and ongoing land degradation alongside biodiversity decline despite forest cover gains. These challenges demand integrated solutions that deliver resilience, carbon sequestration, livelihood security, and ecosystem restoration.

In addition, there is a need to focus on balancing growth with the environment while reducing socio economic disparities, gender barriers and including neglected perspectives of local communities, and non-state actors in policy making and program implementation. While these challenges pose a mammoth task for successful climate action there are also multiple opportunities, both in terms of mitigation and adaptation, which can bring about transformative change in the system.

India's commitments under the Paris Agreement, the Sendai Framework, and the Global Biodiversity Framework, along with robust policies such as the National Action Plan on Climate Change (NAPCC) and state-level Disaster Risk Reduction (DRR) plans, provide a strong foundation for addressing climate challenges. Proven models, including community-led mangrove restoration and agroforestry, demonstrate successful, scalable approaches to climate resilience. The country also holds immense potential in nature-based solutions, further bolstered by a dynamic climate action ecosystem involving government, the private sector, civil society, and local communities, along with rich traditional indigenous knowledge and environmental ethics.

In addition to India's strong commitment to upholding its global climate pledge, there are significant opportunities within the domestic climate policy framework. These include the vast potential of the energy efficiency, renewable energy, and water sectors, with active involvement from both the private and corporate sectors. This paper further explores the roles of these actors in driving India's climate action.

### 1.2. Strategic Synergies with India's Climate Landscape

The second section of the document focuses on the details of the climate action strategy wherein, ACE's strategy is anchored in **eight core principles:** *Sustainability; Scalability; Inclusivity and Participation; Local Relevance and Policy Alignment; Evidence-Based Design; Equity; Integrated Mitigation and Adaptation Approaches; and Measurable, Verifiable and Reportable Outcomes*. It also needs to be backed by evidence-based research while keeping the focus on fair and equitable solutions and integrating both mitigation and adaptation strategies in order to ensure that all outcomes are measurable, verifiable, and reportable.

The action plan also outlines **six strategic priorities**, which will be used for streamlining our work.: *(1) Facilitate climate protection among vulnerable groups; (2) Focus on mitigation and adaptation; (3) Maximize co-benefits in all actions; (4) Leveraging technology in solution design and execution; (5) Build awareness, communication, and*

*capacity; and (6) Strengthen partnerships and networks for collective action*

Lastly, implementation will centre on **the three strategic components** (SCs) (thrust areas and form the base line of ACE's future implementation plan (for the next five years)—*Afforestation & Biodiversity, Coastal Ecosystems, and Disaster Risk Reduction* — delivered in a phased manner, with initial emphasis on Afforestation & Biodiversity and Coastal Ecosystems, progressively integrating Disaster Risk Reduction to ensure holistic, resilient outcomes over the next five years.

## 2. Purpose of the Strategy: the onus to include Climate Action

Climate change has emerged as one of the most complex challenges of our time, threatening global development, and its widespread, unprecedented impacts are disproportionately burdening the world's poorest and most vulnerable populations (IPCC AR6 Synthesis Report, 2023; WMO State of the Global Climate, 2024). Human-induced warming has already reached approximately 1.55°C above pre-industrial levels in 2024—the warmest year on record—leading to shifting weather patterns that threaten food, water, and energy security; rising sea levels that heighten risks for coastal communities; and an increased frequency and intensity of extreme events such as heatwaves, droughts, floods, cyclones, and storms (IPCC AR6 Working Group II, 2022; WMO, 2024). These events have exposed millions to acute food and water insecurity, with mortality from floods, droughts, and storms 15 times higher in highly vulnerable regions compared to low-vulnerability areas between 2010 and 2020 (IPCC AR6, 2023).

Described as a 'super wicked problem' due to its scientific complexity, multiple causal factors, deep uncertainties, and absence of a single solution (Levin et al., 2012), climate change demands urgent, coordinated, and transformative action. In India, the impacts are particularly acute: extreme weather events occurred on 331 of 334 days from January to November 2025 (up from 295 days in 2024), claiming over 4,419 lives, and affecting all 36 states and Union Territories (Centre for Science and Environment/Down to Earth analysis, 2025). Events ranged from unprecedented winter heatwaves to relentless monsoon floods and landslides, underscoring the integration of climate action with disaster risk reduction (DRR) as emphasized in the Sendai Framework for Disaster Risk Reduction (2015–2030), which prioritizes understanding risks, strengthening governance, investing in resilience, and enhancing preparedness.

Moreover, Climate action is inextricably linked to poverty reduction, sustainable development, and DRR, as it amplifies existing social, economic, and environmental inequalities while increasing disaster risks. As climate change exacerbates already existing social, economic, and environmental challenges. Strong progress on SDG 13 (Climate Action) is essential for achieving the entire 2030 Agenda, with critical synergies across goals like SDG 1 (No Poverty), SDG 2 (Zero Hunger), and SDG 11 (Sustainable Cities and Communities) (UN SDG Reports, 2023–2025). Given this context, recognizing this urgency, Dr. Reddy's Foundation (DRF) has integrated climate action into its core mandate through the Action for Climate and Environment (ACE) program, launched in 2021. DRF's climate action program, Action for Climate and Environment (ACE), recognizes in order to limit global

warming and protect livelihoods we need to explore and implement a mix of mitigation and adaptation strategies to reduce the impacts of climate change, implemented in a participatory, community-led, and integrated manner aligned with national frameworks like the National Disaster Management Plan, these efforts aim to limit warming impacts, build resilience to extreme events, enhance livelihoods, and deliver co-benefits such as reduced losses and improved community resilience. This document outlines DRF's climate action strategy for the next five years (2026–2030). It examines the evolving climate and disaster risk context in India—including escalating challenges like near-daily extreme events and opportunities for leveraging integrated DRR approaches—and details ACE's guiding principles, priorities, and thrust areas.

## 3. Current Challenges:

India is both a major greenhouse gas emitter (third in the world after China and the US) contributing approximately 7% of global emissions while representing 17-18% of the global population (Our World in Data, 2025; Global Carbon Project, 2024). Its per capita emissions remain low at around 1.9-2.0 $tCO_2e$—well below the global average of ~4.7-6.6 $tCO_2e$—highlighting the balance between developmental needs and climate responsibility (Hinrich-IMD Sustainable Trade Index, 2025; World Bank/EDGAR data, 2023-2025 updates). At the same time, India ranks among the most vulnerable countries to climate impacts, placing second in the World Risk Index 2025 (due to high exposure and vulnerability to floods, cyclones, and other extremes) and in the top 10 in the Climate Risk Index 2026 for long-term impacts (1995-2024) (World Risk Report 2025; Germanwatch CRI 2026). The country is already facing intensified climate patterns, including water stress, Himalayan glacier retreat, severe cyclones, flooding, prolonged heatwaves, and droughts—with profound effects on health, livelihoods, and infrastructure (IPCC AR6; CSE/Down To Earth, 2025). , With a population exceeding 1.46 billion in 2025 (UN World Population Prospects, 2025) and persistent socio-economic inequities, India's high dependence on climate-sensitive sectors (e.g., ~45-46% of the workforce in agriculture and allied activities; Economic Survey 2024-25; PLFS 2023-24) amplifies these risks, exacerbating disaster losses and livelihood disruptions This section explores the different challenges, barriers and opportunities for climate change action in India

### 3.1. Dependency on Non-Renewables and GHG Emissions

The energy sector in India remains predominantly dependent on coal, which is a primary driver of its greenhouse gas emissions. As the third-largest emitter globally, the country is responsible for 4.34 billion tonnes of $CO_{2e}$ emissions, with energy production accounting to 68.7% of the total emissions (WRI CAIT 4.0 2017). Specifically, nearly half (49%) of the emissions within the energy sector stem from electricity and heat generation, where coal dominates the electricity generation mix, contributing to 74% of total production followed by hydro (11%), natural gas (5%), nuclear (3%), wind (3%), fuel oil (2%), and biofuels (2%), together making up the remaining 26%. This high dependency on coal in India can be attributed to the historical lower cost and high availability of domestic coal resources, with coal making up almost 3-10% of local revenues in some states in India (Spencer et al. 2018).

The government is trying to transition from coal to other fossil free energy sources by investing significantly in renewable energy, expanding capacity, improving efficiency of thermal power generation by introducing new technologies, doubling the coal tax and incentivizing private sector investment. However, coal still may continue to dominate the electricity generation mix due to developmental aspirations, increased electricity demand trends, and economic development policies. Further, rapid industrialization also leads to increased dependency on fossil fuels by energy-intensive industries, including thermal power plants, iron and steel, and cement. Industries also consume around 42% of the electricity generated (IBEF,23-24). Given coal's central position in India's power generation, displacing coal-based systems will be tough, especially since grid integration costs of renewables can be expensive.

### 3.2. Environment and Climate Risk

A broad spectrum of natural hazards and climate risks significantly threaten India's environmental and socio-economic stability, including flooding, cyclones, droughts, sea-level rise, extreme heat waves, landslides, wildfire, and earthquakes. The 2020 Ministry of Earth Sciences (MoES) report, 'Assessment of Climate Change over the Indian Region,' projects increases in the intensity, duration, and frequency of weather-related shocks. A 2025 post-AR6 update notes a 0.5-1.5 mm per day decline in mean southwest monsoon rainfall per decade over the Indo-Gangetic plains and northeast India from 1951–2024, worsening water scarcity and agriculture based livelihood resilience. The IPCC Sixth Assessment Report (AR6) highlights marked rises in extreme temperatures, heat waves, and altered monsoon patterns in South Asia, including India, with projections of intensified heatwaves, floods, and droughts

Through a soil health lens, climate change accelerates degradation, with over 29% of India's land already degraded; In 2025, eastern India's acidic soils expanded due to erratic monsoons, slashing rice yields by up to 25% in Bihar and West Bengal. Projections indicate doubled soil erosion rates in some regions by mid-century under high-emission scenarios, driven by intense rainfall, droughts, and rising temperatures that reduce organic matter, increase salinity, and cause nutrient loss, endangering food security.

Regarding biodiversity, India has lost 90% of its biodiversity hotspot areas due to habitat fragmentation, forest diversion, and infrastructure expansion, which accounts for nearly 20% of observed species declines; climate change threatens extinction for 3% of bird species and larger animals, with 19% of amphibians critically endangered and bee colonies collapsing, exacerbating ecosystem instability, pollination deficits, and food insecurity.

From a disaster risk reduction (DRR) perspective, Asia, including India, faces over 80% of regions with increased extreme events; key challenges include policy-action gaps (e.g., in landslide management) and the need for better Climate Change Adaptation – Disaster Risk Reduction (CCA-DRR) integration to counter rising floods, cyclones, and other hazards causing tens of thousands of fatalities and billions in losses. Examples include 2025's northern India heatwaves exceeding 40°C and record floods, with extreme events on 99% of days in the first nine months, claiming over 4,000 lives, damaging 9.47 million hectares of

crops, and destroying nearly 100,000 homes. India—ranked 9th in the long-term Global Climate Risk Index 2026 (1995–2024) —has suffered over 80,000 deaths and USD 170 billion in damages from climate risks, amplified by high population density, hazard-prone geographies like mountains and coastlines, and urgent needs for soil, water, and biodiversity conservation within DRR frameworks

On the coastal front, India's 7,500 km coastline, supporting over 350 million people, faces escalating climate risks, including sea level rise (SLR) of 0.5-1 m by 2100 under high-emission scenarios, accelerating erosion (33.6% affected), saltwater intrusion, and habitat loss. Mangroves (4,992 sq km) are degrading from warming, salinity, acidification, and stronger cyclones, risking total loss in vulnerable zones by 2125; west coast shows lower resilience due to limited freshwater, east coast vulnerable to storms despite deltaic advantages. Warmer seas disrupt fisheries, coral reefs, and biodiversity, while extreme sea levels rise 0.68-1.12 m, flooding cities like Mumbai (61% vulnerable), Kolkata, and Chennai. Sundarbans mangroves battle floods, sea level rising (SLR), displacing communities and weakening storm barriers. Recent reports (CRI 2026) highlight high coastal vulnerability, urging restoration of ecosystems like mangroves, seagrasses, and salt marshes to build resilience.

Water Insecurity India is not water-rich. With climate change projected to severely impact freshwater availability, water demand has surged from agricultural expansion and irrigation (~70% of usage), urbanization, population growth, industrialization, and economic growth, leading to widespread stress. NITI Aayog's Composite Water Management Index estimates 600 million people—43–45% of India's population—face high to extreme water stress, underscoring the urgent need for disaster risk reduction (DRR) to mitigate cascading impacts on lives and livelihoods. Key issues include poor water quality, inequitable access, uneven distribution, and physical scarcity, hindering water security, economic progress, and resilience against climate-induced hazards. Groundwater supplies ~85% of rural drinking water and 60% of irrigation but faces overexploitation, with 2025 extraction at 247.22 BCM against 448.52 BCM recharge, and 10.8% of assessed units overexploited, driving water table declines that amplify drought risks. Annual per capita availability is projected at 1,401 $m^3$ by 2025 (below the 1,700 $m^3$ stress threshold) and could fall to 1,191 $m^3$ by 2050, signaling severe scarcity that demands integrated DRR strategies. Climate change worsens this through unpredictable availability, increased monsoon variability (World Bank, 2025). Higher temperatures accelerating Himalayan glacier melt and snow cover loss—Asia's "water tower"—threatening the stability of glacier-fed rivers for over 2 billion people downstream. Additionally, climate-induced warming is accelerating groundwater depletion: a 2023 University of Michigan study (published in Science Advances) projects that rates could triple by 2080 (2041–2080 period) under business-as-usual scenarios, as farmers intensify withdrawals to meet higher crop water demands, expanding depletion hotspots to south and central India. This disrupts water balances, heightens flood/drought risks, contaminates coastal freshwater via glacier melt and sea level rise, and endangers lives, infrastructure, health, and productivity. Thus,

sustainable water management is essential for effective climate action.

### 3.3. Socio-Economic Disparities

Poverty and social inequality remain persistent challenges in India's climate action landscape, with climate change acting as a regressive force that disproportionately impacts marginalized groups—rural poor, women, tribal communities, urban slum dwellers, marginal farmers, fisherfolk, and coastal residents—far more severely than affluent populations (IPCC AR6, 2022). Studies indicate that the effects of climate change in India exhibits a significant variation, with economically poor regions and large marginalized populations (for example mountain communities, urban poor or marginal farmers) being more vulnerable to climate hazards than prosperous regions. Climate shocks such as floods, droughts, heatwaves, and cyclones have pushed an additional 50–80 million Indians into poverty since 2010, with rural districts experiencing 15–20% higher poverty rates due to crop losses and limited access to finance (Discover Sustainability, 2025), while 40% of the population in high-vulnerability states faces compounded risks, driving Gini coefficients up 5–10% in affected regions (NITI Aayog, 2025). Low-income urban migrants in cities like Mumbai and Chennai bear 70% of flood-related economic losses (World Bank, 2025), and poverty drives 3–5 times higher disaster mortality, with early warning gaps affecting 60% of vulnerable households (UNDRR Global Assessment Report 2025; NDMA). Coastal degradation, including 40% mangrove loss over the past five decades (MoEFCC 2024–25), severely affects 250–350 million coastal dwellers—especially fisher folk and tribes—through livelihood erosion and sea-level-rise displacement. Biodiversity loss heightens risks for endemic species (IPCC AR6 updates, 2025), further reducing forest resource access critical for tribal livelihoods (UNDP 2025).

Apart from disadvantaged groups forced to live or work on peripheral land that is more prone to climate risks; Marginalized groups often occupy risk-prone lands and lack essential assets, services, information, and early warnings, severely limiting adaptive capacity. poverty and socio-economic discrimination often restrict access to physical, social and financial assets, information and services like health care, emergency response or key extension services to these marginalized communities. This in turn, further aggravates the impact of climate change by limiting communities from making informed choices to adapt to climate change. Hence, focusing on vulnerable groups and facilitating pro-poor climate mitigation and adaptation approach like integrating poverty alleviation, social welfare, ecosystem-based disaster risk reduction, coastal restoration, and equitable afforestation into policies and plans, is the need of the hour for India (FAO 2019).

### 3.4. Communities and Non-State Actors

Another major challenge to climate action in india is the limited participation of communities and local non-state actors in the development of climate action policies and projects. In many cases, local communities, civil society organizations, and stakeholders are excluded from agenda-setting and formulation stages, often engaged only during implementation due to power imbalances in climate governance (CCPI 2025;).

However, early and active community involvement in adaptation planning fosters

ownership, enhances project legitimacy, ensures equitable benefit distribution, and boosts stakeholder support—particularly among water user groups, coastal and vulnerable communities—by aligning interventions with perceived economic, social, and effort costs (IPCC AR6, 2022; UNDP India 2025). To ensure successful implementation, strategies must center communities and non-state actors from the outset, integrating local knowledge and indigenous practices—aligning with national efforts such as the LiFE (Lifestyle for Environment) initiative promoted by NITI Aayog and MoEFCC to drive behavioral change at grassroots levels.

### 3.5. Gender Barrier

Climate change is not gender neutral. It affects women and men differently across socio-economic groups, including caste, ethnicity, and economic status, due to patriarchal norms that increase women's vulnerability. Women contribute valuable knowledge and skills but are often excluded from policy-making in development, resource management, and climate action, making poor women more exposed to impacts despite low GHG emissions (IPCC AR6, 2022; UN Women, 2025). Disparities include reduced access to education, health, nutrition, and mobility; higher disaster mortality and displacement; greater poverty; and limited ownership, rights, decision-making, and representation (UN Women Gender Snapshot, 2025). Forestry and water sectors are gendered—women handle over 70% of global water chores, facing heavier burdens from climate-driven scarcity and pollution (PLFS 2023–24; FAO, 2025). Soil erosion from extreme rains and droughts reduces land productivity, disproportionately burdening women with more labor for water/fuel, food insecurity, lost opportunities, and poverty in rural areas (CRF India, 2025).

Women and girls face 14 times higher disaster mortality, worsened by factors like disability, ethnicity, and class; lacks in preparedness, mental health aid, early warnings, and inclusive policies slow recovery and raise gender-based violence (UNDRR Global Assessment Report, 2025; NDMA Gender-Responsive Advisory, 2025; UN Women Asia-Pacific, 2025). In coastal communities, women in fishing and mangrove areas—up to 40% of resilience participants, intersecting with caste/class—bear greater impacts from sea-level rise, cyclones, habitat loss, salty water shortages, and displacement to unstable jobs, and violence spikes. While both men and women have valuable knowledge, skillsets, and experiences, often women's participation is ignored in formal policy making and agenda setting related to development and natural resources management. A gender-sensitive approach is vital to address women's vulnerabilities and contributions, building resilience through training and inclusion in decisions (NITI Aayog, 2025; UN Women, 2025).

To respond effectively to the adverse impacts of climate change, a gender-inclusive and gender sensitive climate approach is required that explicitly recognizes both the vulnerabilities of women and their contributions to the economy at large. Such an approach pushes towards enhancing women's resilience through capacity building initiatives and actively including them in decision-making process related to climate action.

### 3.6. The Rapid Urbanisation

Rapid urbanization is another major challenge in India for climate action. Cities, occupying

just 2% of land area, contribute up to 60% of global GHG emissions and consume 78% of the world's energy (UN-Habitat, 2020). India's urban population approached 500 million in 2025, consuming ~70% of total primary energy supply, with projections to reach over 800 million by 2050 (EPIC-India, 2025; UNDESA, 2014). This surge increases ecological footprints through heightened demands for water, food, energy, and resources, straining infrastructure like housing, transportation, waste management, and recycling. For instance, urban India generated ~42 million tons of municipal solid waste annually by 2025, with only a fraction treated, leading to methane emissions and environmental degradation (UNDP Asia-Pacific, 2025; CEEW, 2025). Population pressures exacerbate air pollution, urban heat islands, green space loss, soil erosion, and water scarcity, while land use changes and industrialization drive GHG emissions (Khosla & Bhardwaj, 2018; WRI India, 2025). Heightening vulnerability to disasters and extremes amid urban poverty, inadequate housing, water & sanitation, health, and emergency systems, making urban residents more susceptible to flooding and health risks (CPREE Princeton, 2025). From a disaster risk reduction (DRR) perspective, rapid urbanization amplifies exposure to floods, cyclones, and heatwaves, with 235 extreme weather days in 2025 claiming thousands of lives and damaging infrastructure (UNDRR Global Assessment Report, 2025; NIUA, 2025). Coastal ecosystems face severe threats from urban expansion, with sea-level rise at 3.3 mm/year eroding 27% of coastlines, encroaching on mangroves (40% loss over decades), and displacing communities, as seen in Chennai's wetland decline. Afforestation efforts are undermined by urban sprawl degrading greenery, with only 21% tree cover in cities, exacerbating heat islands and soil erosion; urban forests could sequester carbon and restore habitats, yet schemes like Green India Mission see limited implementation amid land pressures (Current Conservation, 2014 update; PMC, 2016). Biodiversity loss intersects with urbanization through habitat fragmentation, species decline (~10% at risk), Though cities are economic growth centers, welfare conditions remain dire in urban India making the vulnerable communities even more susceptible to climate risks like urban flooding. Efforts by policy makers and administrators to address climate change and urbanization will need to address multiple intersecting challenges including those of population growth, access, inclusivity, livelihoods and well-being through integrated, nature-based urban planning

## 4. Opportunities

### 4.1. India's Global and Domestic Policy

India is a major active player in the global climate change negotiations and shows strong policy commitments to lowering carbon emissions through concerted climate action. India ratified the Paris Climate Agreement, despite the country's low per capita emissions, India submitted ambitious Nationally Determined Contributions (NDCs) in 2022: reducing GDP emissions intensity by 45% from 2005 levels by 2030; achieving 50% non-fossil electric capacity by 2030 (already met in 2025); and creating an additional 2.5–3 billion tonnes $CO_2e$ carbon sink through enhanced forest and tree cover by 2030. These NDCs, rated 2°C-compatible, integrate mitigation, adaptation, livelihoods, and resilience (Climate Action Tracker 2025; CCPI 2026). India is one of the few countries whose NDC is rated highly in the international arena for being compatible with

limiting temperature rise to below 2 degrees Celsius (TERI 2018) and providing a major thrust for climate action. Domestically, the National Action Plan on Climate Change (NAPCC, 2008) and its eight missions provide a solid framework. . India's NAPCC launched in 2008 is a cornerstone policy document detailing India's commitment to reducing GHG emissions and addressing climate change. NAPCC is implemented through eight National Missions -National Mission on Solar Energy, Enhanced Energy Efficiency, Conserving Water, Sustainable Habitat, Sustaining the Himalayan Ecosystem to create a 'Green India' through afforestation, Sustainable Agriculture and finally, a mission on Strategic Knowledge for Climate Change for building a dynamic knowledge system that informs and supports national policy and action for climate issues. With the above domestic climate policy being favorable, Key opportunities for ACE's focus include:

**Afforestation & Biodiversity:** The National Mission for a Green India targets restoring 26 million hectares of degraded land by 2030, with phased plans for forests, grasslands, and mined areas (MoEFCC 2024–25). The updated National Biodiversity Strategy and Action Plan (2024–2030) commits to restoring 30% of degraded terrestrial, inland, marine, and coastal ecosystems, aligned with the Kunming-Montreal Global Biodiversity Framework (UNDP 2025).

**Coastal Ecosystems:** Policies promote ecosystem-based management, supported by the National Mangrove Committee (identifying 38 critical sites) and initiatives like the Indian Ocean Coastal Regeneration Initiative for community-led restoration against sea-level rise and cyclones (MoEFCC 2024–25; AKF 2025).

**Disaster Risk Reduction:** Alignment with the Sendai Framework, the updated National Disaster Management Plan (2025), and NAPCC's Strategic Knowledge Mission enables resilient infrastructure, early warnings, and nature-based solutions amid rising extremes (NDMA 2025; UNDRR 2025).

These policies create a robust enabling environment for nature-based solutions in afforestation, biodiversity conservation, coastal protection, and DRR, driving transformative climate action.

### 4.2. The Nationally Determined Contributors

India's s NDCs, updated in 2022, create strong opportunities for climate action through nature-based solutions. The key targets are reducing emissions intensity of GDP by 45% from 2005 levels by 2030 and Creating an additional carbon sink of 2.5–3 billion tonnes of $CO_2$ equivalent through enhanced forest and tree cover by 2030. These commitments open major opportunities for afforestation and biodiversity by driving large-scale tree planting and ecosystem restoration. They align with the National Mission for a Green India and the updated National Biodiversity Strategy and Action Plan (2024–2030), which aims to restore 30% of degraded land, inland waters, marine, and coastal areas under the Kunming-Montreal Global Biodiversity Framework. For coastal ecosystems, the NDCs highlight adaptation in vulnerable coastal zones, supported by ecosystem-based approaches such as the National Mangrove Committee initiatives that shield communities from sea-level rise and cyclones. Other supporting

programs include the Green Skill Development Programme (GSDP), which trains youth for green jobs in afforestation, biodiversity conservation, and coastal restoration

In disaster risk reduction, the NDCs promote resilience for vulnerable groups, in line with India's commitments under the Sendai Framework (2015–2030). The updated National Disaster Management Plan (2025), and the Disaster Management (Amendment) Act 2025, advances proactive measures like early warnings and resilient infrastructure strengthens holistic DRR with community-based risk reduction, funding for disaster-prone districts, and resilient infrastructure development.

State-level actions are crucial for localized resilience. Complementing the national missions, State Action Plans on Climate Change (SAPCC) serves as the primary policy document at the sub-national level to understand the climate risks, address climate change vulnerabilities and increase resilience. As of 2025, 34 states and union territories have developed or updated their State Action Plans on Climate Change (SAPCCs), integrating local vulnerabilities into sectoral programs.

Together, these NDCs, national policies, and state specific action plans provide excellent opportunities for nature-based solutions that deliver multiple benefits: carbon sequestration, biodiversity protection, coastal defence, and stronger disaster resilience

### 4.3. Indigenous Knowledge and Environment

India's rich traditional indigenous knowledge offers valuable opportunities for climate action through nature-based solutions. Traditional indigenous knowledge encompasses contextualized local beliefs, practices, and customs accumulated over generations about the environment, guiding responses to changes like phenology and weather patterns (Kernecker et al. 2017). Traditional indigenous knowledge is unique and complementary in providing additional information and insights about changes in the natural worldthat are not as readily accessible through conventional science and environmental observations. In India, there are numerous examples of practices on community forests, preserving biodiversity and supporting restoration that stem from local knowledge and help communities adapt to changing climate. In addition, a strong environmental ethic and a sense of community embedded in Indian culture; Indigenous communities have long protected sacred groves in regions like the Western Ghats, and Northeast. One more example is, sustainable management of Kangayam grasslands in South India for over 150 years, aiding mitigation and adaptation (The Role of Traditional Ecological Knowledge in Shaping Climate Resilient Practices, 2025; NIUA Report on Traditional & Indigenous Practices for Climate Resilience in India). Coastal tribes practice traditional mangrove stewardship in areas like the Sundarbans and Kutch, fostering habitat restoration, cyclone buffering, and resilience against sea-level rise, integrating with modern conservation for enhanced protection (Leveraging Indigenous Knowledge for Climate Change Adaptation in the Indo-Pacific Region, 2024; The Traditional Knowledge Advantage, IFAD Report). Indigenous early warning systems, resilient housing designs (e.g., elevated structures in flood-prone areas), and adaptive strategies in drylands mitigate hazards and erosion, complementing scientific tools for community-led DRR (The Role of

Indigenous and Traditional Knowledge in Ecosystem Restoration and DRR, 2018; The Role of Traditional Knowledge in Climate Change Adaptation in India, 2024).

Blending this knowledge with modern science—such as in wetland conservation, species protection, and early warnings—can enhance ecosystem restoration, biodiversity conservation, coastal defence, and proactive DRR, fostering inclusive and sustainable outcomes.

### 4.4. Sustainable Agriculture and Water: Pathways to Regenerative Resilience

Agriculture and allied sectors are vital for India's development, providing livelihoods for over 45% of the population, driving rural economies, and ensuring national food security. In recent years, India has witnessed growing success in shifting from resource-intensive conventional practices to regenerative agriculture (RA), which restores soil health, enhances biodiversity, and builds climate resilience. Regenerative systems—such as natural farming, conservation tillage, crop diversification and crop rotation—focus on efficient resource use, carbon sequestration, and ecosystem regeneration. Notable examples include programs that supported thousands of farmers in transitioning to regenerative methods, reducing input costs by up to 30% while improving yields and soil fertility. Initiatives enabled farmers to build viable businesses through regenerative farming and bio-resource centers, demonstrating scalable income diversification. Similarly, regenerative agriculture focused projects transformed soybean, corn, and grape cultivation, boosting productivity and community resilience amid erratic weather. Globally recognized efforts, like Sikkim's fully organic status (FAO Future Policy Gold Award winner), continue to inspire, with the state expanding regenerative practices to restore degraded lands and support biodiversity.

Water management is a critical connector in RA, enabling mitigation and adaptation to climate impacts. Regenerative practices inherently promote water-efficient techniques, such as cover cropping and reduced tillage, which improve soil retention and recharge groundwater. Embracing water-focused measures yields triple wins: coordinating sectors to adapt to extremes like floods and droughts, ensuring efficient supply to cut emissions, and upholding the human right to safe water and sanitation while advancing interlinked SDGs (UN Water 2019; UNESCO-UN Water Report 2025). Water links key global frameworks—the Paris Agreement, 2030 Agenda, and Sendai Framework—offering opportunities for climate-resilient management to slow climate change, shield against events, and adapt effectively.

Recognizing the pivotal role of agriculture and water in rural livelihoods and climate adaptation, Dr. Reddy's Foundation (DRF) has carved out the strategic component of "Agriculture & Water" from its initial climate strategy, and decided to come up with a dedicated strategy and program on "Regenerative agriculture." This move underscores RA's critical importance in empowering rural communities to become climate-resilient by enhancing soil health, fostering sustainable income streams for millions of smallholders, integrating livestock management for holistic farm systems, promoting non-farm livelihoods for diversified economic opportunities, and skilling rural youth in agriculture to build a capable

workforce for long-term sustainability. Integrating regenerative agriculture with sustainable water strategies amplifies these benefits, building resilient rural ecosystems and communities.

### 4.5. Energy Efficiency and Renewables

Energy is the key driver of India's economic growth and essential for sustaining the economy. The country has significant untapped potential in energy efficiency and renewable, offering major opportunities for a low-carbon transition and climate action over the next five years (2026–2030). India has made substantial progress through ambitious policies, including the Perform, Achieve and Trade (PAT) scheme for industrial efficiency, coal cess funding clean energy, and rapid renewable capacity expansion—reaching over 200 GW installed renewable capacity by 2025, with solar and wind leading growth (CEA Report 2025). Looking ahead, projections indicate renewable capacity could grow to 500 GW by 2030, driven by falling solar costs (now under USD 0.03/kWh) and supportive auctions, enabling solutions like grid modernization and storage integration to address intermittency (ETC India's 2030 Decarbonisation Roadmap).

India continues to lead globally, co-founding the International Solar Alliance (ISA) at COP21 and advancing cooperation on clean energy access and technology transfer, with opportunities for bilateral partnerships to deploy advanced efficiency solutions. Further, India has been fairly successful in promoting and mainstreaming energy efficiency through schemes based on strategies of mass awareness, demand aggregation and bulk procurement, like Unnat Jeevan by affordable LEDs and Appliances for All (UJALA), street lighting programs, energy efficient agriculture pumps (ESS GOI 2020). The National Green Hydrogen Mission further scale impact, with solutions like smart metering under RDSS targeting 250 million installations by 2026 to cut losses 12–15% and enable demand-side management (PIB Solar Surge 2025; Atlantic Council Pathway 2025).

Therefore, Strong policy support—aligned with NDC targets of 50% non-fossil power capacity (achieved ahead of schedule in 2025)—combined with growing corporate commitments and citizen awareness creates a highly favourable environment for climate action. These developments enable scalable solutions that deliver co-benefits: reduced emissions (potentially 1 Gt $CO_2e$ avoided by 2030 through efficiency gains), enhanced energy security via diversified sources, job creation in green sectors (estimated 3.5 million new jobs by 2030), and resilience for vulnerable communities through decentralised renewable systems (RMI Empowering India 2025; IEA India Outlook).

In this regard, the organization's youth strategy covers the opportunities in Green sectors to equip the youth, especially from low-income communities, with future-relevant green skills that prepare them for employment in emerging sectors contributing to environmental sustainability and climate resilience.

### 4.6. Private Sector Engagement

The Indian corporate and private sector is a key player for climate action in India and increasingly aligning with national agendas to drive mitigation and adaptation. As major contributors to GHG emissions, industries hold substantial opportunities to enhance resource efficiency, reduce ecological footprints, and support climate plans, particularly through

greening energy, transport, buildings, waste, and nature-based solutions. Over the next five years, the sector can mobilize significant technology, finance, and capacity building, with potential annual investments of USD 190 billion in climate action (State of Climate Finance in India 2025). This engagement not only advances national goals and safeguards long-term resources but also fulfills CSR and sustainability commitments.

Their engagement in climate change mitigation and adaptation needs to be explored as well as leveraged particularly in the field of greening of key sectors of the Indian economy like agriculture, water, buildings, energy, transport and waste. The Corporate sector can play a key role in mobilizing the desired technological, financial and capacity building support towards climate action and collaborate with the development and research sectors to strengthen the existing responses to climate change. Key opportunities include leveraging the draft Climate Finance Taxonomy (2025) for finance and innovation to channel green investments and prevent greenwashing, supporting India's net-zero pathway by 2070. Collaborative initiatives can build on platforms for funding and visibility, alongside private-led resilience projects such as urban heat action plans. . This not only helps industries achieve the climate goals and mitigate the adverse impact of climate, but also safeguards their long term resource base that is required for business and meets their 'Corporate Social Responsibility' and sustainability goals. Already, a large number of major corporate houses and industries in India have actively engaged in climate change initiatives across multiple sectors. These engagements enable scalable solutions that deliver co-benefits, including emissions reduction, enhanced resilience, millions of green jobs by 2030, and sustainable development.

A wide network of international, national and local grassroots level organizations and institutions are currently working in India on climate research and action to solve the challenges faced by different sectors (e.g., energy, mobility and clean tech) and different strategic ecosystems and areas (e.g. mountains, urban, coastal system) along with climate action. These organizations include government departments (e.g. MoEFCC at the Center, and State government departments or cells); action research, policy and advocacy-based organizations (e.g. TERI,); academic & research institutes and universities (IISc. TSAS, ICRISAT, state universities etc.); consultancy and carbon regulators like Verra, Gold Standards and other organizations intending the implementation of climate-smart practices. This extensive network of organizations and institutions, have been working individually and collaboratively on climate research and action for a long time and have created an extensive and in-depth body of work and expertise. New and innovative research and development activities conducted by such institutes in the different sectors of climate action also serve as a potential database of knowledge and ideas that can be leveraged and used to build any climate program.

## 5. Strategy for Climate Action for Resilient Future (ACE Strategy)

Climate action for a resilient future will be guided by eight strategic principles, which will form the core philosophy of any climate intervention or action taken up by ACE. Given that climate action has multiple priorities to address, the strategic priorities will help

prioritize and streamline ACE's work in climate action and these will be in line with the global and national climate agenda. The operationalization of these principles and priorities will be done through the interventions taken under the strategic components, which will be the major thrust areas and will form the backbone of a future implementation plan.

## 6. Strategic Principles

The Action for Climate and Environment (ACE) program of Dr. Reddy's Foundation operates under a set of eight core strategic principles that form the guiding philosophy for all interventions. These principles ensure that actions are impactful, sustainable, scalable and aligned with broader climate and development goals, guiding ACE's work across its thrust areas—Afforestation & Biodiversity, Coastal Ecosystems, and Disaster Risk Reduction—over the next five years (2026–2030).

### 6.1. Sustainability

Any action taken must be sustainable. This means that our strategies need to balance the three pillars of sustainability i.e. be environmentally friendly, economically sound and societally acceptable across time. The action must aim to increase system resilience and avoid any detrimental impacts on the society, the economy or the natural environment. Sustainable interventions should promote long-term viability, such as restoring degraded lands through afforestation to combat soil erosion affecting 29% of India's land, creating carbon sinks that support the national target of 2.5–3 billion tonnes $CO_2e$ by 2030 while delivering ongoing ecosystem services.

To effectively promote interventions aimed at improving farmers' income and overall well-being, it is essential to place farmers at the heart of the process, ensuring that they are active participants at every stage. At DRF, our approach will prioritize farmer-centered solutions, where every intervention is designed with the needs and insights of farmers as the guiding force. This means that farmer participation will not only inform but also validate the solutions we introduce, ensuring they are contextually relevant and practical for the community.

From the initial stages of identifying challenges to the design and implementation of solutions, farmers will be directly involved in the process. Their input, feedback, and experiences will be integral at every step, making them active stakeholders in the entire journey. By adopting a participatory approach, we aim to co-create solutions that resonate with farmers, empowering them to take ownership of the changes and drive their own path toward greater income and well-being. Ultimately, this inclusive and collaborative approach will ensure that interventions are sustainable, effective, and tailored to the real-world needs of farmers.

### 6.2. Scalability

Any action selected must be scalable that is they must be realistically feasible for implementation by the actors involved at a larger scale given the local conditions, finances, and capacities. Solutions must also be transferable to other areas. Solutions should have the potential for replication and expansion to maximize reach and impact. Scalable solutions enable replication, for example scaling community-led mangrove restoration (restoring thousands of hectares) to protect larger stretches of India's 7,500 km coastline

from projected sea-level rise of 0.5–1 m by 2100.

### 6.3. Inclusivity and Participation

Any action undertaken must be inclusive and participatory which means that the diverse perspectives and knowledge of multiple stakeholders will be utilized for the planning and implementation of the solutions. Engaging diverse stakeholders, especially vulnerable communities, women, and local actors, in decision-making and implementation like DRR planning and execution, ensuring local ownership in early warning systems etc.

### 6.4. Local Relevance and Policy Alignment

Relevance to local context and alignment with climate policies and developmental priorities must be considered before selecting any action. Tailored to regional needs while complying with national climate policies, developmental priorities, and global frameworks such as adapting biodiversity projects in the project locations to local species while complying with the 2024–2030 National Biodiversity Strategy targeting 30% ecosystem restoration under the Kunming-Montreal Framework.

### 6.5. Evidence-Based Design

Any action taken must be backed by evidence-based research that reflects current scientific knowledge and local understanding. Evidence-based design backed by data and research, like using satellite mapping of mangroves restoration sites, finalising the technical design of restoration plan of the site etc. to inform coastal restoration priorities, ensuring interventions effectively address vulnerabilities like cyclone surges impacting coastal residents.

### 6.6. Equity

Actions must focus on fair and equitable solutions to address climate risks and impacts, with focus on the most vulnerable socio-economic groups like fishing communities and women. Fair and equitable outcomes prioritize justice for marginalized groups, directing benefits from afforestation to rural poor and tribal communities hardest hit by biodiversity loss (up to 10% species at risk), reducing socio-economic gaps exacerbated by climate shocks that pushed vulnerable communities into poverty.

### 6.7. Integrated Mitigation and Adaptation Approaches

A mix of both mitigation and adaptation strategies need to be integrated as a part of climate action to reduce carbon emissions and strengthen resilience for future climate conditions. Integration of mitigation and adaptation balances emission reductions with resilience, exemplified by mangrove projects that sequester carbon while buffering disasters, delivering dual benefits in high-risk coastal zones facing intensified cyclones.

### 6.8. Measurable, Verifiable, and Reportable Outcomes

The outcome of any climate action program must be measurable, verifiable and reportable to ensure transparency and traceability. Outcomes must be trackable with clear metrics for transparency, traceability and accountability. Measurable, verifiable, and reportable results track progress with clear metrics, such as monitoring restored hectares and reduced disaster losses against baselines, promoting transparency and accountability.

These principles underpin ACE's work across its thrust areas, ensuring holistic and result based climate action in the face of escalating risks.

## 7. Strategic Priorities (2026-2030)

### 7.1. Strategic Priority 1: *Facilitate climate protection among vulnerable groups*

ACE will prioritize climate action especially for socio- economically vulnerable individuals and groups including indigenous communities and women as they are the most impacted, by climate change. For example, in coastal ecosystem program, wellbeing of fishing communities with limited access to resources and services will be prioritized. Gender will be a key component that will be integrated into our climate action strategies. Gender equality and women's empowerment are recognized as fundamental to socioeconomic development and successful climate action. Effort will be put to prioritize and mainstream gender in all of ACE's climate change actions and strategies, wherever possible.

### 7.2. Strategic Priority 2: *Focus on mitigation and adaptation*

ACE will focus on undertaking a mix of mitigation and adaptation actions across sectors,to limit GHG emissions while building community resilience to climate impacts. This dual approach recognizes that mitigation alone cannot address unavoidable changes, and adaptation without mitigation risks escalating future vulnerabilities. Mitigation efforts over the next five years will focus on reducing emissions through nature-based solutions, such as large-scale afforestation to contribute to India's NDC target and restoring mangroves that sequester carbon while protecting coasts. Adaptation actions will prioritize resilience-building, including community-led coastal restoration to buffer against sea-level rise and cyclones. According to IPCC 2018, if mitigation and adaptation synergies are maximized while trade-offs are minimized, the avoided climate change impacts on sustainable development, poverty alleviation and reducing inequalities would be greater.

### 7.3. Strategic Priority 3: *Maximize co-benefit approach in all actions*

ACE will focus on identifying strategies with co-benefits i.e. prioritize win-win solutions aimed at capturing not only climate benefits but also secondary economic, social or environmental benefits in a single measure or policy. Co-benefits are the additional indirect benefits that can be derived as a result of a climate action that was aimed at reducing emissions or adapting to climate risk. ACE's interventions will deliver greater co-benefits for poverty reduction and inequality alleviation. For example, mangrove restoration mitigates emissions through carbon storage (up to 1,000 $tCO_2$/ha over lifetimes) while adapting communities to storms and erosion; similarly, afforestation enhances biodiversity and soil health (mitigation) while providing natural flood barriers and livelihood opportunities (adaptation). Over the next five years, this integrated approach will ensure holistic outcomes, reducing vulnerability for marginalized groups and contributing to India's net-zero ambitions.

### 7.4. Strategic Priority 4: *Leveraging Technology in Solution Design and Execution*

Technology is a vital contributor to sustainable livelihoods and climate action. According to UNEP (2011) technology includes (i) hard

technologies which cover tangible assets like physical infrastructure, machinery and equipment; (ii) soft technology i.e. knowledge and skills, and encompass elements of awareness-generation, including education, training programs and capacity building; and lastly (iii) organizational technologies which refers to the institutional framework, or organization, involved in the adoption and diffusion process of a new technology (e.g. lead farmers platform or water users association). Digital innovation will also be considered a part of the package of practices. Efforts will be focused on blending appropriate technologies for better climate action.

### 7.5. Strategic Priority 5: *Build Awareness, Communication and Capacity*

Climate science is often filled with technical jargon and statistics that can seem abstract and intangible to non- scientists. Awareness generation and effective communication about the different facets of climate change including the science, impacts and interventions, becomes paramount for successful climate action and stakeholder engagement. There is a need for effectively communicating knowledge generated as part of the climate action program and building capacity of different stakeholders. Effective communication and capacity building activities will also focus on tailoring the packaging of information into the right format based on the target audience. For example, conference proceeding, policy brief or journal publications might be appropriate for research groups and policymakers, but direct engagement using participatory visual tools will be more effective for local communities.

### 7.6. Strategic Priority 6: *Strengthen Partnership and Networks for Collective Action*

ACE will leverage the power of multi-stakeholder partnerships and knowledge of existing climate networks for effective and efficient implementation of our programs, and this will be a major priority area of our strategic vision. ACE will engage all relevant stakeholders ranging from the government, non- governmental organizations, research institutes, civil society, communities and private sector organization at different spatial scales.

## 8. Strategic Components

ACE aims to develop a climate- resilient future by focusing on three main thematic areas:

***(1) Afforestation and Biodiversity; (2) Coastal Ecosystems; (3) Disaster Risk Reduction*** initiatives in the next five years as strategic components. A wide range of potential activities have been listed under each strategic component based on current literature and discussion with subject experts. Evidence based research including baseline studies and local stakeholder inputs will help in finalizing the activities and their on-ground implementation. The work on these thrust areas will be carried out in a phased manner with the initial focus on two of three strategic components; namely afforestation and biodiversity and Coastal Ecosystem, which will be expanded over time to the third strategic component, Disaster Risk Reduction. By 2027, it is expected that we will have strengthened the coastal eco system and Afforestation and Biodiversity interventions and initiated the on-ground implementation of some key activities from disaster risk reduction strategic

component. All the strategic components will also serve to provide inputs to local and regional policy planning and decision-making. The main target groups will be socio-economically vulnerable individuals and groups including indigenous communities and women, identified during SC initiation. For example, in coastal eco system intervention, coastal communities, especially women from those communities are focused as important stakeholder and engaged in the work to bring ownership of interventions and achieve the desired outcomes for the intervention.

### 8.1. Strategic Component 1 (SC01): *Afforestation and Biodiversity*

The strategic component of Afforestation and Biodiversity adopts a holistic approach to environmental protection, integrating interventions across regenerative agriculture farmlands, coastal ecosystems, water bodies, and forestry practices. This component centers on scalable actions to restore ecosystems, enhance green cover, and build climate resilience over the next five years (2026–2030), aligning with India's NDC target of creating an additional 2.5–3 billion tonnes $CO_2$ equivalent carbon sink by 2030 through enhanced tree cover.

This component includes various interventions centred focusing implementation at scale. The main objectives are to (1) establish fertile and stable soil bases, (2) enhance above- and below-ground biodiversity, (3) increase green cover, (4) promote sustainable land use and carbon offsetting while making communities climate-resilient, and (5) generate additional income from produce and carbon sequestration.

Our approach towards the afforestation interventions not only promotes the Green Cover but also enhances biodiversity. Our afforestation intervention covers forestry activity through the focus on green coverage in barren lands/ forest lands/ degraded lands/ water bodies/ roadside avenue plantation. Agroforestry model covers both barren land agro forestry and orchard based agroforestry models. Under the biodiversity interventions, all the four ecosystem services – Provisioning & Regulating services, Cultural & Supporting functions will be addressed holistically. Biodiversity is typically a measure of variation at the genetic, species, and ecosystem level. Implementation of various interventions contributing to these services will not only aid in climate change mitigation but also enhance the biodiversity by improving food and nutrition security.

Our science-based approach to afforestation not only augments green cover but also enhances biodiversity through a scientific methodology that selects quality planting material—such as certified, disease-resistant seedlings sourced from accredited nurseries—to achieve high survival rates (targeting 80–90% through site-specific preparation and monitoring). Integration of biologics, like bio-fertilizers, bio-pesticides, and microbial inoculants, improves plant health by enhancing nutrient uptake, pest resistance, and root systems, leading to improved carbon sequestration (up to 20–30% higher in treated sites) and survivability amid climate stresses like droughts and heatwaves. For example, interventions in regenerative agriculture farmlands ensure environmental benefits without impacting yields, while in coastal ecosystems, they create habitats for aquatic fauna and buffer against natural calamities like cyclones (which affected millions in 2025, per NDMA data). Integration of afforestation

around the water bodies like Lakes/ ponds transforms water bodies into biodiversity hubs, supporting aquatic flora and fauna amid rising water stress (affecting 43–45% of India's population, NITI Aayog 2025).

ACE's climate action strategies will prioritize research-based, low-resource interventions that are easy to scale and execute cost-effectively, with designs tailored to local contexts through scientific assessments of soil types, climate zones, native species suitability, and community needs. For agroforestry models, this involves context-based designs—such as multi-tier systems in barren lands for soil stabilization, intercropping in farmlands for diversified yields, and selected local species for green cover/ avenue plantation through afforestation for windbreaks and erosion control—ensuring technical accuracy and ecological fit based on site-specific data from tools like soil analysis, GIS mapping and biodiversity surveys.

To ensure robust monitoring and evaluation, ACE employs a comprehensive transparent and traceable system which includes

a) Geo-tagged boundary mapping for precise site delineation,
b) Traceability-enabled planting material tracked from the seed stage in nurseries to saplings planted in farmlands or barren lands leveraging the digital tools,
c) Record keeping of regular growth measurements (e.g., height, girth, and canopy development) to assess progress,
d) Integration of site-specific nutrient management based on soil testing to optimize inputs and boost plant vitality.
e) Regular assessment of below/ above ground biodiversity improvement

### 8.1.1. Focus on Agroforestry

Agroforestry plays a central role in ACE's afforestation and biodiversity efforts, integrating trees with crops or livestock to build climate resilience, improve soil health, boost biodiversity, sequester carbon, and enhance farmer incomes. Over the next five years (2026–2030), DRF will prioritize agroforestry in barren lands, farmlands, and as shelter belts in coastal ecosystems, tailoring models to local contexts in current focus states like Andhra Pradesh, Telangana, Madhya Pradesh, and Himachal Pradesh. This approach draws on collaborations with government research bodies, state/district agriculture departments, and knowledge partners like ICAR, ICFRE, and CGIAR to select drought/flood-tolerant species, minimize water use, and ensure economic viability for smallholders (average landholding 1–2 hectares). Agroforestry enhances resilience against climate variability, improves yields in rainfed agriculture (covering about 51% of India's net sown area), and combats soil erosion affecting nearly 30% of the country's land, including coastal farmlands where erosion impacts 41–63% of coastlines in states like Tamil Nadu, Kerala, and West Bengal. DRF adapts agroforestry models to regional agro-climatic conditions for maximum impact; Following are the different planting models followed by DRF's agroforestry intervention

***Core activities include:***

- **Agri-Silvicultural System (Tree-Crop Integration):** Trees intercropped with groundnuts, millets (ragi, jowar), pulses, or maize in farmlands. Suited to semi-arid red soils in Andhra Pradesh's Rayalaseema and Telangana's districts with low rainfall (500–800 mm), it provides shade, windbreaks,

and nitrogen fixation to increase crop yields by 15–25% and generate timber/fodder income after 5–7 years. In Madhya Pradesh's plateau regions, it pairs with soybean/wheat for erosion control in ravines. In Himachal Pradesh's sub-tropical valleys, it combines with horticultural crops like peas for higher yields. Spacing: 10x10 m for trees, allowing 80–100 trees/ha.

- **Silvo-Pastoral System (Tree-Fodder/Livestock:** Trees combined with grasses or fodder crops for livestock grazing, ideal for barren or degraded lands (20–30% of area in these states). In Andhra Pradesh and Telangana's drought-prone districts, it improves soil fertility and reduces erosion in hilly terrains, supporting dairy/goat farming amid dry spells (increasing biomass by 30–40%). Madhya Pradesh's Seoni/Balaghat forests integrate with bamboo for wildlife corridors and tribal livelihoods. In Himachal Pradesh's mid-hills, it uses fodder trees for sheep rearing to address winter feed scarcity.
- **Boundary/Shelterbelt Planting:** Trees along field edges or as windbreaks to protect crops from hot winds and dust storms. This model enhances microclimates, reduces evaporation by 20%, and sequesters 10–15 $tCO_2$/ha/year, suitable for cotton/groundnut farms in Andhra Pradesh and Telangana. In Madhya Pradesh's Jabalpur ravines, it stabilizes soils against floods. In Himachal Pradesh, conifer belts shield orchards from winds, supporting the state's 33% forest cover goal.
- **Horti-Agri System (Fruit Tree-based):** Fruit trees integrated with horticultural crops like chillies, vegetables, or apples in irrigated pockets. It diversifies income and builds drought resilience with stable yields. In Andhra Pradesh's Krishna River basins and Telangana's Nizamabad, it pairs with mango/pomegranate/coconut. Madhya Pradesh's Balaghat uses citrus in forested areas. In Himachal Pradesh, it focuses on apple/walnut with vegetables in valleys, leveraging the region's 28% share in India's fruit production.
- Agroforestry offers high potential in barren lands and farmlands to offset carbon, provide economic benefits to farmers, and improve ecosystem health. For example, intercropping fruit-bearing species in coconut orchards or fallow lands has improved soil fertility, attracted fauna, and aided sequestration.

Scaling agroforestry faces clear barriers, such as insecure land tenure, limiting farmer adoption (affecting 20–30% of smallholders in rural India, per ICRIER 2025), lack of access to quality seedlings and biologics in remote areas, financial constraints including high initial costs without immediate returns, knowledge gaps on context-specific models, market linkages for products, policy inconsistencies across states, and climate risks like prolonged droughts reducing survival rates (down to 50–60% in high-vulnerability zones, FAO 2025).

To overcome these, DRF's solutions include:

a) Promoting agroforestry with individual farmers owning lands.
b) Nudging groups to secure land rights through community agreements and local advocacy.
c) Establishing and operating local nurseries for affordable, traceable planting material.
d) Connecting farmers to subsidies via schemes like the National Mission on Sustainable Agriculture.

e) Offering extension training and digital apps for knowledge dissemination to farmers/ target communities
f) Developing value chains for timber and non-timber products to ensure economic viability.
g) Selecting resilient species with biologic integration to boost survivability to 80–90%.
h) Designing systems for farmers to earn income from the third year via cover crops.
i) Exploring and connecting farmers to incentives for carbon sequestration through carbon/green credits.

DRF aims to scale agroforestry to 50,000 acres (approximately 20,234 hectares) by 2030, yielding substantial sequestration potential estimated at 1.86 million tonnes of $CO_2$ over five years (based on an average rate of 18.35 Mg $CO_2$/ha/year from tree and soil components, derived from Indian studies showing 0.25–19.14 Mg C/ha/year), contributing to India's NDC goals while providing economic and resilience benefits across these districts.

### 8.1.2. Afforestation

Afforestation interventions form the backbone of ACE's efforts to restore degraded landscapes, increase green cover, sequester carbon, and enhance ecosystem services, targeting barren or degraded lands, water bodies, and public spaces over the next five years (2026–2030). This aligns with India's NDC goal of an additional 2.5–3 billion tonnes $CO_2$ equivalent carbon sink by 2030, addressing land degradation affecting 29% of India's area (FAO 2025) and supporting biodiversity in vulnerable zones.

The objectives of afforestation are to (1) rehabilitate barren and degraded lands for productive use, (2) improve water retention and quality through riparian planting, (3) reduce urban heat islands and erosion via strategic green cover, (4) promote sustainable land management for carbon offsetting and community resilience, and (5) generate co-benefits like improved air quality and livelihoods from non-timber forest products.

DRF's science-based approach selects quality planting material—certified, local species, climate-resilient seedlings from accredited nurseries—to achieve high survival rates (80–90%). Designs are tailored to local contexts via assessments of soil types, hydrology, and ecology, in partnership with ICAR, ICFRE, and state forest departments, ensuring ecological fit for the project regions.

Robust monitoring includes geo-tagged boundary mapping, traceability of planting material from nursery seeds to field saplings via app-based tracking, regular growth measurements (height, canopy), and site-specific nutrient management based on soil testing to optimize health and outcomes.

***Core activities include:***

- **Green Cover on Barren or Degraded Lands:** Planting native species on wastelands (e.g., 1,91,000 hectares annual gains in India from 2015–2025, FAO 2025) to stabilize soils, prevent erosion in rain-shadow areas like Rayalaseema (Andhra Pradesh), and restore habitats in ravines like Jabalpur (Madhya Pradesh), targeting 50,000 acres by 2030 for 1.86 million tonnes $CO_2$ sequestration over five years.

- **Avenue Plantation:** Linear planting along roadsides, canals, and farmlands to mitigate heat islands (reducing temperatures by 2–

5°C in urban areas), sequester carbon (10–15 $tCO_2$/ha/year), and enhance aesthetics/biodiversity, as in Telangana's Nizamabad or Himachal Pradesh's Solan districts where it shields orchards from winds.

- **Water Bodies Rejuvenation:** Riparian afforestation around lakes, ponds, and rivers to improve water quality, recharge groundwater (amid 43–45% water stress, NITI Aayog 2025), and create aquatic habitats, transforming truncated or polluted water bodies into biodiversity hubs in regions like Telangana or Madhya Pradesh.

Scaling afforestation faces barriers like land access issues, high initial costs, seedling quality gaps, and climate risks reducing survival (50–60% in drought zones). Based on DRF's experience, scaling afforestation to achieve 70–80% survival rates and large impact is challenging, with barriers like land access, high initial costs, seedling quality gaps, and climate risks (e.g., droughts dropping survival to 50–60% in vulnerable zones, FAO 2025). However, over the next five years, DRF will tackle these to expand afforestation on barren/degraded lands, around water bodies, and via avenue plantations, supporting India's NDC carbon sink target of 2.5–3 billion tonnes $CO_2$ equivalent by 2030.

a) DRF's approach towards the workable solution to overcome the barriers in scaling the afforestation intervention are:
b) Secure community agreements for common/waste lands via local panchayats
c) High Initial Costs involving site preparation, fencing, and maintenance deter participation are addressed through linking the plantation to subsidies under National Mission for a Green India (covering 50–70% costs) and pursue CSR partnerships
d) Seedling Quality Gaps are addressed through Setting up local nurseries for traceable, certified material
e) Climate Risks and Maintenance Gaps such as droughts, grazing, and pests lower survival is addressed through choosing resilient species; adding fencing/guards;
f) Train communities on maintenance with extension programs, apps.
g) Explore value chain integration for timber/non-timber products with returns from year 3–5
h) Link to carbon/green credits for sequestration rewards.

By applying these solutions in phases—starting with pilots and scaling via partnerships—DRF will reach high survival rates, restore thousands of hectares yearly, and provide co-benefits like better biodiversity, water retention, and livelihoods, advancing ecological health and community resilience.

### 8.1.3. Biodiversity & Ecosystem Services

***Core activities include:***

- **Pollinator Gardens:** Pollinator gardens represent a targeted intervention within ACE's afforestation and biodiversity component, designed to enhance biodiversity in farmlands and local ecosystems by attracting and supporting pollinators like bees, butterflies, moths, and wasps. Over the next five years (2026–2030), DRF will scale pollinator gardens as compact, flower-rich habitats integrated into agricultural fields, orchards, and degraded lands, addressing the 10–20% decline in pollinator populations due to climate shifts and habitat loss (IPBES

2025), which threatens one-third of global food production reliant on pollinators (FAO 2025).

**Key Objectives:** (1) boost pollinator diversity and abundance for improved crop pollination, (2) enhance ecosystem services like natural pest control and soil health, (3) increase farm productivity without additional land use, and (4) generate co-benefits like higher yields (up to 15–25% in pollinator-dependent crops) and community education on biodiversity.

Key aspects of implementation include developing pollinator gardens amid agricultural fields to attract essential insects, thereby supporting plant reproduction and food security. These gardens use a mix of perennial and annual flowers, herbs, and shrubs to provide year-round nectar and pollen, creating corridors that connect fragmented habitats and boost local biodiversity. DRF's science-based approach involves selecting quality planting material— nectar-rich native flower seeds and seedlings to achieve high establishment rates (80–90% through site preparation and monitoring), identifying the suitable site for establishing the garden, engaging the local farmers to protect and nurture the garden etc. Designs are tailored to local contexts via assessments of soil types, crop patterns, and pollinator needs, in partnership with local agriculture extension system. To ensure robust monitoring and evaluation, ACE measures regular growth parameters (e.g., bloom density and pollinator counts), and nutrient management based to optimize floral diversity and longevity.

Scaling pollinator gardens faces barriers such as limited farmer awareness of benefits (affecting adoption in 60–70% of smallholdings, ICRIER 2025), high setup costs for seeds and maintenance, pest/disease vulnerabilities, and climate impacts like erratic rainfall reducing bloom periods (down to 50–60% effectiveness in drought zones, FAO 2025). DRF adopted the local context based solutions, which include community education workshops, digital apps for knowledge sharing of farmers/ other community members, subsidizing the planting material cost to the farmers, and integration of resilient, native species to reduce the risks of lower survival of the pollinator garden.

Pollinator gardens serve as vital indicators of ecological health, fostering resilient farmlands and communities while contributing to sustainable biodiversity and agriculture.

- **Butterfly Gardens:** Butterfly gardens are a targeted intervention in ACE's afforestation and biodiversity work, creating flower-rich plots in farmlands, field edges, and degraded areas to support butterfly populations and boost overall ecosystem diversity. In the next five years, DRF will scale these gardens to counter butterfly declines (10–30% in recent decades from habitat loss and climate shifts, per IPBES 2025 and Butterfly Conservation India reports), as butterflies indicate healthy ecosystems and aid crop pollination.

**Key Objectives:** (1) supplying nectar and host plants for butterfly life cycles, (2) increasing insect diversity for pest control and pollination, and (3) providing benefits like 10–20% higher crop yields and greater community conservation awareness.

DRF uses a science-based method, choosing local species from nurseries for better establishment rates, and adding companion

plants to strengthen plant health, blooms, and habitats against rain variability and heatwaves. The local context based design are adapted considering the soil, crops, and butterfly species via local horticulture experts.

Monitoring features like growth checks like bloom density, butterfly counts, optimal floral life are recorded periodically to assess the status and corrective actions are taken accordingly. Implementation focuses on full gardens with nectar (adult food) and host plants (larval growth), planted as fences or borders to form mini-forests that attract species and link fragmented habitats.

Scaling faces clear barriers: low farmer awareness (affecting 60–70% smallholdings, ICRIER 2025), high setup costs, pest risks, and dry spells cutting blooms (50–60% effectiveness in droughts, FAO 2025). Solutions include workshops and apps for education, subsidizing the costs covering 90% costs for farmers group are followed for the success of the intervention.

Butterfly gardens signal ecological health, building resilient farms and communities while supporting sustainable biodiversity and agriculture.

- **Beekeeping:** Biodiversity-centred beekeeping is a key intervention in ACE's afforestation and biodiversity work, placing beehives in farmlands and restored sites to support bee populations and ecosystem health. From 2026–2030, DRF will scale this non-commercial practice to counter 20–30% bee declines from habitat loss and climate shifts (IPBES 2025; FAO reports), as bees pollinate one-third of food crops and wild plants.

**Key Objectives:** (1) Boost bee diversity for better pollination, (2) Enhance natural pest control and plant reproduction, (3) Create pollinator corridors without disrupting land use. (4) Deliver ecosystem benefits and indirect crop gains.

DRF uses science-based hive placement with sustainable, native-bee-friendly equipment for 80% colony survival, adding probiotics and forage plants for bee health against heat/pesticides. Designs adapt to local flora and species with support of technical experts/ horticulture department.

Monitoring will be ensured through daily tracked colonies, health checks (population, mites), forage surveys for optimal habitat are reported on a periodical basis. The major Scaling barriers for this initiative are a) Low awareness (60–70% farmers, ICRIER 2025), b) setup costs for bee hives and colony, c) occurrence of diseases/pesticides, heat reducing viability (50–60% in droughts, FAO 2025). The solution framework followed by DRF are to conduct regular workshops/apps for farmers' education, and 90% subsidy through CSR grant for the bee hives procurement and management by the farmer. Biodiversity-centred beekeeping signals ecological health, building resilient ecosystems and communities while aiding sustainable pollination.

- **Bio Control Units:** Local bio control units are one of the unique intervention in ACE's afforestation and biodiversity work to be initiated in next phase of strategy. Establishing small-scale facilities to culture natural predators and parasitoids for pest management in farmlands and ecosystems is the major focus of this intiaitive. From 2026–2030, DRF will scale these units as non-commercial tools to reduce chemical

pesticides, promote natural balance, and enhance biodiversity, addressing pest resistance and environmental contamination affecting 20–30% of India's farmlands (FAO 2025; IPM reports).

**Key Objectives:** (1) Culture beneficial organisms to suppress pests naturally, (2) Boost ecosystem health and insect diversity for pollination/pest control, (3) Minimize chemical use without impacting yields or land, (4) Deliver benefits like healthier soils and indirect biodiversity gains.

DRF uses a science-based approach, selecting quality cultures (e.g., Isaria, Encarsia) from accredited labs for better efficacy rates, integrating biologics (microbial enhancers) for better organism vitality amid climate stresses like heat/droughts. Designs adapt to local pests, crops, and ecology with support of local public extension system such as KVK/ Research centres/ Agriculture University. The key monitoring metrics of the initiative are mandatory tracking of culture batches from lab to field release on a daily basis, efficacy checks (pest counts, bio-indicator levels), and soil-test-based adjustments for optimal deployment.

The implementation of this initiative is going to be local woman/ youth based micro Units of culture predators/parasitoids (e.g., ladybugs, wasps) for release in fields on a chargeable basis to farmers highlighting the reduction of reliance on chemicals and serving as bio-indicators of ecosystem health. The major challenge for scaling this initiative are low awareness among the farmers (60–70% farmers, ICRIER 2025), high setup costs, culture viability issues. The planned approach for the solution is bottom up by involving the aspirant from the beginning of the intervention and completing the required capacity building and handholding support to become successful. Apart from training and handholding, extension of subsidies under different schemes/ grant support to nudge the youth/women to explore the pilot in the project geography. Local bio control units signal ecological health, building resilient farms/communities and supporting sustainable biodiversity/pest management. Afforestation and biodiversity serve as indicators of ecological health, ensuring the physical and psychological well-being of entire ecosystems while fostering resilient communities.

### 8.2. Strategic Component 2 (SC02): *Coastal Ecosystem*

The Coastal Ecosystems component strengthens shoreline resilience and safeguards vulnerable communities, aligning with India's NDC adaptation goals to combat sea-level rise (3.3 mm/year average, UNDP 2025) and cyclones impacting 250–350 million people. Mangrove restoration intervention as part of the Coastal ecosystem efforts offer substantial ecological contributions by stabilizing coastal ecosystems, preventing soil erosion, and regulating water flow, which collectively enhance shoreline protection against sea-level rise and storm surges. Over the next five years (2026–2030), these interventions can restore 10,000–20,000 hectares in vulnerable regions like India's east coast, based on current pilot successes (e.g., 3,826 hectares restored in 2025, UNDP data), reducing erosion rates by 30–50% in planted areas and improving water quality through natural filtration of sediments and pollutants (ICFRE 2025 studies). This creates opportunities for long-term ecological balance, as mangroves act as bio-shields that mitigate flood risks—potentially averting USD 5–10 billion in annual cyclone damages (NDMA

2025 estimates)—while fostering sustainable socio-economic activities like fishing by maintaining tidal hydrology. In terms of carbon sequestration, mangroves are highly efficient "blue carbon" sinks, storing up to 1,000 $tCO_2$/ha over their lifetime, with roots and sediments trapping 3–5 times more carbon than terrestrial forests (IPCC AR6 WGIII, 2022). while shelter belt integration (casuarina/palmyrah) adds 10–15 $tCO_2$/ha/year, additional carbon sinks thereby enhancing the ecosystem and community resilience.

Biodiversity benefits arise from creating multi-layered habitats within the coastal ecosystem/ mangroves sites that support aquatic fauna, birds, and insects, with mixed species planting enhancing species richness by 20–40% in restored sites (CMFRI 2025 reports). Over the next five years, this can conserve 10–15% more marine species in DRF's project areas like Andhra Pradesh, Gujarat, Tamil Nadu and Odisha, where mangroves provide nurseries for fish (increasing stocks by 15–25%) and corridors for migratory birds, countering habitat loss affecting 50% of global mangroves at risk by 2050 (IUCN 2025). Opportunities include women's-led income activities like eco-tourism, which sustain conservation and boost local biodiversity monitoring, fostering resilient ecosystems that reduce disaster risks and support livelihoods.

**Key Objectives:** (1) protecting shorelines and mitigating carbon emissions, (2) enhancing aquatic habitats, (3) improving livelihoods via mangrove-linked income, and (4) boosting resilience to cyclones, surges, and sea-level rise.

In the Coastal Ecosystem intervention, DRF engages local women of coastal communities majorly from the fishing families from the outset to build ownership, involving them in propagule collection, planting material prep, sapling planting, site maintenance (weeding, waterway protection), and income activities like beekeeping, mud crab farming, and eco-tourism. This creates employment days near homes and boosts family well-being, as women—up to 40% of resilience participants—bear disproportionate impacts from habitat loss, salinity, displacement, and violence yet lead restorations (e.g., 18,000 women replanting 6,400 hectares in Odisha's Sundarbans, UNDP/GCA 2025).

DRF's Coastal Ecosystem efforts are largely divided into four major interventions. The first intervention is community owned mangroves restoration intervention. The second intervention involves protecting the shoreline to reduce the cyclone/ disaster risks for the local communities. The third intervention is to focus on additional income generation activities for local women to own the mangroves eco system. The last intervention is holistic and integrated one focusing on the reduction of disaster risks for the coastal communities thereby reducing their vulnerabilities due to climate impact.

### 8.2.1. Community centred Mangroves Plantation/ Restoration:

DRF's science-based restoration begins with baseline surveys (GIS mapping for salinity, biodiversity, vulnerabilities) to guide designs, followed by nursery preparation of healthy planting material per technical standards. Communities, led by women, prepare sites based on assessments validated by knowledge partners and in-house teams, with women handling propagule collection and sapling planting for initial employment days. App-based monitoring tracks growth for 80–90% survival and carbon sequestration (e.g., 1,000

tCO₂/ha). Phase 2 integrates biodiversity via mixed species planting for aquatic fauna enhancement. Upon stabilization, women receive training in income activities (beekeeping, mud crab farming, eco-tourism) to sustain conservation, prevent damage, and improve family well-being. The project sites are selected for intertidal zones with 2–4 daily inundations, 10–30 ppt salinity, and 20–40 cm mudflat depth, using GIS/soil tests to avoid high-wave or polluted areas. Species include Avicennia marina (high-salinity tolerant pioneers), Rhizophora mucronata (mid-intertidal stability), and Bruguiera gymnorrhiza (biodiversity-rich back mangroves), based on local ecology and climate projections. Preparation creates 1–2 m waterways for hydrology, removes invasives, elevates mudflats, and applies biologics for root survival. Integrated with community-driven shelter belts (casuarina/palmyrah) for multi-layered barriers against erosion/storms, fostering ownership and biodiversity corridors.

Mangrove restoration will be a core focus of our work, with a significant emphasis on rebuilding coastal ecosystems to enhance resilience and protect biodiversity. However, integrating biodiversity conservation efforts, such as artificial reefs and habitat restoration for various fauna, will be pursued on a smaller scale due to several regulatory and logistical challenges. One of the primary setbacks is the stringent Environmental Impact Assessment (EIA) process, which requires comprehensive scientific studies, including marine biodiversity surveys and water quality analysis. These assessments demand technical expertise and substantial financial resources, making them difficult for many organizations to manage.

Additionally, the multi-agency approval process adds complexity, as each government department has its own documentation and review procedures, leading to administrative delays. The prolonged approval timelines significantly increase operational costs and strain NGO resources, limiting the ability to sustain long regulatory procedures. For instance, artificial reef projects, in particular, face further hurdles due to strict material safety compliance standards, requiring laboratory certifications to ensure ecological compatibility.

Local resistance, especially from fishing communities, poses another challenge. Concerns about restricted fishing zones or potential ecological disturbances often lead to public objections, further delaying or even preventing project approval. These challenges, combined with financial and time constraints, hinder the full-scale integration of biodiversity conservation efforts. Despite these setbacks, we remain committed to pursuing small-scale biodiversity initiatives, with a primary focus on large-scale mangrove restoration as a critical component of our work.

### 8.2.2. Shelterbelt Plantation (Casuarina/ Palmyrah):

Shelterbelts along coastlines to prevent erosion/storm damage, sequestering 10–15 tCO₂/ha/year. Casuarina and Palmyrah plantations as shelterbelts offer significant opportunities for ecological protection by stabilizing coastal soils, reducing saltwater intrusion, and maintaining environmental balance in vulnerable shorelines. For ecology, these plantations act as bio-shields that check erosion and buffer land from sea impacts, supporting water and soil conservation to improve overall coastal conditions, as seen in

Odisha where Casuarina helps mitigate salt spray on agricultural lands. Possibilities include integrating them with native vegetation to enhance ecological services, such as sediment trapping and habitat creation, potentially restoring degraded coastlines at a lower cost than hard infrastructure. In terms of biodiversity conservation and enhancement, these shelterbelts can augment natural forests by absorbing wind and tidal energy, creating habitats for aquatic fauna and improving biodiversity through multi-species planting. Opportunities lie in blending exotic Casuarina with native Palmyrah to boost ecosystem diversity, though evidence from Odisha shows native vegetation outperforms monocultures in life-saving storm protection, suggesting hybrid models could enhance species richness and resilience. This could conserve biodiversity hotspots, reducing collapse risks for 50% of global mangrove ecosystems by 2050, while fostering corridors for wildlife in arid coastal areas. From a disaster risk reduction lens, shelterbelts mitigate coastal hazards like cyclones, tsunamis, and high winds by deflecting energy and reducing erosion, bolstering socio-economic resilience and aiding disaster management. In India, Casuarina belts have protected against salt spray and wind damage, with potential to secure human settlements and agricultural lands, as evidenced in Odisha's post-cyclone recovery. Opportunities include community-driven planting for long-term risk reduction, integrating with mangroves for hybrid bio-shields that could save lives and minimize economic losses from increasing extreme events.

### 8.2.3. Additional Income Activities by local Women in Mangroves Ecosystem:

In coastal communities, women can generate additional income through sustainable activities tied to mangrove ecosystems, enhancing livelihoods while promoting conservation. Key opportunities include eco-tourism, where women lead boat safaris and guided tours in areas like Maharashtra's mangroves, earning from visitor fees and handicrafts from sustainable materials, as collectives have boosted local economies by 20–30% in recent pilots (UNDP 2025; The Guardian 2022). Mud crab farming and clam collection offer steady revenue, with women models in India's Sundarbans harvesting sustainably to build markets, potentially increasing household income by USD 100–200/month (The Nature Conservancy 2025; Reasons to be Cheerful 2025). Seaweed cultivation provides low-investment options, empowering women in coastal Odisha and Tamil Nadu to earn from harvesting and processing for food/cosmetics, with global demand projected to grow 9% annually by 2030, yielding 15–25% higher returns than traditional fishing (CABI 2025; Frontiers in Sustainable Food Systems 2025). Beekeeping in mangrove areas leverages floral resources for honey production, as trained women in Sundarbans collectives generate supplementary earnings while conserving habitats (Global Issues 2025; Mongabay India 2020). Over the next five years, these activities—supported by training and microfinance—could create sustainable and scale level employment days for women in DRF’s coastal ecosystem project sites fostering gender equality, reducing poverty, and building climate resilience through diversified, eco-friendly income streams. DRF has already introduced bee keeping and seaweed cultivation as additional income activities on a pilot scale and will focus

on scaling up these interventions and other opportunities depending on the local context.

### 8.2.4. Reduced Coastal Salinity:

This is focused on mitigating salinity intrusion—where saltwater from the sea infiltrates freshwater sources like groundwater and rivers, degrading soil, water quality, and agriculture. This is a growing issue in India, where approximately 40% of coastal aquifers are affected by salinity, as reported by the Central Ground Water Board (CGWB) in 2025, primarily due to over-pumping, sea-level rise, and climate-driven factors like reduced freshwater inflows. The approach combines natural and community-based methods to block saltwater intrusion, protect freshwater resources, and build long-term resilience, emphasizing phased implementation for shoreline protection and buffering. The strategy outlines a three-phase process to safeguard coastlines from salinity and related threats like erosion and storm surges. In Phase 1, Planting Mangroves and Shelter Belts which are already explained above. This initial stage involves planting mangroves (salt-tolerant trees that act as natural barriers) and shelterbelts using species like casuarina and palmyrah. Mangroves trap sediments and reduce wave energy, while shelterbelts (rows of trees) create windbreaks to prevent saltwater spray from infiltrating inland. This directly combats salinity by stabilizing soils and limiting seawater penetration, with mangroves alone capable of reducing erosion by 30–50% in restored areas (based on ICFRE studies). In practice, this phase sets the foundation for ecological defence, as seen in similar Indian projects where mangrove belts have protected 7,500 km of coastline from cyclone impacts. As the next step, we will focus on educating communities on Ecosystem Care and Erosion Control; It involves training locals on practices like monitoring plant growth, weeding, and waterway management to prevent erosion and ensure long-term viability. The goal is to empower communities to care for the barriers, fostering ownership and sustainability. For example, education programs can reduce human-induced damage (e.g., over-harvesting) and enhance erosion control, as vegetative barriers like these have been shown to lower soil loss by 20–40% in coastal zones (from UN-Habitat and science literature on vegetated buffers). The last step is to Linking the restoration and conservation efforts to Resilient Designs and Early Warnings: The final phase connects the physical barriers to broader resilience systems, incorporating "resilient designs" (e.g., elevated structures or hybrid green-gray infrastructure) and early warning systems through local governance like panchayats (village councils) and government agencies. This integrates community alerts for storms or surges, ensuring timely evacuations and maintenance. It creates a comprehensive defence, reducing disaster risks—such as the 235 extreme events in 2025 that caused widespread flooding (NDMA data)—and protecting freshwater sources from salinity spikes during high tides.

Overall, this strategy promotes sustainable, community-driven coastal protection, blending natural barriers with education and technology to mitigate salinity's impacts on water security, agriculture, and livelihoods in a changing climate.

## 8.3. Strategic Component 3 (SC03): *Disaster Risk Reduction*

The ACE program's Disaster Risk Reduction (DRR) component integrates proactive

preparedness, mitigation, and recovery to build resilience against climate disasters such as heatwaves, droughts, and floods. It intersects with agriculture and irrigation, rural livelihoods, coastal ecosystems, and biodiversity. Over the next five years (2026–2030), DRF will prioritize community-scale DRR interventions, shifting from individual farm-level actions to village or farming-system plans. This will leverage government convergence, local institutions, and solution designs based on local ecology and livelihood landscapes. The approach extends beyond farms to integrate the broader landscape for better risk reduction and preparedness.

The delivery model centres on village women as community animators—trained facilitators who lead hazard mapping, early warnings, and resilience activities, ensuring gender-inclusive participation and ownership. These animators will use lead farmer platforms to promote climate-resilient land-use practices among farmers and agricultural labourers. They will also engage local institutions like village panchayats, farmer groups, women groups, and line departments to facilitate stakeholder convergence for community disaster risk reduction.

To boost disaster preparedness, DRF will leverage panchayat institutions as key stakeholders, collaborating on village-level risk assessments, contingency planning, and DRR integration into annual development plans. Panchayats will coordinate with line departments (e.g., agriculture for crop advisories, revenue for flood mapping, health for heatwave protocols) to access resources like MGNREGS for water structures or PM Fasal Bima Yojana for insurance, fostering decentralized, multi-hazard responses aligned with NDMA guidelines.

The DRR component's objectives are designed to create a comprehensive, community-led framework that addresses multi-hazards like heatwaves, droughts, and floods, intersecting with agriculture, coastal ecosystems, and biodiversity. Village women as community animators will lead implementation, ensuring gender-inclusive, localized actions. The key objectives of the DRR intervention is as mentioned in the following sections.

### 8.3.1. Enhance Early Warning and Preparedness for Multi-Hazards:

This objective focuses on proactive detection and response to reduce hazard exposure. Over the next five years, DRF will deploy localized early warning systems (EWS) using tools like WeatherSnap for 200x200m forecasts and app-based alerts integrating IMD data with community outreach/SMS for 80–90% coverage in project villages. Women animators will conduct hazard mapping and drills, leveraging panchayats for dissemination. Opportunities include reducing heatwave impact by 20–30% through color-coded alerts and training village level volunteers under Aapda Mitra.. The Impact includes improved preparedness in flood-prone and drought-hit areas of the project locations, saving livelihoods in rainfed agriculture (51% of sown area) by enabling timely crop adjustments.

### 8.3.2. Mitigate Risks through Ecosystem-based Solutions:

Mitigation emphasizes nature-based measures to lessen hazard intensity, intersecting with agriculture (e.g., drought-tolerant crops), coastal ecosystems (mangrove buffers), water bodies rejuvenation and protection and

biodiversity (bio-control units). From 2026–2030, DRF will restore mangroves/shelter belts across the coastlines of Andhra Pradesh, Gujarat and other states, using scince backed design for 80–90% survival and sequestering blue carbon (based on 1,000 $tCO_2$/ha for mangroves, CMFRI 2025). Women animators will lead site prep and monitoring. Opportunities include reducing flood risks in coastal AP (41–63% erosion vulnerability) by 30–50% via hybrid bio-shields and conserving 10–15% more marine species through habitat enhancement. The Impact covers lower erosion in 29% degraded lands (FAO 2025), boosting agricultural yields by 15–25% in integrated systems and protecting biodiversity amid 10% species risk (IPCC AR6).

### 8.3.3. Build Livelihood Security for farmers and Coastal and Tribal Communities:

This objective diversifies incomes to cushion hazard impacts, focusing on non-farm options like mushroom cultivation, beekeeping, and eco-tourism in mangroves or seas weed cultivation. Over five years, DRF will train 50,00 women/youth in resilient practices, creating 1–2 million employment days (e.g., mud crab farming yielding USD 100–200/month, TNC 2025). Animators will link to schemes like NRLM for credit. Opportunities include reducing poverty from shocks by 15–20% through nan-farm interventions

### 8.3.4. Foster Recovery with Institutional Support:

This objective emphasizes, *"building back better"* after disasters by linking immediate relief with long-term development, ensuring communities recover stronger and more resilient. Over the next five years, DRF will facilitate recovery through institutional partnerships, focusing on rapid rehabilitation of agriculture (e.g., seed distribution for drought-hit farms), coastal livelihoods (e.g., resettling post-cyclones), and biodiversity (e.g., replanting mangroves after storms). Women animators will coordinate local needs assessments, while panchayats integrate recovery into annual plans with line departments (e.g., revenue for damage compensation, health for post-flood medical camps). Opportunities such as resilient water body designs, integrating green cover for soil erosion prevention and biodiversity-linked recovery like pollinator gardens and beekeeping (boosting yields by 10–20%). The Impact can be cut recovery time by 30–50% for village households, lowering poverty spikes from shocks and ensuring sustainable livelihoods.

DRF's science-based approach begins with baseline vulnerability assessments—including GIS hazard mapping, water body surveys, cropping systems, farmers' practices, and community risk profiles—to guide localized designs. This is followed by a robust framework for farming systems and biodiversity conservation, then structured execution through community platforms of lead farmers and local animators, in collaboration with local government, formal, and informal institutions. By integrating soil data with historical crop and weather patterns, DRF develops actionable, relevant local-level early warning systems. The use of biologics and technology—such as microbial soil enhancers for drought-resilient crops, digital dissemination through bulk sms/ apps and IoT sensors for flood/ draught/ heatwaves/ dryspell warnings—improves outcomes amid rising extremes (235 events in 2025, NDMA data).

DRR component will execute cost-effective, scalable actions with a three-phase rollout:

**Phase 1 – Preparedness and Early Warning:** Deploy localized EWS for heatwaves (e.g., color-coded alerts via SMS/apps) and floods/droughts (integrating IMD forecasts with community radio), training women animators to disseminate advisories.

**Phase 2 – Mitigation and Integration:** Enhance agriculture resilience through climate-smart practices (e.g., drought-tolerant crops in Bihar/UP, reducing losses by 20–30%, ICAR 2025); restore coastal mangroves/shelter belts for flood buffering (sequestering 10–15 $tCO_2$/ha/year); and promote biodiversity via pollinator gardens/bio-control units to combat infestations naturally.

**Phase 3 – Recovery and Resilience:** Support post-disaster recovery through convergence with government. E.g. insurance linkages (e.g., PM Fasal Bima Yojana) and alternative livelihoods (e.g., beekeeping in mangroves for coastal women), building long-term capacity.

## 9. Partnerships

Partnerships and multi-stakeholder networks are at the core of any successful climate action program. ACE recognizes that the execution of this strategy will only be possible with the support of multiple partners. Climate actions will require collaborative efforts and the support of a strong network of multi-stakeholder partners ranging from Government, Corporate CSRs, think tanks, NGOs, research organizations and universities. Local communities and civil society organizations at large will also play a critical role in shaping and providing legitimacy to our climate action work thus creating positive impacts at multiple spatial scales ranging from individual, community to system levels. ACE also strongly believes that this climate action strategy will not only help us in developing new partnerships but will also strengthen our collaboration with our existing network of current partners.

## 10. Conclusion

ACE envisions that our climate action strategy will guide our work in contributing to positive outcomes for climate mitigation, adaptation and policy. To ensure greater effectiveness in implementation, ACE will monitor and revisit our strategy into 2030, review the progress and impacts of our selected strategic components for mid- course correction if needed. This work will be driven by evidence-based research, strong partnership and networks, knowledge sharing and on- field implementation.

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