UK Government

Nature-based Solutions

A review of key issues in India

Study Partners:

IORA Ecological Solutions | Vertiver enabling sustainability

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Glossary

AMRUT	Atal Mission for Rejuvenation and Urban Transformation
ANR	Assisted natural regeneration
AR	Artificial Regeneration
CAMPA	Compensatory Afforestation Fund Management and Planning Authority
CDM	Clean Development Mechanism
CDRI	Coalition for Disaster Resilient Infrastructure
CEEW	Council on Energy, Environment and Water
DAY-NULM	Deen Dayal Antyodaya Yojana – National Urban Livelihoods Mission
DRR	Disaster Risk Reduction
EbA	Ecosystem-based Approach
FC	Finance Commission
FCDO	Foreign, Commonwealth & Development Office
FOLU	Food and Land Use Coalition
GCF	Green Climate Fund
GHG	Greenhouse gases
GIM	Green India Mission
GW	Gigawatt
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
IREDA	Indian Renewable Energy Development Agency Limited
JNNURM	Jawaharlal Nehru National Urban Renewal Mission
LBCD	Loose Boulder Check Dam
MGNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
MOEFCC	Ministry of Environment, Forests and Climate Change
NABARD	National Bank for Agriculture and Rural Development
NAEB	National Afforestation and Eco-development Board
NAP	National Afforestation Programme
NAPCC	National Action Plan for Climate Change
NbS	Nature-based Solutions
NBT	National Biodiversity Targets
NDC	National Determined Contributions
NDMA	National Disaster Management Authority
NMEEE	National Mission for Enhanced Energy Efficiency
NPDM	National Policy on Disaster Management
NTFP	Non-Timber Forest Products
NWF	National Water Framework Bill
NWP	National Water Policy
OECD	Organisation for Economic Co-operation and Development
PMUY	Pradhan Mantri Ujjwala Yojana
REDD+	Reducing emissions from deforestation and forest degradation
SBM	Swachh Bharat Mission

SCM	Smart Cities Mission
ToF	Trees outside Forests
UNDP	United Nations Development Programme
WWF	World Wildlife Fund

I. Executive Summary

Nature-based Solutions (NbS) protect, enhance and replenish the natural resources that are the basis for achieving food, energy and water security, urban resilience, protection of biodiversity and habitats, restoration of land and reduction of disaster risk. It is estimated that Nature-based Solutions provide more than one-third of cost-effective climate mitigation required till 2030 .

The emergence of the term Nature-based Solutions has raised some questions about its relationship to many existing approaches such as Ecosystems-based Adaptation (EBA), Land Restoration etc. For the purposes of this study, all solutions that deliver multiple cross-sectoral benefits, while protecting and enhancing the natural capital that provides these benefits, fall under the singular umbrella of NbS. These include 'Nature-based', 'Nature-derived' and 'Nature-inspired' solutions, that use both pure nature based as well as hybrid approaches to generate multiple benefits. An example of hybrid NbS includes urban green infrastructure, creation of parks and ponds and green buildings, that provide benefits of temperature regulation, carbon sequestration, recreation, ground water recharge as well as co-benefits of reduced energy costs, improved air and soil quality, urban heat island mitigation, habitat protection, lower resource footprint, improved public health, reduced exposure to natural hazards and various socio-cultural services etc. NbS provide a holistic framework for meeting national priorities and sustainable development goals of India.

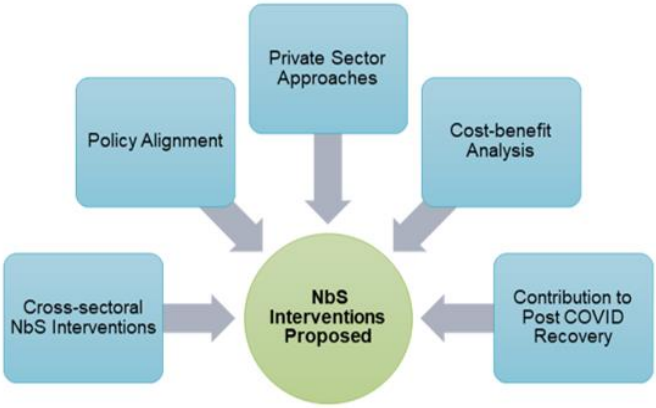
The Foreign and Commonwealth Development Office (FCDO) India is considering the use of NbS in their country investment portfolio in alignment with India's National Priorities vis-à-vis sustainable development and climate change. FCDO commissioned the study, to identify and assess investment interventions that can enable the achievement of several goals including "protecting natural resources and biodiversity," enabling "just rural transition," building "sustainable supply chains particularly in the context of natural resource-based processes" and enhancing the adaptive capacity of the population to tackle climate risks.

This study by Iora Ecological and Vertiver, reviews some best practices of NbS across key development sectors in India. It aims to support the Foreign, Commonwealth & Development Office (FCDO) in selecting an appropriate mix of cost-effective and scalable NbS investments that support India's climate change mitigation and adaptation, biodiversity protection and disaster risk reduction goals.

The study carries out an analysis of 134 case studies, that were selected for their use of Nature-based Solutions across various sectors. These case studies are distributed across sectors as follows: Forest (including Land Restoration) & Biodiversity Conservation (37), Food Security (29), Energy Security (12), Water Security (21), Disaster Risk Reduction (10), Sustainable Habitats (25). Each case study was ranked on the basis of three parameters: 'Design,' 'Implementation,' and 'Benefits.' The 'Design' criteria help determine whether a given project was designed to be inclusive at the planning stage and whether its regional, technological and policy focus render it scalable and replicable. Scoring case studies on Design indicators can provide early insight into the potential impact of planned interventions. To determine the

sustainability of proposed interventions, each case study was further scored on two 'Implementation' criteria—Governance and Cost-effectiveness— and Government buy-in, Cost efficiency of Inputs and Robust Monitoring and Reporting Systems as indicators. In the third parameter, 'Benefits', all known and potential 'Benefits' (Direct and Indirect or Co-benefits), accrued under each case study were mapped and scored.

The study carries out an assessment of various government and non-government case studies, and also provides an overview of private sector investments in NbS interventions through CSR or other impact models. As priorities for 'building back greener' take centre stage in Post-COVID policy and business planning, the study presents an outline of how NbS guided approaches can support these goals in India.



Assessment of case studies shows that NbS applied across sectors, can provide both short term benefits and long-term benefits with low risk, tackle climate change related hazards through low maintenance and low-cost approaches, help people adapt to the effects of change and disasters whilst slowing warming and protecting biodiversity.

Quantifying the value of NbS is limited by the availability of data on market-based valuations of the benefits of such approaches. Benefits from ecosystem-based NbS such as climate regulation, gene pool protection, biodiversity protection etc. increase as time passes, and non-availability of such data makes it difficult to calculate monetary returns to society or environment from such interventions. An attempt has been made to quantify (non-market based) short and term long term benefits using replacement cost and benefit transfer methods in the five case studies included for Cost-benefit Analysis. However, this approach may not reflect the complete economic value of such benefits. Hybrid NbS such as engineering and renewable power can show immediate, measurable impacts and can in the short turn curb the impact of specific hazards in short term, however, these may be more expensive and deliver fewer co-benefits.

Stakeholder consultations were carried out to validate and prioritize the NbS Criteria & Indicators developed. A first round of consultations were done with internal domain experts in IORA Ecological Solutions and Vertiver. A long list of criteria and indicators was created for validation in the second round with external experts. These consultations also generated feedback on the methodology for the cost benefit analysis carried out. Stakeholders consulted during the second round of consultation represented IUCN, World Bank Group, WRI, FCDO, MOEFCC, State Forest Departments.

The overall methodology of the study along with criteria and indicators were discussed and validated during the consultations. Key inputs from stakeholders are as follows: development

funding, public finance and CSR tend to focus on short-term returns and therefore may not explicitly see the merit of supporting NbS projects; assessing the geographical and temporal effectiveness of an NbS can provide early indication of potential scalability of intervention; since technology in some form is essential to almost all NbS, hybrid NbS approaches can be specifically geared towards risk mitigation and adaptation; since majority of the programs are funded through grants, other financial instruments such as asset tokenization, blockchains, Incentive-based Mechanisms/Payment for Ecosystem Services, PPP etc. for financing NbS in future should also be considered. Detailed inputs from experts are provide in Annexure 1.

While effort has been made to shortlist all interventions with the highest impact for each sector, it is important to note that NbS interventions in a given sector are deeply linked to and cut across various sectors. Sector-specific findings of the study are summarized below.

Water Security

Lack of equitable access to water, poor water quality, unsustainable use of groundwater, especially in agriculture and poor governance, are some of the key challenges in India's water sector. The National Water Policy (NWP 2012), highlighted the ecological and environmental aspects of water allocation It emphasized the use of hydrological units and integrating quality, quantity and environmental aspects as the basis for planning, development and management of water resources. The Draft National Water Framework (NWF) Bill, 2016, embodies the principles of protection, conservation, regulation and management of water and enables legal and executive action on water at all levels of governance.

Under this sector, NbS projects with stated objectives for revival and recharge of water sources and related areas of sustainable land use and restoration, coastal management, climate resilience of coastal communities, livelihoods linked to conservation of agro-ecology and ecosystem services and protection of habitats and biodiversity, have been analysed. Findings suggest that the following interventions would yield the maximum benefits and co-benefits under an NbS approach for the water sector: *rainwater harvesting, afforestation/reforestation in catchments, ground water recharge, resilient crop planning, spring shed development, wetland restoration, river basin conservation and rejuvenation, and building capacity to implement such activities*. Rainwater harvesting practices in rural and urban habitats, green infrastructure—especially permeable road infrastructure, increased green cover in rural and urban areas and efficiency of water use in agriculture through technological as well as crop selection and related practices will also improve water security under NbS approaches.

Food Security

The availability, access, quality and safety of food are linked to agriculture, human health, economic growth and stability. Food security is intertwined with water security, land availability and fertility. Decades of fertilizer use and input heavy farming have created challenges to agro-

biodiversity, soil and water conservation. Impacts of climate change threaten farming and allied sectors of livestock, forestry, fisheries and aquaculture across India.

The study assesses the direct and indirect benefits of investing in agriculture and land-use based interventions. These include Zero-budget Natural Farming, Sustainable Livelihoods, Livestock Management, Sustainable Land Management, Soil Moisture and Nutrient Improvement, Ground Water Recharge, Water Conservation, Organic Farming, Watershed Management, Improved Agriculture/Crop Land Management, Cropland and Grassland Land-use Conversions and Soil Protection and Conservation.

The analysis suggests that the following NbS investments would yield maximum benefits and co-benefits to enable food security: *crop diversification, community-based fodder banks, soil and water conservation structures, crop residue management, nutrient management, zero tillage, effective agro-advisory, weather based crop insurance.* Additionally, low carbon agriculture practices, sustainable supply chains for sustainable agriculture/fisheries/NTFPs, livestock management, and creating market linkages for naturally farmed products will also contribute to food security, while generating inclusive and sustainable livelihoods.

Energy Security

India is close to achieving its target of 175 GW of installed renewable capacity by 2022 and has doubled down on its goals by aiming for 450 GW by 2030. To reduce energy dependence on imported fuel, India has also been promoting energy efficiency through various schemes and is making a major push for electric mobility vehicles and cooking appliances.

According to the International Energy Agency, India's demand for energy will experience the largest increase in the next 20 years. Ramping up investment in sustainable energy will be key to achieving energy security while contributing to protecting habitats, biodiversity and human well-being from the adverse impacts of CO2 emissions and carbon intensity related to the use of biomass for energy. It will also help meet India's National Determined Contributions (NDC) target of reducing GDP emissions intensity by 33%–35% below 2005 levels by 2030.The National Mission on Enhanced Energy Efficiency (Green Infrastructure) are examples of hybrid NbS approaches that enable climate mitigation while promoting energy security and just rural transitions.

The analysis suggests that *investments in solar pumps in agriculture, green buildings/infrastructure, renewable energy especially solar rooftops in urban areas, hybrid approaches that combine solar with wind and biomass-based energy and biofuel production, would yield the maximum benefits and co benefits under an NbS approach towards energy security in rural and urban areas*. In addition, clean cooking, energy efficiency practices and waste-to-energy (such as from crop residue and municipal solid waste) can also help achieve energy security.

Forest (Including Land Restoration) and Biodiversity Conservation

Some key challenges to forests and biodiversity in India include conversion of forest land, land degradation, habitat and species loss, increase of invasive species, and human animal conflicts. These contribute to the loss of regulating and provisioning ecosystem services from forests that are linked to food, water and energy security in rural and urban areas. The current per capita forest area of 0.064 hectares in India, compared to the world average of 0.64 hectares, is a testament to the enormous pressure on India's forests.

As part of its Nationally Determined Contributions (NDCs), India aims to create 2.5–3 GtCO2e of carbon stock through additional forest and tree cover. Safeguarding biodiversity through sustainable management of ecosystems will not only meet this climate mitigation target, but will also enable adaptation (building more stress-tolerant ecosystems). Ecosystem based Adaptation (EbA) can reduce social vulnerability to climate hazards. If designed, implemented and monitored with full engagement of local stakeholders, such measures can prove to be cost effective, accessible and sustainable.

NbS approaches to conserve and protect forestry and biodiversity sector in India have the potential to support broader climate strategies (e.g., Net zero emissions) and various social and economic objectives of the government. Current approaches include Afforestation/ Reforestation, Sustainable Forest/Land Management Practice, Forest Conservation and Protection, REDD+/CDM Projects, Biodiversity Conservation and Ecotourism, protection of Himalayan Biodiversity, and Natural Resource Management.

Analysis suggests that enhancing investments in the following interventions would yield maximum benefits and co-benefits under an NbS approach: *plantations, agroforestry, soil and water conservation (trenches, check dams), community mobilization for forest and biodiversity conservation (e.g. through Van Suraksha Samitis), conservation of sacred groves and promotion of fuel efficient chullahs (clean cooking stoves).* Given that India has raised its target for restoring degraded land from 21 million hectare to 26 million hectares by 2030 under the Bonn challenge, interventions such as restoration of degraded forests, assisted natural regeneration, improved land management practices, trees outside forests can also help conserve forests and biodiversity and meet the national goals of achieving land degradation neutrality.

Disaster Risk Reduction

India's diverse socio-geographic regions, spread across different climatic zones, are extremely vulnerable to natural disasters such as floods, cyclones, earthquakes and droughts. Additionally, constituent populations are vulnerable to human induced disasters such as chemical leakages, pandemics, fires, nuclear explosions etc. These inflict heavy public health, economic, environmental, social and cultural toll on communities. Taking a Nature-based Solutions approach for planning, preparing for, and mitigating the impacts of such disasters, can lower vulnerability and build the adaptive capabilities of communities.

India's Disaster Risk Reduction policy follows holistic, proactive, integrated and technology driven strategies to minimize the loss to life, livelihoods and property that is caused by natural or

manmade disasters. Currently the Disaster Risk Management policy is driven by Prime Minister's Ten-Point Agenda, which includes disaster risk management consideration across all development activities, risk coverage for poor households, SMEs and multi-national corporations, gender empowerment and inclusion, global risk mapping, leveraging technology and building capacity.

Selected DRR case studies focus on mitigation of urban, rural and coastal disasters including flood mitigation (urban and rural) measures, coastal erosion/storm protection, landslide risk reduction, and management of cyclone-based emergencies as well as climate change adaptation and mitigation, for building resilience and reducing vulnerability. Lack of coordination amongst institutions regarding relief, recovery and reconstruction and lack of holistic approaches for mitigating disaster risk are areas that an NbS led policy-based emergency response can address.

Investments in bioengineering for landslide risk reduction, green and grey hybrid infrastructure for storm water protection system, coastal shelter belt plantation, drought and flood management, disaster preparedness (preparation of land & water use master plan), timely and appropriate early warning systems in local language, climate resilient technology transfer for enhancing adaptive capacity of communities and capacity building for early response would yield the maximum benefits and co benefits under a mix of pure and hybrid NbS approaches for the disaster risk reduction sector.

Sustainable Habitat (Urban and Rural)

Urbanisation in India increased from 27.81% in 2001 to 31.16% in 2011 (Census of India) and inter-state migration was close to 9 million annually between 2011 and 2016. Integrating green and blue spaces such as forests, parks, wetlands, green roofs in the design of new infrastructure and using energy and resource efficient materials in construction are key to developing sustainable habitats that promote human health, protect biodiversity and eliminate negative externalities of waste and pollution generated due to pressures on rural and urban habitats.

Policies and programmes on sustainable habitats introduced by the government range from delivery of water, sanitation and transportation services for all, including for marginalised population (Atal Mission for Rejuvenation and Urban Transformation (AMRUT)), to waste management (Swachh Bharat Abhiyan). Additionally, the India Smart Cities Mission (SCM) is enabling solutions for energy efficiency, green development and circular economy to promote sustainable habitats.

Many interventions aimed at creating sustainable habitats also cut across energy, water, food, biodiversity and DRR sectors. The study analyses projects on wetland/mangrove conservation, rejuvenation of water bodies, rain water harvesting, integrating green and gray infrastructure, bioremediation, biofuels and waste management. The key challenges in the sector are lack of cost-effective and scalable solutions across rural and urban India. Lack of robust policy incentives for developing green infrastructure, un-coordinated response from different

government bodies on various aspects of sustainable habitats and difficulty in accessing knowledge as well as eco-friendly building materials pose further difficulties.

The analysis suggests that *investments in urban forestry/plantation efficient green and gray infrastructure, biological reclamation of degraded land, use of alternate fuel/solar/wind powered instruments (roof top solar power grid, electric vehicles etc.), wetland/lake rejuvenation, green buildings would yield the maximum benefits and co benefits under an NbS approach.* In addition, urban green spaces, bioaugmentation, curbing toxicity by phytoremediation would also help in achieving urban resilience.

Private Sector Investments and Financial Instruments in NbS

An analysis of CSR (Corporate Social Responsibility) expenditure in the fiscal year 2018-19 of the 19 largest companies in India revealed that the highest CSR investments are on Forest (Including Land Restoration) & Biodiversity Conservation followed by Water Security, Energy Security, Sustainable Habitat Food Security and Disaster Risk reduction.

Companies have also incorporated NbS solutions such as renewable power generation, green procurement, climate resilient green infrastructure, water conservation and use of waste materials such as fly ash and waste biomass as part of their core business operations. Many firms are actively working towards revamping production processes through eco-innovations and circular economy approaches.

Financial Instruments for NbS

Majority of the NbS case studies considered were funded through grants from state and national governments, a mix of grants and loans from public sector institutions like NABARD and grants and low-cost loans from international development finance institutions (DFIs) like USAID, World Bank, KFW, JICA, GEF etc. In case of private sector financing, most forestry and water related NbS were funded through CSR grants. Non-CSR funds from corporations have mostly contributed to energy security through renewable power generation.

Instruments such as equity financing used for funding solar power projects under the National Solar Mission and Indian rupee dominated Green Bonds like the one used by NTPC are also fast becoming mainstream instruments. Private companies like Tata Cleantech etc. have also raised money through issuing green bonds or obtaining concessional loans from banks to endow their environment projects.

In some cases, international DFIs provide capital to Indian financial institutions to set up dedicated lines of credit for specific NbS areas. Examples of this include the SIDBI-KfW energy efficiency scheme, NABARD-KfW credit for watershed development and soil conservation etc.

NbS for Post-COVID-19 Green Growth

During the pandemic, the Indian government committed approximately $ 328.76 Billion in fiscal stimulus, accounting for 15 percent of GDP, as a relief and recovery package to make India “Atma Nirbhar” (self-reliant). Part of this stimulus package supports rural job creation through

afforestation ($ 0.8 Billion), and production linked incentives for building domestic manufacturing capacity, such as battery storage ($2.67 Billion). Creation of rural infrastructure assets through land, soil and water management as part of the Mahatma Gandhi National Rural Employment Guarantee Act is also being further supported under this stimulus, creating the basis for long-term climate resilience and environmental benefits. At the same time, the economic package also focuses on spending on coal infrastructure ($ 6.82 Billion), including the commercial mining of coal. So, the signals are mixed and leaning towards a 'brown 'stimulus rather than a 'green ' recovery package. Allocation for MGNREGA, increased by 65 per cent to help migrant workers who have returned to their home states find livelihoods. The Mahatma Gandhi National Rural Employment Guarantee scheme has been given an extra $ 9.3 billion, taking its allocation to $ 13.8 billion from the Budget figure of $8.4 billion. This package increased the total number of working days to 300 crore man-days, helping states provide increased employment opportunity to the locals.

Investment in agro-forestry and silvo-pastoral systems that can sustain a larger population and curb rural out-migration will aid in providing enhanced and inclusive livelihoods leading to food security. Other measures include leveraging local NRM and job programmes like the MGNREGA to develop resilient farming structures, restore degraded ecosystems and increase climate resilience as well as de-centralising food storage and supply chains can also be prioritized for post-COVID recovery.

Investment in improved water infrastructure is a key priority for building resilience and it can also stimulate green growth, offering new jobs, and reduce the drain on the public purse from future epidemics.

Addressing Transboundary Issues

India shares borders with seven countries. Many of these harbour contiguous ecosystems of vital significance, including two global biodiversity hotspots. These geographical areas offer strategic investment opportunities for NbS from the perspective of ecosystem service flows and risk mitigation. One of the transboundary ecosystems analysed in this study is the Sundarbans, which extend across a total area of 9,630 km^2., sixty percent of which falls in Bangladesh. Protection of this ecosystem will ensure the continued flow of a range of benefits and co-benefits that include provisioning services such as food and fodder, honey, fisheries and timbers and related livelihoods, regulating services such as stormwater protection, erosion control, habitat and biodiversity protection, carbon sequestration, species protection, pollination, waste assimilation and cultural services such as recreation and ecotourism. An assessment by the World Bank reveals that a joint effort by India and Bangladesh, for the protection and conservation of Sundarbans area, may lead to 36% higher benefits for both countries across fisheries, storm protection and tourism.

Given the range of shared ecosystems such as fisheries, forests, mountains, mangroves, rivers across various national boundaries, adopting NbS to protect and enhance these resources can deliver many economic, social and environmental benefits to India as well as partner countries.

Policies to Support Benefits from Nature: Recommendations

Nature-based Solutions provide a unified framework for restoring and enhancing the natural capital that is vital to protecting biodiversity, and combatting climate change. When nature is placed at the heart of economic, environmental and social decision making, various priorities of sustainable development can be met simultaneously.

There is a need to build a knowledge base on how NbS can help address climate change mitigation and adaptation and enhance the resilience of ecosystems and people alike. The knowledge base needs to be coupled with strong regulation and implementation strategies that help scale up suitable interventions. Generating awareness on the integrated nature of NbS among policy makers, implementation agencies and community stakeholders is important to implementing innovative solutions that also leverage traditional and local knowledge.

Some key policy areas that require attention:

- Strengthening Governance Regime

  Establishing and demonstrating the cost-benefits of NbS and developing policies that subsidise NbS approaches and innovative solutions (both engineering based and non-engineering action based) is needed. Public investment in research and capacity building, engaging experts and undertaking demonstration projects on NbS is key. Policy environment should enable private sector awareness and participation in adoption of NbS across business value chains as well as CSR projects.
  Managing existing flagship schemes and funds in a convergent manner could strengthen NbS implementation and raise/redirect initial capital that is required. For instance National Clean Energy and Environment Fund, Compensatory Afforestation Fund, District Mineral Foundation funds and National and state disaster mitigation funds etc. can be tapped for anchoring NbS projects. Different policies and programmes like MGNREGA, state action plans for climate change, DRR management plans, city master plans could be recalibrated to integrate natural assets and NbS.
  Urban and rural local bodies can utilise centrally available grants to implement locally led actions based on NbS.

- Afforestation and Reforestation

  Forestry sector requires better monitoring, verification and reporting of interventions as well as assessments of carbon sequestration and other mitigation and adaptation achievements. Work towards achieving Bonn Challenge targets and REDD+ should be directly aligned in policy platforms such as the Green India Mission and Compensatory Afforestation fund.
  For cost effective, result oriented, and include robust monitoring of outcomes key digital knowledge and data portals can be created. Example includes the Sikkim Climate Inventory Monitoring System (SCIMS), a GHG Inventory Management System which is capable of

estimating and generating reports of the annual Greenhouse Gas (GHG) inventory by sources and sinks (CO2, CH4 and N2O and their CO2-eq. numbers) and a Climate Monitoring, Reporting and Verification (MRV) System which tracks the impact of the mitigation or sequestration actions taken by the State and those by the private sector as well. Large-scale eco restoration projects could be taken up with the involvement of communities, supported by spatial analysis and ICTs.

- Strengthening Sustainable Agriculture

Organic practices and land management changes that increase soil-carbon concentration and amass direct benefits for people should be made mainstream through policy directives and re-directing of financial incentives for all stakeholders involved.
The food production sector contributes significantly to the overall national GHG emissions. Its role in climate mitigation potential through improvements in land-use management, manure management, livestock management, Soil-based strategies etc. is gaining rapid attention. The adoption of NbS for just three activities—fertiliser use, zero-tillage and rice-water management—could provide more than 50% of the total climate mitigation potential of the agriculture sector. There is a need to generate region specific evidence of the effectiveness of these practices to support greater adoption and policy action.
Investments in agro-forestry and silvo-pastoral systems that can sustain more people and stem rural out-migration could aid in reducing sudden pressures on the agriculture sector due to challenges such as COVID-19. More efficient value chains for agro-forestry products combined with higher quality planting material are needed. Cities can include peri-urban/urban agriculture in their planning as a means to improve food accessibility and to promote local markets, consumption and resilience.

- Realising the Potential of Renewables

India has ambitious clean energy targets with 450 GW capacity aimed in renewables by 2030. India has also been promoting energy efficiency through various schemes and is making a major push for electric mobility vehicles and cooking appliances. However, there is still a need for extensive R&D (specially in various classes of EVs, including the battery, hybrid and fuel cell vehicles) and capacity building in development of renewable energy solutions coupled with the financing of these at the micro level.

- Tackling Disasters through Prevention and Adaptation

The best way to tackle DRR is through prevention and adaptation planning that minimizes disasters and their associated effects. Examples include scaling up of national afforestation programmes; wetland and mangrove restoration, management and protection of forest cover and landscape planning. The funding required to catalyse NbS at large scale especially to tackle immediate risk mitigation measures, remains a challenge in India. Leveraging local resources, traditional knowledge and know-how, and promoting sustainable lifestyles through behaviour change should form an integral part of overall NbS

approach in India. This requires massive investment in capacity building and awareness programs.

- Developing Sustainable Habitats

Developing sustainable habitats requires cross-sectoral design, technology and process innovations to align shelter, transportation and livelihood services with conservation of natural resources. Since India is one of the fastest growing economies in the world and is expected to be one of the top three economic players in the next 10-15 years, investing in development of roadmaps for blue and green spaces under NbS such as biophilic cities (cities that invest heavily in restoring and growing natural areas), real time mapping of carbon footprints, carbon sequestration potential of an area, and designing NbS targeted towards the societal challenges (following the latest IUCN standard for NbS) will be key to increasing urban resilience and opening new opportunities and green jobs. Shared public transportation, designing of walkable cities and promotion of bicycle friendly infrastructure are important investments for long term sustainable development in India. As a country that leapfrogged into the smartphone revolution almost overnight from almost no telephone connectivity, India has the agility and the ability to embrace a new paradigm for sustainable development that is rooted in Nature-based Solutions.
Smart technologies to enable sustainable transitions— IoT water sensors and monitors, early warning systems, on-demand Agri-advisory, smart energy meters— are all important for facilitating hybrid NbS in this sector. Assessing the technological basis of an intervention and its relationship to scalability and affordability is key to evaluating investments.

- Harnessing Private and Development Finance

The role of private capital in NbS remains nascent but instruments such as equity financing used for funding solar power projects under the National Solar Mission and Indian rupee dominated Green Bonds like the one used by NTPC, fast becoming mainstream instruments could provide a solution. Private companies like Tata Cleantech etc. have also raised money through issuing green bonds or obtaining concessional loans from banks to finance their environment projects. CSR also remains a mechanism for leveraging private investments in NbS. Valuation of ecosystem services and natural capital accounting practices can help unlock additional capital.

Sustainable supply chains by including the risk to nature and ecosystem services in corporate value chains is critical. Mainstreaming reporting on biodiversity parameters, in addition to climate impacts can also enhance private sector investment.
Additional capital sources may include working with Development Finance Institutions to promote NbS commodities, products and programmes. Policy reforms, especially as a part of COVID-19 recovery, such as redirecting agricultural subsidies towards conversion to organic agriculture and green public procurement can further strengthen the investment in NbS.

- Valuation of Ecosystem services and Incentive based mechanisms

Monetisation of some ecosystem services can help generate private capital and larger participation in conservation projects. Reliable assessments of cost and benefits would help scale up NbS solutions and help leverage private innovation and business expertise.

1. Introduction

Nature-based Solutions (NbS) are interventions designed around the management, conservation and enhancement of natural resources that yield multiple environmental, social and economic benefits and co-benefits. NbS is an umbrella term that encompasses various approaches that put nature at the centre of designing solutions that build climate resilience and create sustainable economies. IUCN categorizes all NbS under five approaches—Ecosystem Restoration, Issue-specific Ecosystem-Related, Infrastructure-Related, Ecosystem-based management and Ecosystem protection. Simple solutions, such as using native vegetation in place of concrete for controlling soil erosion and reducing water runoff along road embankments, to restoration of landscape-scale watersheds to improve water quality and availability, all constitute NbS.[1]

Climate change and biodiversity loss are two interlinked urgent global challenges—climate change and its impacts are direct drivers of biodiversity loss, and ecosystem services that are enhanced by biodiversity are crucial for climate change mitigation and adaptation.[2,3] NbS could account for one-third of the solutions for climate change, and provide 170 billion worth of benefits in ecosystem services by 2030, according to Food and Land Use Coalition (FOLU).[2,4,5] Since NbS simultaneously deliver benefits across various sectors, they also enable the achievement of all United Nations Sustainable Development Goals (SDGs).[6,7] Nature-based Solutions are also key to regaining the lost balance between health of natural ecosystems and people exposed by the Covid-19 pandemic.[8]

Currently, only three percent of the global climate funding focuses on NbS. The OECD-WWF calls for governments to build economic systems that value nature as the central source of human well-being and environmental health in the post-COVID-19 world, for a green and resilient recovery.[8] IPBES, in a report released in October 2020, stated that "*future pandemics will emerge more often, spread more rapidly, do more damage to the world economy and kill more people than COVID-19, unless there is a transformative change in the global approach to dealing with infectious diseases. The same human activities that drive climate change and biodiversity loss also drive pandemic risk through their impacts on our environment. Changes in the way we use land; the expansion and intensification of agriculture; and unsustainable trade, production and consumption disrupt nature and increase contact between wildlife, livestock, pathogens and people*."[9]

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[8] https://www.oecd.org/about/secretary-general/oecd-wwf-dialogue-nature-based-solutions-for-green-and-resilient-recovery-june-2020.htm
[9] https://www.genevaenvironmentnetwork.org/resources/updates/updates-on-covid-19-and-the-environment/

India's economy shrunk by 23.9% in June and another 7.5% by September 2020 as a fallout of the Covid-19 pandemic.[10] While India has been fully committed to meeting its Paris Agreement and other sustainable development targets, it is imperative that it prioritize economic growth in the short term to ensure stability and reducing vulnerability. Placing Nature-based Solutions at the centre of its economic planning can go a long way in helping build back a more resilient and healthy economy in the country.[11]

The 2015 Adaptation Gap Report states that total government spending on developing capacity and adaptation in India has grown consistently and is expected to reach $360 billion (in 2005 prices) by 2030. It also states that India needs over $1 trillion until 2030 to adapt to the impacts of climate change and estimates loss and damage from extreme events in the country at $5-6 billion per annum[12.] Investments in Nature-based Solutions can play a significant role in filling these adaptation gaps as the deliver higher social and economic returns on each unit of investment compared to business-as-usual development approaches.

This study reviews some best practices of Nature-based Solutions across sectors in India and will support the Foreign, Commonwealth & Development Office (FCDO) in selecting an appropriate mix of cost-effective and scalable NbS investments in India that support climate change mitigation and adaptation, biodiversity protection and disaster risk reduction.

1.1. Key Objectives and Challenges

FCDO's investment priorities in India aim towards "protecting natural resources and biodiversity," enabling "just rural transitions," "building sustainable supply chains particularly in the context of natural resource-based processes" and "enhancing the adaptive capacity" of the population to climate risks.

This study aims to support FCDO's investment decisions in NbS by presenting an analysis of case studies that deliver highest benefits across their key investment priorities. It maps the policy appetite for implementing NbS models and presents the range of ecological, social and economic benefits associated with NbS approaches. By applying the criteria of inclusivity to score the studies, the study also incorporates gender considerations and empowerment of poor and marginalised people. It also maps private sector interests in implementing NbS, such as in agricultural value chains, and presents the potential of adoption of NbS approaches within existing or planned supply chains. Given the urgent global priorities for climate risk reduction, the study also presents an outline of climate change mitigation benefits achieved by NbS across all sectors and also links it with the potential to use financial instruments.

The study presents an outline of the role NbS can play in post-COVID recovery, including in the 'Building Back Greener' agenda, and identifies specific sectors that offer the best potential

[10] *https://timesofindia.indiatimes.com/business/india-business/gdp-contracts-by-7-5-in-q2-after-record-slump-of-23-9-in-q1/articleshow/79447117.cms*
[12] *https://www.ceew.in/sites/default/files/CEEW-IIMA-IITGn-Adaptation-Gap-Report-30Nov15.pdf*

returns that may also align with existing/ potential FCDO investments (renewable energy infrastructure, agricultural value chains).

2. About Nature-based Solutions

2.1. Defining Nature-based Solutions

Nature-based Solutions are measures designed to yield multiple benefits and co-benefits across natural capital, environmental, societal and economic dimensions (European Commission 2015). NbS is often considered an umbrella term for prioritizing the sustenance of natural resources while enhancing economic and social assets. Some definitions of NbS, in use are stated below:

1 *"actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits"* (IUCN)
2 *"deliver measurable positive climate adaptation and /or mitigation benefits that have human development and biodiversity co-benefits managing anticipated climate risks to nature"* (WWF)
3 "*Nature-based approaches such as ecosystem-based adaptation (EbA) and mitigation (EbM), eco-disaster risk reduction (eco-DRR), Green Infrastructure (GI) and natural climate solutions"* (NCS- Nature Based Initiative)
4 *"Cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience. Such solutions bring more, and more diverse, nature and natural features and processes into cities, landscapes and seascapes, through locally adapted, resource-efficient and systemic interventions"* (European Commission)
5 Promoting and better relying on biological diversity to increase the resistance and resilience of social-ecological systems to global changes and extreme or unexpected events and the delivery of a range of ES. (excerpt from NbS definition by EC)

Adapting key elements of these definitions, we have developed a guiding definition of Nature-based Solutions that addresses the Indian context— *"NbS are those solutions that are designed to enable climate change adaptation and mitigation; reduce disaster risk; achieve food, water and energy security; promote rural and urban resilience; enable livelihood generation; create sustainable supply chains; reduce poverty; protect natural ecosystems and biodiversity; and ensure human well-being through inclusive approaches, These solutions may span the domains of policy, technology, natural ecosystem processes, social infrastructure and financial models."*

2.2. Types of Nature-based Solutions

Based on global practices that aim to simultaneously tackle environmental, social and economic issues, NbS are classified under the following three categories (IUCN):

1. **Nature Based:** Solutions based on nature that use the power of functioning ecosystems as infrastructure to provide natural services to benefit society and the environment.

2. **Nature Derived:** Wind, wave and solar energy —solutions to help fulfil our low carbon energy needs through production methods deriving from natural sources.
3. **Nature Inspired:** Solutions that involve innovative design and production of materials, structures, and systems that are modelled on biological processes.

To limit warming to 1.5ºC or well below 2°C, society requires a combination of nature-inspired, nature-derived and nature-based solutions, along with significant reductions in fossil fuel emissions.[11]

The emergence of the term Nature-based Solutions also raises questions about its relationship to other approaches like Ecosystems-based Adaptation, Land Restoration etc. For the purposes of this study, all such approaches are considered NbS as they deliver multiple benefits and covered under the proposed functional definition. Under NbS a single solution can deliver a range of benefits by protecting and enhancing the underlying natural capital.

2.3. Mitigation Potential of Nature-based Solutions

IPCC states that "Special Pathways limiting global warming to 1.5°C with no or limited overshoot would require rapid and far-reaching transitions in energy, land, urban and infrastructure (including transport and buildings), and industrial systems (high confidence). These systems transitions are unprecedented in terms of scale, but not necessarily in terms of speed, and imply deep emissions reductions in all sectors, a wide portfolio of mitigation options and a significant upscaling of investments in those options (medium confidence)." According to the IPCC, the mitigation potential from avoided deforestation and land degradation is 0.4–5.8 Gt CO^2 yr^{-1}.

Nature-based Solutions have the potential to mitigate 10-12 Gt of CO_2 annually and can account for more than one-third of the cost-effective climate mitigation required till 2030, helping stabilize warming to below 2 °C[12]. In addition, the carbon sequestration potential in vegetation and soils from afforestation and reforestation has a range of 0.5–10.1 Gt CO_2 yr^{-1}.[13]

Agriculture is responsible for almost 22% of all anthropogenic GHG emissions in India[14] [15]. According to the IPCC, NbS with the maximum potential for building resilience include better cropland management, cohesive water management, agroforestry, agricultural modification, and forest management[16]. Studies show that in India, the adoption of NbS for just three activities—fertiliser use, zero-tillage and rice-water management—could provide more than 50% of the total climate mitigation potential of the agriculture sector. The highest mitigation potential can be

[11] *https://portals.iucn.org/library/sites/library/files/documents/2020-021-En.pdf*

[12] *Natural climate solutions | PNAS*

[13] *Sustainable energy transformations in India under climate policy - Shukla - 2013 - Sustainable Development - Wiley Online Library*

[14] *http://www.fao.org/3/i6583e/i6583e.pdf*

[15] *Achieving mitigation and adaptation to climate change through sustainable agroforestry practices in Africa - ScienceDirect*

[16] *Building up family farmers' resilience through nature-based solutions in Latin America and the Caribbean (ifad.org)*

gained by intervention in rice cultivation (~36 MtCO2e yr−1), followed by management of buffalo (~14 MtCO2e yr−1), wheat (~11 MtCO2e yr−1) and cattle (~7 MtCO2e yr−1). The cultivation of cotton and sugarcane each also show mitigation potential of about 5 MtCO2e yr−1[17].

Restoration of degraded land can also generate benefits in terms of ecosystem services and increase in carbon stock. A study by UNEP estimates that additional carbon storage of 1008.49 Mt C over a period of 75 years (13.45 Mt C/yr) is possible in India, given the current trends in forest management policy of the government[18].

NbS can conserve, convert or restore land to ensure that vegetation absorbs additional CO_2 emissions from the atmosphere. In doing so, they also generate various co-benefits towards soil productivity, additional income sources to local communities, improving air and water quality, and preserving biodiversity. Healthy forest landscapes that store carbon, also provide a number of essential services including retention and filtration of rainwater, prevention of soil erosion, and provision of habitat. Effective forest and land-use policies (IUCN) that protect forests and wildlife contribute to biodiversity protection are also considered NbS approaches. Mitigation approaches such as generation of electricity using solar and wind resources, and use of low carbon fuels such as biofuels and hydrogen, etc. are also considered NbS.

3. Nature-based Solutions In India:Policy Context

The study conducts an assessment of NbS-aligned policy actions and financing frameworks that support India's national priorities and commitments—Nationally Determined Contributions (NDC), National Biodiversity Targets (NBTs) and Sustainable Development Goals (SDGs).

In 2009, India announced voluntary targets to reduce the emissions intensity of its GDP by 20-25% against 2005 levels by 2020 at COP 15, Copenhagen. India followed this with its NDC pledge that includes the following targets:

- To reduce the emissions intensity of its GDP by 33-35% from 2005 levels by 2030.
- To increase the share of non-fossil fuel-based energy resources to 40% of installed electric power capacity by 2030, conditional on technology transfer and international climate finance support, such as the Green Climate Fund (GCF).
- To create an additional (cumulative) carbon sink of 2.5-3 GtCO2-eq through additional afforestation by 2030.

The National Forest Policy of 1988 re-oriented the use-centric approach of the1952 National Forest Policy towards greater focus on ecological dimensions of forests. The policy advocated for environmental stability through preservation and restoration of ecological balance,

[17] *(PDF) Cost-effective opportunities for climate change mitigation in Indian agriculture (researchgate.net)*
[18] *http://www.fao.org/3/XII/0405-B2.htm*

conserving natural heritage & genetic resources of the country, increasing forest cover (to 33% of the total geographic area of the country) through afforestation and social forestry programmes, and increasing productivity of forests to meet local and national needs. It was the first major policy that dealt with Tribal rights on forests.

A major enunciation in the 1988 policy was the concept of Joint Forest Management (JFM), introduced in 1990 involving village communities and voluntary agencies to regenerate forests. Another major legislation was the Biological Diversity Act, 2002 was introduced to provide for conservation of biological diversity, sustainable use of its components and fair and equitable sharing of the benefits. Although not directly related to the protection of forests, it had components which would ultimately help in the conservation of forest. Additionally, the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006. The Act provided for a mechanism for the formal recognition of rights of STs and other forest dwelling communities, along with providing an opportunity to integrate them, in the process of conserving and protecting the forests.

Finally, in the year 2018, the Central Government released the draft National Forest Policy, 2018. The upcoming policy seeks to address new challenges that the country has come to face- climate change, human-animal conflict and declining green cover.

Apart from the National Forest Policy, Government of India introduced several programs and schemes on protection and improvement of green cover that includes National Afforestation Programme (NAP), Green India Mission (GIM) and Compensatory Afforestation Fund Management and Planning Authority (CAMPA). The Green India Mission (GIM) under the National Action Plan for Climate Change (NAPCC) seeks to address climate change by increasing the forest/tree cover and improving the quality of forest/tree cover while providing alternative fuel sources to households. Between the period 2015-16 to 2019-20, the gross area planted across the country under the scheme stands at around 1.42 lakh Ha[19] .

The Finance Commission (FC) of India recognised forests as National treasure by factoring 7.5 % weightage to the area under forest in its devolution formula. This provides an additional for incentive to states for creation of carbon sinks supporting NbS initiatives. The 15th Finance commission has further enhanced the weight given to the forestry sector in the devolution formula to 10%. This is expected to enhance the transfers on account of forest and ecology to $ 64,740 Million. Preliminary estimates suggest that the restoration and enhancement of open forests alone may not be sufficient to meet India NDC target. There is a need to look at sectors outside forestry to enhance the country's carbon stocks.

In conjunction with afforestation, the Ministry of Jal Shakti stresses on water conservation and rainwater harvesting, renovation of traditional and other water bodies/tanks, reuse, bore well recharge structures and watershed development. India's comprehensive laws and policies related to water include: National Water Policy, National Water Mission, Water Framework Law

[19] *ES 2020-21_Volume-1-2 [28-01-21] (indiabudget.gov.in)*

(Draft), Model Groundwater Bill (Draft), Dam Safety Bill, and Interstate Water Disputes Amendment Bill. The National Water Policy (NWP 2012) outlines a common integrated perspective to govern the planning and management of water resources, considering local, regional, and national contexts and to be environmentally sound. It states that water needs to be managed as a common pool resource under the public trust doctrine to ensure equitable and sustainable development for all.

The Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) serves as NbS as it involves work towards restoration of water bodies, and land including afforestation. It was initiated and implemented to enhance livelihood security of households in rural areas by providing at least 100 days of guaranteed wage employment to every household whose adult member volunteers do unskilled manual work. One of the components of MGNREGS is recruiting the rural population for plantation work related to increasing and improving green cover. 13.1 million saplings were planted under its 'Roadside Plantation' component between FY2014-15 and FY2019-20 and 1.4 million saplings planted through convergence of the MGNREGS with the Jal Shakti Abhiyan between FY2018-19 to FY2019-20.

In continuation of MGNREGA and self-employment programmes, which are geared towards livelihood generation and land restoration. Government of India has taken significant steps to address under-and mal-nutrition through its National Food Security Act 2013, Anganwadi programmes and mid-day meal schemes. In addition, it launched a number of programmes that benefit farmers, namely, Rashtriya Krishi Vikas Yojana (RKVY), the Integrated Schemes on Oilseeds, Pulses, Palm oil and Maize (ISOPOM), Pradhan Mantri Fasal Bima Yojana, the e-marketplace, as well as a massive irrigation and soil and water harvesting programme to increase the country's gross irrigated area from 90 million hectares to 103 million hectares. Other programs to address food security include targeted Public Distribution System including Antodaya Anna Yojna, nutrition programmes like mid-day meals, Integrated Child Development Services, etc. to improve food and nutrition security. The ration card scheme which provides subsidized food for low-income families, is a gender responsive mechanism through which female household members can access affordable food and related supplies.

In 2016, the government launched a number of programmes to double farmer incomes by 2022. These seek to remove bottlenecks for greater agricultural productivity, especially in rainfed areas. They include:

- The National Food Security Mission,
- Rashtriya Krishi Vikas Yojana (RKVY),
- The Integrated Schemes on Oilseeds, Pulses, Palm oil and Maize (ISOPOM),
- Pradhan Mantri Fasal Bima Yojana,
- The e-marketplace

Social protection programmes in India have helped in improving incomes as well as in providing protection to the population, especially to the poor, from shocks in the economy. However, there is a need to ensure a rights-based approach and nutrition education to achieve the goals of food

security for all. These programmes and schemes are supporting mechanisms for NbS that address food security, rural distress, just rural transition and sustainable supply chain.

In the energy sector as well India has made significant strides towards Energy Security through its commitment to development of renewable energy (175 GW RE generation capacity through 2022) and reduce imports of oil by 10% during till 2022 and reduce emission intensity of GDP to meet its NDC targets. Some of the flagship projects/schemes that target energy security and sustainability include the National Solar Mission, FAME India, KUSUM yojana, Bharat emission norms VI and GRIHA building code, etc.

The National Mission for Enhanced Energy Efficiency (NMEEE) was designed to achieve energy savings of about 20,000 MW and fossil fuel savings of 23 million tonnes and reduction of 98.55 million tonnes of GHG emissions per year, upon completion.

In 2016, the Pradhan Mantri Ujjwala Yojana (PMUY) scheme was launched. It aimed to provide a free LPG connection, subsidized refills to below poverty line (BPL) women to promote clean cooking. The GoI had pledged to provide 50 million free LPG connections by 2019, but successfully achieved 80 million i.e., 30 million more than the target, which was the target for 2020. This would lead to a significant reduction in black carbon emission (Gupta, Shankar, & Joshi, 2010).

By February 2020, India had deployed a total of 90 GW of grid-connected renewable electricity capacity and is making progress towards its target of 175 GW of renewables by 2022. Further, India has increased its renewable energy target to 450 GW by 2030. Seeing capacity growth to almost 430 GW by 2030 and 800 GW by 2040, India will have its coal-generated electricity use reduced from 74% today to 46% by 2040. In NDCs targets, India has also committed to raise nuclear capacity from its current 5.8 GW to 63 GW by 2032.

GoI also implemented the Deen Dayal Upadhyaya Gram Jyoti Yojana (DDUGJY) in 2015, to support the adoption of decentralized distributed electricity in rural India via off-grid installations.

Recognising the need to address DRR holistically, India adopted the Disaster Management Act in 2005, which ushered in a paradigm shift from a relief-centric approach to a more proactive regime that laid greater emphasis on preparedness, prevention and mitigation. The National Policy on Disaster Management, 2009 (NPDM) has been prepared in pursuance of the act, and lays the framework/roadmap for handling disasters in a holistic manner. In 2016, India released the country's first ever National Disaster Management Plan, a document based on the global blueprint for reducing disaster losses, the Sendai Framework for Disaster Risk Reduction. It covers phases of disaster management, from prevention and mitigation to response and recovery.

India established the National Disaster Management Authority (NDMA) in 2005. NDMA serves as the nodal agency to set up guidelines, best practices and institutional partnerships in times of a natural or man-made disaster. The State Disaster Management Authorities (SDMA) are

respective implementing vehicles at the provincial level, following the planning as done by the NDMA.

Initiatives such as shelter coastal belts, early warning systems in coastal areas/landslide prone areas, drought/flood management systems in agricultural areas, storm water protection infrastructure in urban areas and the like are some major NbS under these schemes.

India's Smart City Mission and AMRUT schemes are focused on creating sustainable rural and urban habitats. Mission activities include increasing green spaces, development of disaster resilient infrastructure, rainwater harvesting, waste management, electric mobility, promoting urban green cover and directly and indirectly support India's mitigation and adaptation goals under the Paris agreement. The Smart City Mission cuts across almost all NDCs to enable resilient environmental and economic ecosystems and also delivers various co-benefits of mitigation, adaptation and biodiversity protection.

The Swachh Bharat Abhiyan has been instrumental in increasing the rate of waste processing from 17.97 per cent in 2015-16 to 60 per cent in 2019-20[20]. India Smart Cities Mission (SCM) is focusing on various smart solutions that range from bringing energy efficiency to promoting carbon neutral transportation and promoting green cover. Since the launch of the Mission, 5,151 projects worth more than INR 2 trillion ($ 26.7 billion) are at various stages of implementation.[21]

The Prime Minister's Science Technology and Innovation Advisory Council has launched the Wealth Mission to identify, test, validate and scale up technologies that generate value out of waste, while creating healthier environments and the Ministry of Science has several circular economy initiatives in place. The Ministry of Jal Shakti is working on water conservation through watershed development and intensive afforestation as well as through deployment of critical infrastructure to ensure availability of waste in all rural and urban households of India. They are deploying IoT applications for water quality and availability monitoring.

In 2015, as the Jawaharlal Nehru National Urban Renewal Mission (JNNURM) entered its final phase, six new missions were launched by the Government of India— the Atal Mission for Rejuvenation and Urban Transformation (AMRUT); Pradhan Mantri Awas Yojana (PMAY) – Housing for all (Urban), Smart Cities Mission (SCM), Swachh Bharat Mission (SBM), Heritage City Development and Augmentation Yojana (HRIDAY) and Deen Dayal Antyodaya Yojana – National Urban Livelihoods Mission (DAY-NULM). These were complemented by schemes to improve urban mobility. As a cluster, the missions aimed at improving the quality of life in urban areas and enhancing the delivery of urban services.

Our assessment across all sectors crucial to sustainable development, climate risk mitigation, adaptation and disaster risk reduction shows a strong commitment of India towards

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[20] *https://sustainabledevelopment.un.org/content/documents/26279VNR_2020_India_Report.pdf*

[21] *ibis*

sustainability goals that can be enabled by NbS and a highly conducive policy framework to support NbS interventions. Investments that can help prioritise and augment the design of NbS, along with creating evidence of their capacity to help national goals can leverage this policy scenario to achieve national priorities as well as FCDO goals. Including the added lens of gender and social inclusivity in NbS intervention planning can further enhance their contribution. **Annexure 9.2** outlines the various policy-based missions, targets and actions that are facilitating NbS approaches in India.

4. Study Approach and Methodology

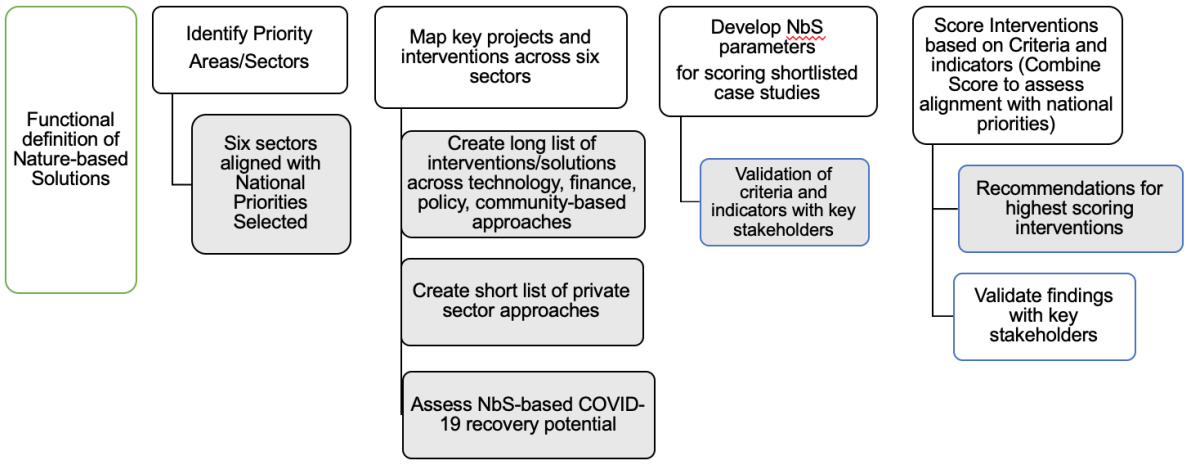


FIGURE 1: STUDY APPROACH

The scoring methodology created for this study, provides a framework for assessing the relative potential of NbS-led practices and interventions to meet the broadest environmental, economic and social goals. To assess and shortlist effective NbS case studies in India, interventions that aligned with the functional definition of NbS were mapped and geographies and sectors identified vis a vis national priority. 134 case studies, selected for their use of Nature-based Solutions across sectors, were analysed under this study. These are distributed across sectors as follows: Forests/Biodiversity (37), Food Security (29), Energy Security (12), Water Security (21), DRR (10), Sustainable Habitats (25).

Each case study was scored on the basis of three parameters— 'Design' 'Implementation' and 'Benefits' detailed in Table 1. The **Design** parameter and its related criteria help determine whether the project's regional, technological and policy focus render it scalable and replicable and whether it is inclusive (of gender and marginalized populations) at planning stage and. Scoring case studies on Design indicators can provide early insight into the potential impact of planned interventions. To determine sustainability of proposed interventions, studies were scored on two key **Implementation** criteria—governance and cost-effectiveness—through indicators that include government buy-in, low-cost inputs and monitoring and reporting systems. Finally, the range of all known and potential **Benefits (**direct and indirect), accrued under each case study were mapped and scored.

Direct and indirect benefits were scored on pre-selected indicators that were mapped across the six study sectors. However, it is important to note that these do not represent all potential benefits that could be accrued under the case study interventions. The scores only reflect the benefits that expert opinion and available literature ascribe to such interventions.

Cumulative scoring under the three above stated parameters, can help shortlist NbS interventions with the highest potential for overall impact. Benefit and co-benefit indicator scores can also be combined to assess the contribution of an intervention to climate change mitigation, climate change adaptation, biodiversity protection and disaster risk reduction, can also help prioritize investments in relevant interventions (Annexure 3). The study methodology covering inception-to-impact features of NbS under three parameters— Design, Implementation and Benefits—is detailed in Table 1.

TABLE 1: CRITERIA AND SCORING METHODOLOGY

Parameter	**Criteria**	**Indicators**	**Scoring Scale**
DESIGN *(Based on stated objectives, process, and outcome articulated at project design level)*	**INCLUSIVE** *Considerations that go beyond the direct needs for growth and income, and include the needs of marginalized people including gender to ensure human well-being, social and environmental sustainability, and empowerment have been factored at the design stage of a project.*	Stakeholder (community) engagement considered in planning process	Yes: 1 No: 0
		Equality-key stakeholder needs were included	Yes: 1 No: 0
		Intended impact of intervention on marginalized communities	Yes: 1 No: 0
	SCALABILITY *Conditions that pave the way for an intervention to be scaled up and replicated have been factored within the design stage of the project. Studies scored on three regional and three technological possibilities.*	Replicability/Scalability of interventions determined by design at geographical scale—a national scale project is assumed to imbibe highest scalability considerations within its design, followed by state and local scale respectively, thereby three scores have been assigned	Nation-wide: 3 Regional: 2 Local: 1
		Scalability of intervention determined by use of technology. Interventions that use technologies such as drip irrigation and solar power pumps that can be produced at large scale, for any geography are scored as highest on scalability. While such technologies are more	High: 3 Medium: 2 Low: 1

		resource and carbon intensive than pure NbS, they may score higher on risk mitigation potential. Any intervention that combines technology with conventional techniques such as improved agriculture methods, land management practices etc. are scored medium (2) and case studies that do not feature use of technology to determine impact have been scored low (1)	
		Policy Centric Approaches- A case study has stated alignment/objective towards meeting government goals and/or states the use of government schemes at design stage.	Yes: 1 No: 0
IMPLEMENTATION *(Based on details of project implementation stated in study)*	**GOVERNANCE** *Conditions that ensure good governance of a project shown in its implementation plan. Each intervention is scored based on three indicators of Governance.*	Local Government buy-in which validates that local administration was a partner in the planning and support of the implementation	Yes: 1 No: 0
		Monitoring body/structure is in place to ensure regular monitoring of the status and impacts of intervention	Yes: 1 No: 0
		Transparency in governance has been ensured through third party assessment/audits and/or impact assessment.	Yes: 1 No: 0
	COST EFFECTIVENESS *Where data was available (5 out of the 134 case studies) considerations of cost: benefit ratio to determine cost effectiveness of an intervention. Also scored on the extent of nature-*	Low-cost inputs such as local labour, traditional methods have been used.	Yes: 1 No: 0
		Local resources to offset implementation costs	Labour and knowledge Both: 2 Partially: 1 No: 0
		Public Private Partnership model-Project has been implemented through	Yes: 1 No: 0

	based inputs used versus engineered ones, in addition to local resource, knowledge, and taps into local policies and schemes for funding/PPP/Convergence.	resources in addition to grants	
BENEFITS	**DIRECT AND INDIRECT BENEFITS** *Mapping of all known and potential benefits generated under interventions across environmental, social and economic dimensions. Each benefit scored separately. Cumulative score of all direct and indirect benefits can also reflect on potential impact of the project on climate change mitigation, adaptation, disaster risk reduction and biodiversity protection.*	Indicators include: Groundwater Recharge, Reduced Pollution, Carbon Sequestration, Climate Resilience, Disaster Prevention, Water and soil Conservation, Biodiversity Conservation, Reduced GHG emissions, Knowledge Enhancement/Capacity Building, Food Security, Enhanced Aesthetic/Cultural Value, Livelihood Enhancement, Increased Household Income, NTFP Market Access, Sustainable Supply Chain, Employment Generation, Livelihood Creation, Reduced Costs, Energy Savings, Sustainable Supply Chain, Reduced congestion, Reduced noise pollution, Ease of living, Convenient access	Yes: 1 No: 0 Individual score for each mapped benefit
Above Scoring Methodology also helps map benefits under four National Priorities		**Benefit Indicators**	
Climate Adaptation		Climate resilience, Groundwater recharge, Pollution reduction, Soil Enhancement/Protection, Livelihood Enhancement, Sustainable Supply Chain, Food Security, Flood/Drought Protection	
Climate Mitigation		GHG reduction, Carbon Sequestration	
Disaster Risk Reduction		Disaster Prevention, Flood/Drought Protection	
Biodiversity Protection		Biodiversity Conservation, Secure Habitat	

Gaps and limitations in sectoral information, impede the identification of a complete array of benefits and co-benefits of each intervention. These gaps include—availability of data for detailed evaluation, absence of interlinkages between interventions and impacts, unclear context behind the design of interventions. Since most of the case studies do not specifically align their work with NbS goals, categorizing the data available in these studies within an NbS evaluation framework proved challenging. We have attempted to cover the absence of such information by scoring interventions cumulatively based on whether they combine benefits, co-benefits with effectiveness of project design and project implementation.

Some case studies were also assessed on the basis of their Cost-Benefit Analysis to evaluate total returns accrued on expenditures on NbS. A Cost-benefit Analysis (CBA) is of particular relevance in the context of NbS, given their focus on delivering high returns of benefits for a one-time fixed cost. This study presents an analysis of five case studies including “Scenarios” to depict the impact of proposed NbS interventions and assess trade-offs that may exist. One of the CBA also includes “without-NbS” scenarios, Alternative NbS scenarios and Engineered Solution (Non-NbS scenarios). Details of this analysis are provided in Section 5.2.

Stakeholder consultations were carried out to validate and prioritize the NbS Criteria & Indicators developed. A first round of consultation was done with internal domain experts in IORA Ecological Solutions and Vertiver. A long list of criteria and indicators was created for validation in the second round with external experts. These consultations also generated feedback on the methodology for the cost benefit analysis carried out. Stakeholders consulted during the second round of consultation represented IUCN, World Bank Group, WRI, FCDO, MOEFCC, State Forest Departments.

The overall methodology of the study along with criteria and indicators were discussed and validated during the consultations. Key inputs from stakeholders are as follows: development funding, public finance and CSR tend to focus on short-term returns and therefore may not explicitly see the merit of supporting NbS projects; assessing the geographical and temporal effectiveness of an NbS can provide early indication of potential scalability of intervention; since technology is essential to almost all NbS, hybrid NbS approaches can be specifically geared towards risk mitigation and adaptation; since majority of the programs are funded through grants, other financial instruments such as asset tokenization, blockchains, Incentive-based Mechanisms/Payment for Ecosystem Services, PPP etc. for financing NbS in future should also be considered.

5. Key Findings

The following six development sectors were selected based on FCDO’s and India’s national priorities:

1. Water Security
2. Food Security
3. Energy Security

4. Forest (Including Land Restoration) & Biodiversity Conservation (Includes Coastal and Marine ecosystems, Mangroves, Himalayan Ecosystems)
5. Disaster Risk Reduction
6. Sustainable Habitat (Including Green Infrastructure, Transport/Mobility, Pollution Control and Water/Waste Management)

5.1. Sectoral Analysis

5.1.1. Water Security

UN-water defines water security as “the capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human wellbeing and socio-economic development, for ensuring protection against water-borne pollution and water related disasters, and for preserving ecosystems in a climate of peace and political stability” (UN Water, 2013). Whilst India is a top-ranking nation for water-based investments, unsustainable use of groundwater, especially in agriculture, poor governance, and water quality remain challenging issues in the country.

Interventions such as drip irrigation and watershed management for agriculture and sustainable water management in urban areas through rain water harvesting and upgradation of sewage systems have been introduced. However, these need to be massively scaled to address the issues of water access and availability. This will also require addressing the inadequate institutional capacities that constrain their implementation.

An analysis of 21 case studies in this sector shows that rainwater harvesting, afforestation/reforestation of catchments, groundwater recharge, resilient crop planning, spring-shed development, wetland restoration, river basin conservation and rejuvenation, and building institutional and technical capacity to implement such activities would yield the maximum benefits and co benefits under an NbS approach for water security. Rainwater harvesting practices in rural and urban habitats, green infrastructure especially permeable road infrastructure, increased green cover in rural and urban areas and efficiency of water use in agriculture through technological as well as crop selection and related practices will also improve water security under NbS approaches.

Table 2 outlines the highest scoring NbS interventions that enable water security. The complete scoring matrix is shown in **Annexure 3.** Based on models available on ‘Climate Change Information Portal’ of India (GIZ), the states of Madhya Pradesh, Assam, Tamil Nadu, West Bengal, Odisha are considered ‘most vulnerable’ on Temperature, Precipitation and Climate extremes indices. The intervention mix shortlisted by the scoring method can be prioritized in these geographies to reduce vulnerability to climate change.

Water Security Story

Rally for Rivers project in East Godavari Riverine Estuarine Ecosystem in Andhra Pradesh-Nature-based Solution for Water Security

Rally for Rivers project was implemented in the East Godavari Riverine Estuarine Ecosystem in Andhra Pradesh. East Godavari Riverine Estuarine Ecosystem (EGREE) in Andhra Pradesh is the second largest mangrove forests in the east coast of India. Rally for Rivers is a movement to save India's lifelines. . It offers a comprehensive solution to augment water flow by restoring tree cover through massive community afforestation, driven by policymaking. Increasing tree cover along river banks for a minimum width of 1 km will restore soil nutrients and improve the soil's capacity to absorb water during rains and release it slowly into ground aquifers and rivers. Trees also influence precipitation patterns by recycling absorbed water back into the atmosphere through evapotranspiration.

RfR promotes planting endemic trees along river banks on government-owned land and converting privately owned land to agroforestry with lucrative economic benefits. This supports bio-diversity and enriches the riverine ecosystem by bringing back migratory birds, reviving aquatic life, offering a conducive environment for worms, insects and plant life to flourish, enriching soil and purifying water.

TABLE 2: TOP SCORING NBS INTERVENTIONS IN WATER SECURITY SECTOR

<table>
<tr><th colspan="4">Intervention Mix From Highest Scoring Case Studies:</th></tr>
<tr><td colspan="4">– Rainwater Harvesting
– Afforestation/Reforestation
– Ground Water Recharge
– Resilient crop planning
– Spring Shed, Wetland, River Basin conservation and rejuvenation
– Capacity Building</td></tr>
<tr><th colspan="4">Intervention mix under four key National Priorities</th></tr>
<tr><th>Climate Adaptation</th><th>Climate Mitigation</th><th>Disaster Risk Reduction</th><th>Biodiversity Conservation</th></tr>
<tr><td>● Employment generation and livelihoods enhancement,
● Sustainable communities and disaster risk reduction,
● Climate-resilient food and agriculture,
● Coastal and marine biodiversity and conservation</td><td>● Afforestation
● Soil and Water Conservation</td><td>● Climate Resilient Urban Centres.
● Community-based conservation and restoration of coastal ecosystem,
● Promote climate-adapted livelihood options.</td><td>● Ecosystem Conservation (Wetland, Mangrove, Coastal)
● Soil and Water Conservation,
● Biodiversity Conservation</td></tr>
<tr><td></td><td>Variables Considered[22]</td><td colspan="2">Madhya Pradesh, Assam, Tamil Nadu, West Bengal, Odisha</td></tr>
</table>

[22] *Map Gallery – Climate Change Information Portal (climatevulnerability.in)*

Most Vulnerable States in the Sector	Temperature, Precipitation and Climate extremes indices	

5.1.2. Food Security

India has become a net food exporter with a five-fold increase in food grain production in the past 65 years. Irrigation, soil and water harvesting programmes have increased India's gross irrigated area substantially. However, India ranks 103rd out of 119 qualifying countries in the Global Hunger Index 2018. Nearly 47 million or four out of ten children in India, do not meet their full human potential because of chronic undernutrition or stunting.

In addition to low agricultural productivity, local of storage infrastructure for emergency situations, climate change challenges to livestock, forestry, fisheries and aquaculture resources, and social and economic consequences such as poor population health, reduced incomes, eroded livelihoods and trade disruption continue to threaten food security in India. With 17% of the world's food consumers and nearly 195 million undernourished people, India already shares one quarter of the global hunger burden. Challenges in this sector are also linked to increase in rural-to-urban migration which further exacerbates the pressures on food production and sustainable supply chains.

While the government has taken significant steps to combat under-and mal-nutrition through programs such as mid-day meals at schools, Anganwadi systems, and subsidized grain for those living below the poverty line through the public distribution system, climate proofing the agriculture sector remains a critical priority. As agriculture is directly impacted by and in turn affects climate change, biodiversity, soil fertility and land degradation, Nature-based Solutions can provide an organizing framework to bring together various stakeholders in agriculture — from farmers, Agri-market players, value-chain suppliers, civil society, citizens, and policy makers.

An analysis of 29 case studies in this sector assesses the direct and indirect benefits of investing in agriculture and land use-based interventions. These include Zero-budget Natural Farming, Sustainable Livelihoods, Livestock Management, Sustainable Land Management, Soil Moisture and Nutrient Improvement, Ground Water Recharge, Water Conservation, Organic Farming, Watershed Management, Improved Agriculture/Crop Land Management, Cropland and Grassland Land-use Conversions and Soil Protection and Conservation.

The analysis suggests that NbS investments such as crop diversification, community based fodder banks, soil and water conservation structures, crop residue management, nutrient management, zero tillage, effective agro-advisory, weather based crop insurance, would yield maximum benefits and co benefits to enable food security. Additionally, low carbon agriculture practices, sustainable supply chains for agriculture/fisheries/NTFPs, livestock management, and creating market linkages for naturally farmed products will also contribute to food security and generate inclusive and sustainable livelihoods.

Table 3 outlines the highest scoring NbS interventions that enable Food Security. The complete scoring matrix is shown in **Annexure 3**. Based on models available in the Vulnerability Atlas of India on Agriculture by Indian Council of Agricultural Research (ICAR), the states of Madhya Pradesh, Uttar Pradesh, Rajasthan, Gujarat and Maharashtra are considered 'most vulnerable' on sensitivity, exposure and adaptive capacity details of which are given in Table 3. The intervention mix shortlisted by the scoring method can be prioritized in these geographies to reduce vulnerability to climate change.

Food Security Story

Climate Resilient Interventions in Dairy Sector in Coastal and Arid Areas in Andhra Pradesh --Nature-based Solution for Food Security

A five year project funded by NABARD and implemented by the Department of Animal Husbandry, Government of Andhra Pradesh in climatically vulnerable districts namely, Anantapur, Nellore and Vizianagaram. An integrated and ecosystem based approach was adopted for enhancing the adaptive capacities of small and marginal farmers dependent on the dairy sector in drought and cyclone prone areas of Andhra Pradesh in the light of climate change.
The Project focused on livelihood enhancement through procurement and distribution of about 2,400 nos. of Sahiwal/Ongole variety of cattle to about 2,500 families, development of community-based livestock shelters for heat/cyclone resilience and business models for greater market access, water security through development of underground water storage tanks and rain water harvesting structures. The use of renewable energy was also promoted through the use of biogas units, solar pumps, and biogas powered milk chilling units.

TABLE 3: TOP SCORING NBS INTERVENTIONS IN FOOD SECURITY SECTOR

Intervention Mix From Highest Scoring Case Studies:			
– Establishment of Fodder bank at community level – Soil and water conservation structures – Crop residue management – Nutrient Management – Promotion of zero tillage – Establishment of Agro-advisory – Weather based crop Insurance – Installation of Automated Weather Monitoring station			
Intervention Mix Under Four Impact Parameters			
Climate Adaptation	**Climate Mitigation**	**Disaster Risk Reduction**	**Biodiversity Conservation**

● Climate Smart Agriculture, ● Soil and water conservation ● Ground water recharge ● Crop Insurance ● Crop diversification, ● Intercropping and intensification ● Water harvesting structures ● Early Warning systems ● Agriculture Extension	● Solar pump irrigation ● Underground water pipelines ● Soil and water conservation ● Agroforestry ● Organic Farming ● Multi-layer farming	● Promotion of Climate-Smart Agricultural Practices by supporting ● Climate-Smart Crop Production and Diversification and Climate-Smart Aquaculture, ● Post-harvest Management, ● Market and Agribusiness Promotion, Capacity Building	● Grain Seed banks (GSBs) and Nurseries ● Restoration and revival of ecosystem services ● Agriculture landscape Planning
Most Vulnerable States in the Sector	**Variables Considered** [23] **Sensitivity:** Net sown area, Extent of degraded and waste land, annual rainfall, flood/drought/cyclone proneness, small and marginal farmers, rural population etc. **Exposure:** Precipitation, Temperature, extreme weather **Adaptive capacity**: Agriculture worker, rural poor, literacy, gender gap, access to market, road connectivity, rural electrification, net irrigated area, livestock population, fertilizer consumption, groundwater availability, share of agriculture in state GDP	Madhya Pradesh, Uttar Pradesh, Rajasthan, Gujarat and Maharashtra	

5.1.3. Energy Security

India is the third-largest energy consumer in the world and its demand for energy supply continues to rise as a result of the country's dynamic economic growth and population increase. Energy security is an important issue on the political and scientific agenda of the country and requires responses on both supply and demand sides. This involves efficient conversion and distribution of energy through appropriate practices and end-use technologies. Both supply and demand security necessitate environmental compliance, for long term sustainability[24].

Climate change has two main implications for India's Energy Security—it adversely impacts livelihoods, mainly rural populations, as they directly rely on the environment for their energy

[23] *Vulerability_Atlas_web.pdf (nicra-icar.in)*

[24] *(PDF) India's Energy Transition— Securing Power for a Sustainable Future (researchgate.net)*

needs (IPCC, 2007). Second, climate change and its impacts could possibly hinder the availability of energy resources impacting social, economic and environmental development.

India needs sustained annual economic growth of 8-10% for the next two decades to fulfil its objectives of poverty alleviation and development. In order to achieve this, India needs to increase its energy supply by 3-4 times and electricity generation/capacity supply by 5-6 times as of their 2003-04 levels (Planning Commission, 2006). Different sectors of energy including transport, power and industry are the main sources of GHG emissions like NOx, SOx, PM 2.5 & 10 and decisions on energy security must also include tackling these negative externalities. The National Mission on Enhanced Energy Efficiency (Green Infrastructure) and the Pradhan Mantri Ujjwala Scheme are examples of hybrid NbS approaches that enable climate mitigation while promoting energy security and just rural transitions.

An analysis of 12 case studies in this sector suggests that investments in solar pumps in agriculture, green buildings/infrastructure, renewable energy especially solar rooftops in urban areas, hybrid approaches that combine solar with wind and biomass-based energy and biofuel production, would yield the maximum benefits and co benefits under an NbS approach towards energy security in rural and urban areas. In addition, clean cooking, energy efficiency practices and waste-to-energy (such as from crop residue and municipal solid waste) can also help achieve energy security.

Table 4 outlines the highest scoring NbS interventions that enable Energy security. The complete scoring matrix is shown in **Annexure 3**. Based on the state of access to electricity report by Council on Energy, Environment and Water (CEEW), the states of Rajasthan, Uttar Pradesh, Jharkhand, Madhya Pradesh, Assam are considered 'most vulnerable' on unsatisfied share of grid electrified households. The intervention mix shortlisted by the scoring method can be prioritized in these geographies to reduce vulnerability to climate change.

Energy Security Story

Ground Water Recharge and Solar Micro Irrigation to enhance resilience in Vulnerable Tribal Areas of Odisha-Nature-based Solution for Energy Security

The primary objective of the project is to enhance groundwater recharge in the community ponds through structural adaptation measures and use of solar pumps for micro irrigation to ensure water security and food security in the vulnerable areas of the state. The following results are expected to be achieved by this project
(i) Augmentation of ground water recharge to improve water table and water quality for health and well-being of about 5.2 million vulnerable people through water security
(ii) Improved food security through resilient crop planning (through irrigation) and installation of Ground Water Recharge Shaft (GWRS) in 10,000 tanks.
(iii) Use of solar pumps for irrigation to improve energy access and contribute to the low emission climate resilient crop planning strategy of the state. Other expected outcomes

include policy briefs for the Odisha Ground Water Management and Development Regulation and State Water Policy.
Energy saving of 3.27 million kWh per year will be achieved from 1000 solar pumps. 2614 tCO2eq/annum is expected to be reduced or avoided.

TABLE 4: TOP SCORING NBS INTERVENTIONS IN FOOD SECURITY SECTOR

Intervention Mix From Highest Scoring Case Studies:			
– Construction of groundwater recharge systems through use of solar pumps. – Biofuel production of electricity – Green Buildings/infrastructure – Roof top solar power grids			
Intervention Mix Under Four Impact Parameters			
Climate Adaptation	**Climate Mitigation**	**Disaster Risk Reduction**	**Biodiversity Conservation**
● Solar Power Installation ● Use of alternate fuel for power generation such as Biogas, bagasse, biofuel etc. ● Green Buildings/infrastructure	● Use of solar powered pumps for agriculture ● Energy efficient building ● Green Buildings/infrastructure	● Solar powered weather station, ● Early warning systems and climate resilient infrastructure	● Use of alternate fuel and conservation of natural resources
Most Vulnerable States in the Sector	**Variables Considered[25]** Based on unsatisfied share of grid electrified households	Rajasthan, Uttar Pradesh, Jharkhand, Madhya Pradesh, Assam	

5.1.4. Forest (Including Land Restoration) & Biodiversity Conservation

With only 0.064 ha per capita forest area against the world average of 0.64 ha, India's forests have been under severe pressure for meeting growing demands for alternative land uses, fuel, fodder, grazing, timber, pulpwood and non-wood forest products from ever growing human and livestock population and industrial development and infrastructure needs. Due to rapid industrial development along with an increase in human population from 390 million (1950) to 1 billion in 2001 and domestic animals from 350 million to 520 million, the demand–supply gap for construction and industrial timber, fodder and non-wood forest products is rapidly increasing leading to over-harvesting and degradation of these ecosystems.

Forest degradation, animal human conflicts, conversion of forest land, climate change impacts, loss of native species and increase of invasive, loss of biodiversity, increasing dependence on forest resources etc. are among the top challenges for India's forest and biodiversity sector. Safeguarding biodiversity through the sustainable management of forest ecosystems is a

[25] https://www.ceew.in/sites/default/files/CEEW - India Residential Energy Survey - State of Electricity Access 05Oct20.pdf

strategic way of building climate resilience through mitigation (maintaining and enhancing carbon sinks) and adaptation (building more stress-tolerant ecosystems) and forms the basis of the most multi-benefit yielding Nature-based Solutions (NbS).

India is a part of the United Nations Framework Convention Climate Change, United Nations Convention on Biological Diversity and United Nations Convention to Combat Desertification. The country has set ambitious mitigation strategies under its NDC Goal 5, which aims to create an additional carbon sink of 2 to 3 billion tonnes of CO_2 equivalent by 2030. It has also set a target to achieve 12 National Biodiversity Targets (NBTs) and Land Degradation Neutrality (LDN) target in 26 million hectares of land.

Investment in increasing Trees outside Forests (ToFs) can contribute significantly to achieving the NDC target, especially through agro-forestry. Key challenges in the promotion of ToFs include market support to farmers, regulatory constraints and institutional mechanisms. Initiatives like Green India Mission (GIM) aim to further increase the forest/tree cover on another 5 MHa of forest/ non- forest lands along with providing livelihood support. It is expected to enhance carbon sequestration by about 100 million tonnes CO_2 equivalent annually.

Investing in this sector also helps achieve various SDGs— SDG 15 (life on land) includes several targets related to forests, forests are relevant for several SDGs, SDG 1 (no poverty) through forests providing ecosystem services and income to fight poverty; SDG 2 (zero hunger) through the provision of wild fruit and game; SDG 3 (good health and well-being) through the provision of medicinal plants; SDG 6 (clean water and sanitation) through the provision of fresh water for drinking and irrigation; SDG 13 (climate action) through carbon capture and storage (CCS) and SDG 15 through contributions to biodiversity.

An analysis of 37 case studies in this sector suggests that enhancing investments in interventions such as plantations, agroforestry, soil and water conservation (Loose boulder check dam (LBCD), trenches, check dams), community mobilization for forest and biodiversity conservation (, conservation of sacred groves and promotion of fuel efficient *chullahs* (clean cooking stoves) would yield maximum benefits and co benefits under an NbS approach. Given that India has raised its target for restoring degraded land from 21 million hectare to 26 million hectares by 2030 under the Bonn challenge, interventions such as restoration of degraded forests, assisted natural regeneration, improved land management practices, trees outside forests can also help conserve forests and biodiversity and meet the national goals of achieving land degradation neutrality.

Table 5 outlines the highest scoring NbS interventions for Forest (Including Land Restoration) and Biodiversity Conservation. The complete scoring matrix is shown in **Annexure 3**. Based on the study by Sharma et al., 2017 “Vulnerability of Forests in India a National Scale Assessment”, the states of Himachal Pradesh, Uttarakhand, Tamil Nadu, Madhya Pradesh Andhra Pradesh are considered ‘most vulnerable’ on indices such as temperature and rainfall change and Vegetation cover change. The intervention mix shortlisted by the scoring method can be prioritized in these geographies to reduce vulnerability to climate change.

Forestry Sector Story

TIST Program in India, VCS 001- Nature-based Solution for Forest(Including Land Restoration) and Biodiversity Conservation

The International Small Group and Tree Planting Program (TIST) is a combined reforestation and sustainable development project, in India, carried out by subsistence farmers. The farmers planted trees on their land and retained ownership of the trees and their products. They receive training from TIST and a share of the carbon revenues from CAAC. TIST empowers Small Groups of 6-to-12 subsistence farmers in India, Kenya, Tanzania, and Uganda to combat the devastating effects of deforestation, poverty and drought. Combining sustainable development with carbon sequestration, TIST already supports the reforestation and biodiversity efforts of over 64,000 subsistence farmers. Carbon credit sales generate participant income and provide project funding to address agricultural, HIV/AIDS, nutritional and fuel challenges. As TIST expands to more groups and more areas, it ensures more trees, more biodiversity, more climate change benefit and more income for more people.
TIST provides an administrative backbone that supplies training in building nurseries, tree planting, conservation farming, building fuel-efficient stoves and malaria and HIV/AIDS prevention. Part of the backbone is a two-way communications network that includes newsletters, weekly meetings at the Small Group level, monthly meetings where groups of Small Groups receive training, periodic seminars at the national level and an award winning monitoring system based on hand-held computers and GPS. TIST is available to everyone and all are considered equal. The rotating leadership and the Small Group rules empower women and the undereducated. Those who are the most successful, regardless of education levels or gender, become mentors and leaders.

TABLE 5: TOP SCORING NBS INTERVENTIONS IN FOREST (INCLUDING LAND RESTORATION) AND BIODIVERSITY CONSERVATION SECTOR

Intervention Mix From Highest Scoring Case Studies			
– Plantations – Agroforestry – Soil and water conservation (LBCD, Trenches, Check Dams), – Community mobilisation for forest and biodiversity conservation (Van Suraksha Samiti) – Conservation of Sacred Groves – Distribution of fuel efficient Chullahs (clean cooking stoves)			
Intervention Mix Under Four Impact Parameters			
Climate Adaptation	**Climate Mitigation**	**Disaster Risk Reduction**	**Biodiversity Conservation**

● Sustainable land management and cropping pattern ● Adoption of horticulture crops ● Creating habitat mosaic for biodiversity conservation ● Livelihood Improvement ● Forest fire control and management ● Sustainable energy supply ● Market linkages for agriculture produce ● Demonstrations of private plantation and agroforestry	● Afforestation ● Soil and Water Conservation ● Forest Fire Management, ● Introduction of Improved Chulhas, ● Bamboo based Enterprise, ● Installation of Solar Lights, solar pumps etc.	● Community based restoration of degraded forest areas ● Mangrove and wetland, spring shed restoration and conservation	● Mangrove plantations and conservation, ● Wildlife conservation programs ● Sustainable landscape management ● Creating habitat mosaic for biodiversity conservation
Most Vulnerable States in the Sector	**Variables Considered**[26] Temperature and rainfall change and Vegetation cover change	Himachal Pradesh, Uttarakhand, Tamil Nadu, Madhya Pradesh Andhra Pradesh (Extremely Vulnerable states as per long term 2080 RCP 8.5 scenario)	

5.1.5. Disaster Risk Reduction (DRR)

India's diverse socio-geographic spread across different climatic zones, include many areas that are highly vulnerable to natural disasters such as floods, cyclones, earthquakes and droughts. In addition, various populations are vulnerable to human induced disasters such as chemical leakages, pandemics, fires, nuclear explosions etc. These can inflict heavy social and economic toll on communities in addition to long term environmental and socio-cultural shifts as a result of damages created. Preparing for and mitigating impacts of disaster risks through the application of Nature-based Solutions can lower vulnerability and build the adaptive capabilities of communities.

The absence of uniform policy for relief and emergency response poses a challenge for effective implementation of DRR approaches. Challenges of coordination between institutions regarding relief, recovery and reconstruction may lead to insufficient fund flow, as well as lack of capacity building towards hazard related knowledge and awareness, that are crucial for mitigation and reduction of disasters. The NbS approaches for DRR may offer holistic solutions, combining community-based action and preparedness with area-based development programmes, contributing to climate/disaster resilient infrastructure and building the capacity of affected or prone populations.

[26] *(PDF) Vulnerability of Forests in India: A National Scale Assessment (researchgate.net)*

An analysis of ten case studies in this sector suggests that investments in bioengineering for landslide risk reduction, green and gray hybrid infrastructure for storm water protection system, coastal shelterbelt plantation, drought and flood management, disaster preparedness (preparation of land & water use master plan), timely and appropriate early warning systems in local languages, climate resilient technology transfer for enhancing adaptive capacity of communities and capacity building for early response, would yield the maximum benefits and co-benefits through hybrid NbS approaches.

Table 6 outlines the highest scoring NbS interventions that enable DRR. The complete scoring matrix is shown in **Annexure 3.** Based on the study by Anusheema Chakraborty & P.K. Joshi (2016) 'Mapping Disaster Vulnerability In India Using Analytical Hierarchy Process', Odisha, Assam, Himachal Pradesh, Uttarakhand, West Bengal, Bihar are considered 'most vulnerable' on sensitivity, exposure and adaptive capacity details of which are given in Table 6. The intervention mix shortlisted by the scoring method can be prioritized in these geographies to reduce vulnerability to climate change.

Disaster Risk Reduction Story

Maharashtra Project on Climate Resilient Agriculture-Nature-based Solution for Disaster Risk Reduction

The development objective of the project is to enhance climate-resilience and profitability of smallholder farming systems in selected districts of Maharashtra. This project has four components.
1) Promotion of Climate-resilient Agricultural Systems,
2) Post-harvest Management and Value Chain Promotion,
3) Enhancing the transformative capacity of institutions and stakeholders to promote and pursue a more climate resilient agriculture, with sector strategies and policies based on strong analytical underpinnings and cutting-edge climate, water and crop modeling,
4) Project Management which covers the activities of the Project Management Unit (PMU) set up by the GoM during the project preparation phase.
THe project has brought an increase in water productivity at farm level, provided approximately 13 lakh farmers with agricultural extension services and technology improvement. It will also improve the yield and income of the farmers by 1.5 times till 2023

TABLE 6: TOP SCORING NBS INTERVENTIONS IN DISASTER RISK REDUCTION SECTOR

Intervention Mix from Highest Scoring Case Studies
– Preparation of Land & Water use master plan – Reducing climate risks through timely and appropriate early warning in local language – Climate resilient technology transfer for enhancing the adaptive capacity of the community – Learning and Knowledge Management
Intervention Mix Under Four Impact Parameters

Climate Adaptation	Climate Mitigation	Biodiversity Conservation
● Drought tolerant/ resistant crop like millets, ● Crops having less water requirement, ● Rain Water Harvesting through pond excavation, ditch digging, dug well, ● Soil and water conservation ● -Roof Top Rain Water Harvesting, ● River lift irrigation, check dam construction. ● Early warning systems ● Weather specific agro-advisory services. ● -Integrated pest management, ● -Installation of biogas units, ● Promote climate-adapted livelihood options	● Crops having less water requirement, ● Increasing soil moisture by application of organic carbon.	● Coastal protection (Coastal shelter belt plantation) ● Mangrove and wetland conservation ● Community -based conservation ● Restoration of coastal ecosystem
Most Vulnerable States in the Sector	**Variables Considered**[27] **Sensitivity**: Population density Marginal workers, Forest cover, Protected area, Net sown area **Exposure:** Earthquakes, Flood, Cyclone, Drought, **Adaptive capacity**: literacy, Road, connectivity, Electricity availability, Communication facilities Medical facilities	Odisha, Assam, Himachal Pradesh, Uttarakhand, West Bengal, Bihar

5.1.6. Sustainable Habitat (Urban and Rural)

Buildings and their construction together account for 36 percent of global energy use and 39 percent of energy-related carbon dioxide emissions annually.[28] Meeting the goals of the Paris Agreement will require all buildings to be net zero carbon by 2050, however, today less than 1 percent of the buildings meet that goal.[29] Transportation too contributes significantly to growing CO_2 emissions worldwide. “By 2050, global emissions of greenhouse gases from transportation could grow to about 12 billion tonnes of CO2e annually — unless there are aggressive and sustained changes in how humans get around.”[30]

India’s rapidly growing urban centres and fast developing rural areas throw the issue of creating Sustainable Habitats into urgent focus. Urbanisation in India increased from 27.81% in 2001 to 31.16% in 2011 (Census of India) and Inter-state migration in India was close to 9 million

[27] *Mapping disaster vulnerability in India using analytical hierarchy process (tandfonline.com)*

[28] *https://www.worldgbc.org/sites/default/files/UNEP%20188_GABC_en%20%28web%29.pdf*

[29] *https://www.wri.org/news/2019/09/release-new-research-shows-zero-carbon-buildings-are-possible-where-you-might-least*

[30] *https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_wg3_ar5_chapter8.pdf*

annually between 2011 and 2016. [31] Buildings with green and blue infrastructure and spaces such as forests, parks, wetlands, that reduce carbon emissions, promote human health, protect biodiversity and remove negative externalities of waste and pollution generation and will be key to India's achievement of sustainable development goals.

The key challenges for sustainable habitat in India are lack of capacity and value chains that can support green infrastructure, un-coordinated response from different government bodies and lack of access to verified and validated eco-friendly building materials[32] [33].

Since Sustainable Habitat is a cross-cutting theme encompassing many sectors, key investments made by the cities are grouped under the following verticals:

- **Energy Security-**
    - Energy production from renewables such as Solar Energy for street lighting, Micro-solar based household rooftop panels etc.
    - Implementation of phase wise smart metering systems across cities
    - Assuring energy efficiency through Remote Monitoring Units to sense and interpret consumption and generation trends of energy across regions.
- **Green Infrastructure-**
    - Increasing green cover through the creation of more open spaces, parks and playgrounds.
    - Restoration of existing green areas through improved land use planning.

- **Mobility**
    - Putting emphasis on development of soft mobility corridors for increased use of bicycles
    - Increased provision for purchase, maintenance and infrastructure for E-vehicles
    - Redesigning street infrastructure to allow walkability and better parking management.
    - Smart freight management and enhancement of public transport terminals to promote shared mobility

- **Water Security**

[31] *http://ficci.in/spdocument/23169/Affordable-Housing-Report-Spread-View.pdf*

[32] *Challenges and opportunities associated with waste management in India (nih.gov)*

[33] *(PDF) Urban Challenges in India and the Mission for a Sustainable Habitat (researchgate.net)*

- Intelligent and resilient water pipeline system for 24*7 supply of water to the population.
- Smart and remote metering system to detect leakages and overuse of water.
- Water harvesting through changes in household infrastructure or creation of new collection reservoirs.
- Restoration of ground water reservoirs and canals.
- Recycling and reuse of water for water conservation

- **Waste Management**
  - Recycling and reuse of materials towards net waste output at collection facilities.
  - Toilets with fit-in treatment facility for enhanced sanitation and reduced contamination.
  - Household segregation of waste.

  Promoting waste to wealth entrepreneurships through creation of value-added products or energy from waste

- **Disaster Risk Reduction**
  - Ensuring climate and earthquake/ cyclone resilient design of buildings
  - Improved communication systems for evacuation and disaster preparedness using social and digital media.

An analysis of 25 case studies in this sector suggests that investments in urban forestry/plantation efficient green and gray infrastructure, reclamation of degraded land through vegetation, use of alternative fuel/solar/wind powered instruments (roof top solar power grid, electric vehicles etc.), wetland/lake rejuvenation, green buildings would yield the maximum benefits and co benefits under an NbS approach. In addition, urban green spaces, bioaugmentation, curbing toxicity by phytoremediation would also help in achieving urban resilience.

Table 7 outlines the highest scoring NbS interventions that enable sustainable habitats. The complete scoring matrix is shown in **Annexure 3**. Based on an ecological study by Acharya, Rajib and Porwal, Akash (2020), Uttar Pradesh, Jharkhand, Telangana Bihar, Madhya Pradesh have been identified as ‘most vulnerable’ states. The study takes into account a composite index of vulnerability at the state and district levels based on 15 indicators in these five domains— socioeconomic, demographic, housing and hygiene, epidemiological, and health system. The intervention mix shortlisted by the scoring method can be prioritized in these geographies to reduce vulnerability to climate change.

Sustainable Habitat Story

Community-led Watershed Restoration in Maharashtra-Nature-based Solution for Sustainable Habitat

The Ahmednagar and Beed districts of Maharashtra had dry degraded land which had no scope of restoration via large scale irrigation. The Watershed Organization Trust (WOTR) implemented a participatory WSD to restore the watershed and its agricultural productivity. This was done by integrating ecosystem based solutions (Green) and water management built structures (grey). Construction of Check dams, farm bunding, and loose boulder structures helped slow the velocity of water runoff and increased the infiltration into groundwater reserves. Afforestation, reforestation, agro-forestry and on-farm contour trenching was practiced which regenerated the landscape and helped retain soil and its moisture thus, improving fertility for cultivation. Local people were given all the required hands-on training before implementation. The project became a huge success.

The project restored a degraded watershed area, improved the soil fertility and agricultural productivity. Cropped area increased from 457 ha in 1998 to 566 ha in 2012, net agricultural income increased from $69,000/year to almost $625,000/ year for the watershed. The value of their croplands increased enormously. People remained employed throughout the year and started growing a variety of crops.

TABLE 7: TOP SCORING NBS INTERVENTIONS IN SUSTAINABLE HABITAT SECTOR

Intervention Mix From Highest Scoring Case Studies			
– Urban Forestry/Plantation – Efficient Green and gray infrastructure – Reclamation of degraded land through vegetation – Use of alternative fuel/solar/wind powered instruments (Roof top solar power grid, Electric vehicles etc.) – Wetland/Lake rejuvenation – Green Buildings			
Intervention Mix Under Four Impact Parameters			
Climate Adaptation	**Climate Mitigation**	**Disaster Risk Reduction**	**Biodiversity Conservation**

● Reclamation of degraded land through vegetation, ● Curbing toxicity by phytoremediation, Introducing ecosystem-based management through gully channels linkages and split dams	● Increasing green cover, ● Enrichment of land through indigenous plantation, ● Creating NTFP like medicinal plants, ● Use of energy efficient building, vehicles ● Use of alternative fuel/solar/wind powered instruments	● Efficient Green and gray infrastructure ● Stormwater management infrastructure ● Improving soil quality near contaminated water through bioaugmentation, ● Mitigating marine habitat hazard through microbial remediation	● Conserving biodiversity through land protection and fencing ● Wetland/Lake rejuvenation ● Bioremediation of wastewater through mangroves/wetlands, ● -Increasing livelihood and aquatic habitat through sustaining fisheries and agriculture
Most Vulnerable States in the Sector	**Variables Considered[34]** Scheduled tribe or caste households, Education level in population, Poor households Elderly population, Urbanisation, Population density People per room Households with no toilet facility, no hand-hygiene facility, with health insurance, without easy access to public health facility, Availability of public hospitals (at district level), hospital beds (at state level) Men with any chronic morbidity, who smoke, Women with any chronic morbidity		Uttar Pradesh, Jharkhand, Telangana Bihar, Madhya Pradesh

5.1.7. Transboundary Ecological Challenges and NbS

IUCN classifies the South Asian region as an area with the greatest conservation need as it is home to many protected areas, biosphere reserves, and key biodiversity areas, and features several ecologically sensitive sacred & biodiversity transboundary landscapes, seascapes, river basins and wetlands.

The Himalayas and Hindu Kush mountain ranges, which are biodiversity hotspots span across India, Nepal and Bhutan. The Indo-Gangetic plain that lies south of the Himalayas is formed by the drainage systems of the Indus and Ganga rivers, and stretches across Nepal, Bangladesh, India and Pakistan[35,36]. India and Nepal also share another river basin, along with China – the Kosi basin, which originates on the Tibetan plateau, passes through Nepal, before entering Bihar in India and then meeting the Ganga[37]. The Brahmaputra river originates from the Kailash ranges of the Himalayas flowing through Tibet, Bhutan, India and Bangladesh, and then joins the Ganga. Another river basin shared between India and Bangladesh is the Barak sub-basin that also spans Myanmar[38]. India, Sri Lanka, and Bangladesh also share coral reefs, extensive mangroves and marine areas.

[34] *https://www.thelancet.com/action/showPdf?pii=S2214-109X%2820%2930300-4*

[35] *Impact of climate change on major river basins in India: The Indo-Gangetic-Plains | India Water Portal*

[36] *https://www.iucn.org/commissions/commission-ecosystem-management/regions/south-asia*

[37] *Opportunities and Challenges in the Trans-boundary Koshi River Basin | SpringerLink*

[38] *Welcome To Brahmaputra & Barak Basin Organization, Shillong | Brahmaputra & Barak Basin Organization (cwc.gov.in)*

Each of these different areas are extremely vulnerable to climate change and have faced increased incidences of extreme weather events and natural disasters such as floods, droughts, tidal surges and cyclones, along with stresses due to deforestation, land degradation, and rapid land-use change[39]. In 2020 alone, monsoon floods in the Indo-Gangetic plains, and landslides and potential glacial lake outburst in the Kosi river basin threatened the lives and livelihoods of nearly 9.6 million people. While the river basins face both periodic droughts and floods, the mangroves in India are also vulnerable and have seen a steady decline, with the country losing 40% of its mangrove area over the past century. Similarly, coral reefs in India are also undergoing degradation due to anthropogenic pressures and climate change, facing local scale extinction threat due to coral bleaching, increased disease prevalence, habitat destruction and natural calamities such as tsunami. The land use/cover change in the key basins in the HKH region is alarming.

While the Indus and Ganges basins have lost 90% and 84.5% of their original forest cover, the Yangtze is down to 84.9% and the Brahmaputra basin has 73%. Climate change, agriculture intensification and rapid urbanization have contributed to this change. The traditional methods of dealing with water scarcity are vanishing and the relatively small size of landholdings in the mountains has pronounced the net impact of temperature and rainfall variability on the farm-based economy.

Nature-based Solutions for the management of river basins, mountain ranges and coastal and marine ecosystems provide an effective measure for ensuring the sustainability of these areas and protect communities, however, since these ecosystems span across different countries, transboundary collaboration is essential in order to ensure the success of interventions[40,41,42]

The South Asia Co-operative Environment Programme (SACEP) was established in 1982 as an inter-governmental organisation to promote regional cooperation in South Asia for sustainable development, and natural resource conservation and management. Since its inception, SACEP has developed several programmes, one such being the five-year regional project on ‘Plastic free Rivers and Seas for South Asia’ being implemented with the World Bank to develop plastic pollution mitigation measures. Additionally, the South Asian Seas Programme (SASP) of SACEP aims to sustainably protect and manage the marine environment and related coastal ecosystems of the region[43]. The South Asian Nitrogen Hub funded by the Global Challenges Research Fund (GCRF) of UK Research and Innovation (UKRI) is a five-year project bringing together 32 organisation across all SACEP countries and the UK, with the goal of developing our understanding of the impacts of nitrogen pollution on the environment, health, food security and climate resilience[44]. Similarly, the Koshi Disaster Risk Reduction Knowledge Hub (KDKH) is

[39] *https://www.iucn.org/commissions/commission-ecosystem-management/regions/south-asia*

[40] *(PDF) Mangrove area assessment in India: implication of loss of mangroves (researchgate.net)*

[41] *Coral reef restoration - A way forward to offset the coastal development impacts on Indian coral reefs - ScienceDirect*

[42] *Stakeholders call for more transboundary cooperation to address disaster risk in the Koshi River basin - Bangladesh | ReliefWeb*

[43] *http://www.sacep.org/*

[44] *https://gtr.ukri.org/projects?ref=NE%2FS009019%2F1#/tabOverview*

a portal developed between India, Nepal and China to promote understanding and transboundary decision making in the Kosi basin through exchange of scientific knowledge and experience sharing on water related DRR. KDKH works across the cross-cutting themes of gender and social inclusion, indigenous knowledge and livelihoods, and incorporates community perspectives to facilitate policy changes at the country level[45].

Sundarbans Protection and Conservation: A Transboundary Nature-based Solution

Sundarbans extend across a total land and water area of 9,630 km^2, sixty percent of which falls in Bangladesh. Protection of this ecosystem will ensure the continued flow of a range of benefits that include provisioning services such as food and fodder, honey, fisheries and timbers and related livelihoods, regulating services such as stormwater protection, erosion control, habitat and biodiversity protection, carbon sequestration, species protection, pollination, waste assimilation and cultural services such as recreation and ecotourism. An assessment by the World Bank reveals that a joint effort by India and Bangladesh, for the protection and conservation of Sundarbans area, may lead to 36% higher benefits for both countries across fisheries, storm protection and tourism[46].

Given the range of shared ecosystems such as fisheries, mountains, mangroves, rivers across various national boundaries, Nature-based Solutions to protect and enhance these resources can deliver many economic, social and environmental benefits to India as well as partner countries.

A Cost-benefit Analysis of the Sundarbans Tiger Reserve has been presented in Section 5.2

Another example of transboundary cooperation is the South Asia Food and Nutrition Security Initiative, which aims to address chronic malnutrition by supporting innovative interventions that improve food and nutritional security[47]. Transboundary Rivers of South Asia, another five-year regional programme between Nepal, India, Bangladesh and Myanmar is working to understand and address challenges related to transboundary rivers, and enhance the lives and livelihoods of vulnerable riparian communities[48]. The South Asia Water Initiative (SAWI) promotes economic development, gender inclusion and climate change adaptation across three river basins (Indus, Ganga and Brahmaputra) and one mangrove landscape (Sundarbans), with the work spanning seven countries - Afghanistan, Bangladesh, Bhutan, China, India, Nepal and Pakistan[49]. Transboundary programmes that implement NbS for different ecological concerns are also being carried out across the region. The International Centre for Integrated Mountain Development (ICIMOD) is implementing a programme on landscape management in the

[45] *https://www.icimod.org/initiative/koshi-drr-knowledge-hub/*

[46] *Benefits-of-Cooperation-Focus-on-the-Sundarban-Identification-and-Assessment-Lead.pdf*

[47] *https://www.worldbank.org/en/programs/safansi#1*

[48] *https://www.oxfamindia.org/programdetails/5093/transboundary-rivers-south-asia-trosa*

[49] *https://www.worldbank.org/en/programs/sawi#1*

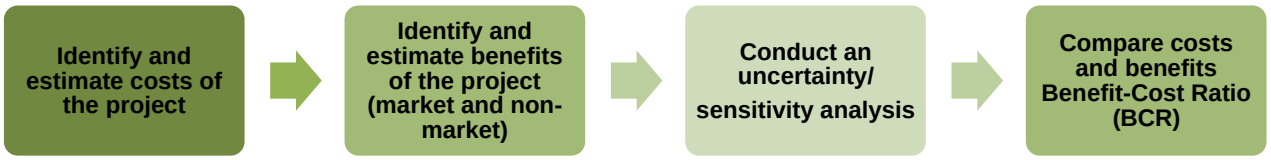
Kangchenjunga Landscape, one of the richest biodiversity landscapes of the Hindu Kush range, across India, Nepal and Bhutan. The programme is working for sustainable management and conservation of natural resources by promoting biodiversity-based enterprises, along with spreading awareness of the economic benefits of ecosystem services provided by the landscape[50]. ICIMOD is also working on developing shared ecotourism projects between India and Bhutan.

The above-mentioned programmes are some successful examples of transboundary cooperation for knowledge sharing, capacity building and policy advocacy to address vulnerabilities of the ecosystems these countries share.

Transboundary areas represent strategic opportunities to mitigate risks and leverage opportunities of shared ecosystems to build climate mitigation and adaptation capacity through NbS. Collaborating on protection of marine, coastal and Himalayan biodiversity and management of river basins are key areas that will benefit tremendously from NbS investments.

5.2. Cost Benefit Analysis for Nature-based Solutions

Since conventional Cost benefit Analysis (CbA) is limited to only market-based benefits, the returns from an array of direct and indirect benefits of nature-based solutions have been presented for five case studies (for which data was available) in this study. To conduct the CbA the study follows these steps:



BCR is the ratio of total present value benefits over a project's lifetime to total present value costs. If a project has a BCR>1, it is expected to deliver a positive Net Present Value (NPV).

5.2.1. WSD program in Kumbharwadi, Maharashtra

Watershed Development (WSD) in India has been a part of the national approach to improve agricultural production and alleviate poverty in rainfed regions since the 1970s. WSD programs aim to restore degraded watersheds in rainfed regions to increase their capacity to capture and store rainwater, reduce soil erosion, and improve soil nutrient and carbon content so they can produce greater agricultural yields and other benefits. As the majority of India's rural poor live in these regions and are dependent on natural resources for their livelihoods and sustenance, improvements in agricultural yields improve human welfare while simultaneously improving

[50] *(PDF) Kangchenjunga Transboundary Conservation and Development Initiative in the Hindu Kush Himalayas (researchgate.net)*

national food security. This Cost Benefit Analysis (CBA) is based on the implementation of a WSD program in Kumbharwadi, Maharashtra. The details of the case study are along with baseline conditions are mentioned in the table below:

TABLE 8: PROJECT DETAILS

Project Area	**Kumbharwadi, Maharashtra, (250 hectares in initial stages)**
Interventions	● Rainwater harvesting and capture as soil-moisture, ● Groundwater, Or Surface Water: ● Check dam, ● Two Nala bunds, ● Tree planting and contour trenching, ● Formation of Self-Help Groups (SHG's)
Success/ Impact Indicators	Employment Generation, Water Conservation, Efficient Farming (Crop Rotation), Avoided Transportation cost for water supply, Self-sufficient (water) by rain water harvesting, Increased ground water levels, Increased wage rates/household income, Avoided emissions

Following are the results of the cost benefit analysis for the WSD. Two scenarios were considered in the case, Scenario 1 whereby costs are maximized and benefits are minimized; and Scenario 2 whereby costs are minimized and benefits are maximized. Based on the scenarios both the costs and benefits are provided across a range. The lower limits pertain to $2,692,576 while the higher includes $3,950,380, Similarly the benefits, comprising of income and avoided costs are also provided in two ranges.

TABLE 9: COST BENEFIT ANALYSIS

Implementation Cost	$2,692,576 to $3,950,380
Benefit Calculation Includes (Market Based estimates)	
Net agricultural income, Net livestock income, avoided travel costs for drinking water, avoided water tanker costs for drinking water	$9,020,520 to $10,127,004
Net present value (NPV) (Base year 1998) (Excluding Carbon Sequestration**)**	**$5,070,140 to $7,434,951**
Benefit Cost Ratio	**Ranges from 2.28 to 3.76**

The NPV (Excluding Carbon Sequestration) of the WSD project in Kumbharwadi ranged from $5.07 to $7.43 million. This equates to benefits of $5,573 to $8,172 per hectare treated or $29,650 to $43,479 per household. The benefit-cost ratio ranged from 2.28 to 3.76. It is evident that the WSD activity has a positive NPV, or is viable even when considering the higher end range of the cost and lower end range of benefits. Further, it is worthwhile to mention that this only includes a subset of the indirect benefits and intangibles that can push up the ratio and overall attractiveness of the program activity substantially, especially for government and impact investors interested in environmental and social co-benefits.

5.2.2. Watershed Development in Bichhiwada Village, Rajasthan

The Case study on Watershed Development in Bichhiwada village, Rajasthan shows that villagers are mostly dependent on land-based activities for their livelihood. The income from migration is secondary economic activity in this area. The analysis has been done based on primary data available from the village and using Net Present Value (NPV), Benefit-Cost Ratio (BCR).

TABLE 10: PROJECT DETAILS

Project Area	**Bichhiwada village, Rajasthan (700 ha)**
Interventions	● Check dams ● Nullahs ● Dams ● Plantations on barren lands ● Group Meetings and discussions
Success/ Impact Indicators	Employment Generation, Water Conservation, Increased production of crops, avoided migration, increased wage rates/household income, avoided emissions, Increased water availability, Waste land into agricultural land

Following are the results of the cost benefit analysis for the Watershed Development in Bichhiwada village, Rajasthan.

TABLE 11: COST BENEFIT ANALYSIS

Implementation Cost (Till 2000)	$ 35,976
Net present value (NPV in 2005) of Implementation cost (1998)	It was calculated to be $ 1,14,800
Benefit Calculation Includes (Market Based estimates)	
Net present value (NPV) of benefits	$2,46,416
Benefit Cost Ratio	**2.14**

The case study uses conventional method of cost benefit analysis in combination with ecosystem services valuation to assess the benefits of the watershed program. 20 indicators were considered to get value of the benefits from the program.

5.2.3. Ecosystem restoration Project-Khasi Hills

REDD+ refers to 'reducing emissions from deforestation and forest degradation in developing countries, and the role of conservation, sustainable management of forests, and enhancement of forest carbon stocks in developing countries'. It was first negotiated at UNFCCC in 2005 with the objective of mitigating climate change by reducing Green-house gases emissions and enhanced forest management. India's National REDD+ Strategy aims to achieve climate

change mitigation by incentivizing forest conservation. Many projects in India have been carried out, one such example is Khasi Hills Community Project in Meghalaya, India.

The Khasi Hills REDD+ Project is situated in the East Khasi Hills District of Meghalaya, India. It engages 10 different indigenous Khasi governments (hima) with approximately 62 villages and small hamlets. The details are given below:

TABLE 12: PROJECT DESCRIPTION

Project Area	**East Khasi Hills District, Meghalaya, India**
Interventions	● Assisted Natural Regeneration ● Controlling Forest Fires ● Sustainable fuelwood production ● Reduce Fuelwood consumption ● Social interventions included formation of self-help groups to promote animal husbandry, ecotourism and people were trained for micro-finance development. ● Farmers' Club were set up to train men in sustainable farming systems, poly-houses were set up to extend the growing season of vegetables.
Success/ Impact Indicators	Conversion of barren land into open or dense forests, Carbon Sequestration, Self-help groups & Farmers' Club formation, Reduction in forest fires, Increase in floral and faunal diversity, Increased annual average income, Biodiversity Rehabilitation , Micro-water shed development, Better yield and high-quality production, Regeneration of coppice, root stocks, seedlings, Soil Health Improvement with less use of chemicals, Year round engagement in cultivation and Plantation of new crops, fruits and vegetables.

Following are the results of the cost benefit analysis for the Ecosystem restoration Project-Khasi Hills.

TABLE 13: COST BENEFIT ANALYSIS

Implementation Cost	$127,126.26
Benefit Calculation Includes (Market Based estimates)	
Net present value (NPV) of benefits	$132,649.32
Benefit Cost Ratio	1.04

In 2013, the project made its first $25,949 in community payments for 5,695 tonnes of carbon dioxide emissions reductions. Through 2019, the Khasi project has paid to approximately 4,400 families and has invested in forest conservation and management.

In 2019, the project reached its break-even point against its investment. The benefit to cost ratio for this project till 2019 is 1.04. The project is expected to offset over 860K tonnes of CO_2. In addition it will improve the overall natural ecosystem of the project area.

5.2.4. Tiger Conservation in Sundarbans/Cost of recreating a Tiger Reserve

Sundarbans are home to 78 species of mangroves have been recorded in the area making it the richest mangrove forest in the world. It supports a wealth of animal species including the single

largest population of tiger and a number of other threatened aquatic mammals such as the Irrawaddy and Ganges river dolphins. It is also called the kingfishers' paradise as out of 12 species found in India, 8 are found here. In the mangrove forest of Indian Sundarbans, a total of 69 floral species belonging to 29 families and 50 genera have been recorded, out of which 34 species are of true mangrove type[51]. Besides conserving the wild, tiger reserves also provide a range of associated economic, social, cultural and spiritual benefits, which are also termed as ecosystem services.

Sundarbans Tiger Reserve (STR) is a maze of estuaries, river channels and creeks encompassing more than 100 islands. It extends over an area of 2,585 km^2 (1700 km^2 of core zone and 885 km^2 of buffer zone) of the total 6,300 km^2 of the Sundarbans. The case study analyses the ecosystem services that flows out of the tiger reserve and the cost of recreating a tiger reserve.

TABLE 14:PROJECT DESCRIPTION

Project Area	**SUNDARBANS TIGER RESERVE**
Interventions	● Ecotourism ● Biodiversity Protection ● Protection / anti-poaching operations /intelligence networking ● Strengthening of infrastructure within tiger reserve ● Creation of inviolate space through relocation
Success/ Impact Indicators	Biodiversity Protection (Increased tiger population), Employment Generation, Seasonal honey collection, Through management and Community-based Ecotourism, Fishing, NWFP collection

TABLE 15: ECOSYSTEM SERVICES FROM SUNDARBANS TIGER RESERVE

Ecosystem Services	Value (in Millions $/ Year)
Employment Generation, Through management and Community-based Ecotourism, Fishing, NWFP, Gene–Pool Protection, Carbon Sequestration, Biological Control, Moderation of Extreme Events, Pollination, Nursery Function, Habitat/ Refugia, Recreation, Gas Regulation, Waste Assimilation	$ 175.36 Million /Year
Management Cost	$ 0.33 Million/Year

The estimated value of the ecosystem services of STR is worth $ 175.36 Million annually. Based on the benefits of $ 175.36 Million per year, for every dollar spent on management costs in STR, flow benefits of $ 530 are realized within and outside the Sundarbans Tiger Reserve. The study also suggests the cost of inaction/recreating a tiger reserve of about 1000 square kilometre will cost approximately $ 6.84 billion which translates to approximately $ 63,013 per hectare[52].

[51] *sundarbans.pdf (iifm.ac.in)*

[52] *IIFM-NTCA-REPORT.compressed-min.pdf*

5.2.5. Cost Benefits Analysis of 3 Star GRIHA Rating Hostel Building to Normal Conventional Hostel

Green Building vs Conventional Building

The paper presented the cost and financial benefits of 3-star GRIHA rating green building in the governmental university Jamia Milia Islamia for J&K students[53]. Providing the benefits of green building over conventional buildings the paper attempted to derive the operational and maintenance benefits of green buildings and spreading awareness among people about green buildings. The following sustainable site planning has been planned in the area of 12255.43 sq.m. of Jamia Milia Islamia campus.

TABLE 16: COST BENEFIT ANALYSIS

Component	Conventional Method	Green Building
Site Development	$ 22,076	$ 30581
Civil work	$ 17,30,659	$ 17,48,822
Sanitary installation and water supply	$ 76,495	$ 83,345
Sewerage and drainage	$ 26,352	$ 26,352
Rainwater Harvesting	-	$4082
Borewell	-	$3406
Total	**$ 19,62,833**	**$ 20,54,243**

The Cost of green building is estimated at **$ 20,54,243** and Cost of conventional building at **$ 19,62,833**. The extra cost for construction of Green building is 4.5% more than the conventional one. Though the cost of green building is more than the conventional one however the building designed has proved in significant reduction in water consumption (up to 45%) and Reducing energy consumption (compared to GRIHA benchmarks) while maintaining occupant comfort.

The total annual savings including lighting, Equipment, Ext lighting, Pumps Fans Heat Relaxation, cooling towards accounting to **54529 KW = $7656**. In long term, the benefits due to the green building will reach the break even in about 10 years which excludes the benefits such as low water consumption, and other benefits such as reduction in cooling loads due improved glazing specifications, better exterior design and better system.

6. Private Sector Investments in NbS

Biodiversity and ecosystem services are critical to the long-term sustenance of businesses. Indian businesses are recognising this and adopting various ecosystem-based approaches to reduce business impacts and dependencies on biodiversity[54]. The 2018 World Economic Forum's Global Risk Report places biodiversity loss and ecosystem collapse as top global risks.

India's gross domestic product (GDP) is expected to reach US$ 6 trillion by 2027 with the development of various business sectors. Rapid economic growth is an imperative for India and

[53] *Cost Benefits Analysis of 3 Star GRIHA Rating Hostel Building to Normal Conventional Hostel Building.pdf (ijesc.org)*

[54] *news-biz-2012-11-en.pdf (cbd.int)*

preservation of its natural resources on which these businesses and population are heavily dependent is equally important to ensure that growth is both inclusive and sustainable.

Corporate Social Responsibility of companies— both private and public—has become a key the sources of funding for sustainable development actions in India. Corporate investments in NbS solutions can be far less expensive than alternatives. Investments in natural systems-based approaches are equally effective and also more attractive for local surrounding communities—while offering multidimensional returns on investment (ROI).

An analysis of the investments made by the top 19 companies in India towards environment-based interventions shows an almost six times increase since 2015 (See Table 31). This is also consistent with the government's ramped up priorities for sustainable development. The CSR investment totalled to Rs 2,793 Crores by the aforementioned companies in the fiscal year 2018-19. Table 37 in the annexure summarizes the five-year trend in CSR investments by the top performing companies.

Aside from CSR, companies have also incorporated NbS related solutions within their business operations. Such solutions include renewable power generation, green procurement, climate resilient green infrastructure, water conservation and internalizing waste materials like fly ash etc in the manufacturing process in their business operations and supply chain. Leading firms have been revamping their production processes through eco-innovation to reduce GHG emissions and source inputs responsibly.

6.1. Sector-Wise Investment through CSR

We have analysed CSR investments in the seven NbS sectors—Water Security, Food Security, Energy Security, Forest and Biodiversity, Forest Land Restoration, Disaster Risk Reduction and Sustainable Habitats. Figures 2 and 3 present the investments in FY 2014-15 and FY 2018-19.

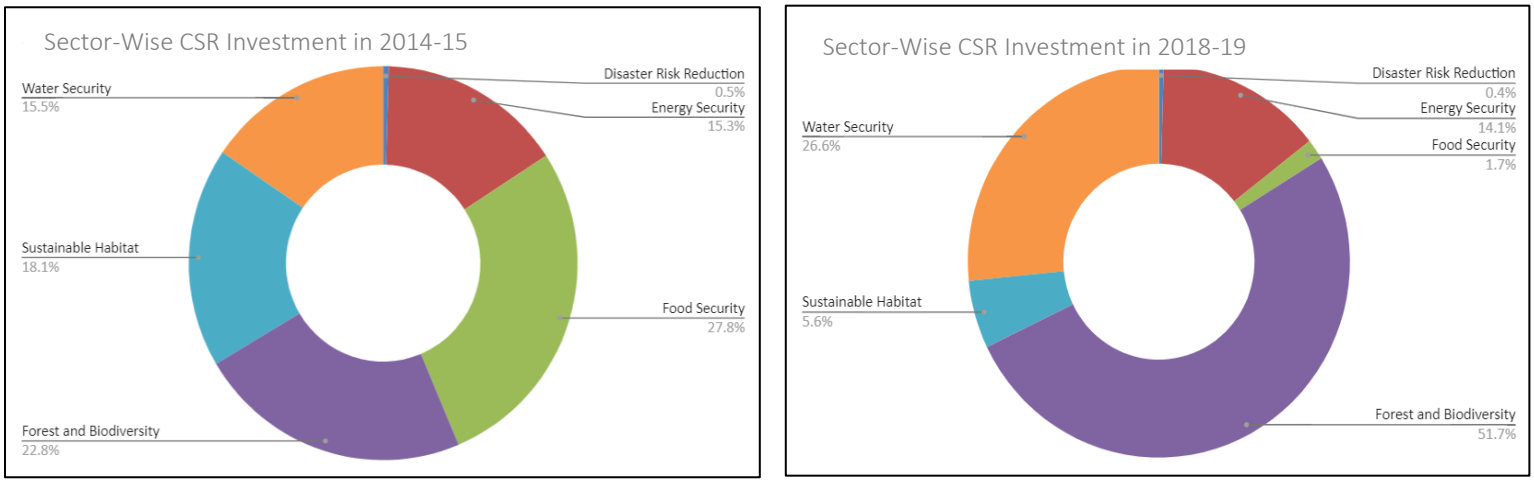


FIGURE 2: SECTOR WISE INVESTMENT IN FY 2014-15 AND FY 2018-2019.

Investment in Disaster Risk Reduction, Energy Security, Forest and Biodiversity Conservation and Water Security has increased significantly in the last decade. Forest and Biodiversity is the largest recipient of CSR resources followed by Sustainable Habitats and Energy Security.

Companies made the highest contribution in the following sectors through CSR in year 2018-19:

- **Water Sector** including water harvesting, conservation and restoration of reservoirs received a total $ 36.16 Million investment by the top CSR spending private firms.
- **Sustainable Habitat** that primarily encompasses projects based on mobility, urban waste management and green infrastructure received a total investment of $ 7.73 Million.
- **Forest (Including Land Restoration) & Biodiversity Conservation** practice received a total investment of $71.1 Million.
- **Food Security** projects that promoted good agricultural practices and nutrition received a total investment of $ 7.73 Million.
- **The Energy Sector** included projects in renewable energy production (Solar and Wind) received an investment of $ 19.37 Million.
- **Disaster Risk Reduction** that includes initiatives ensuring climate resilient infrastructure and hazard mitigation measures has witnessed a low yet appreciable increase in reception of funds from these private players. It received an amount of $ 0.55 Million.

The top CSR spenders in each sector in year 2018-19 were as follows:

- **Water Sector**- Hindustan Unilever Limited spent $17.32 Million in Water Conservation Projects (PAN India).
- **Sustainable Habitat**-HPCL-Mittal Energy Limited invested $7.95 Million in community infrastructure and environmental sustainability.
- **Forest and Biodiversity Conservation**- ITC limited assured environmental sustainability through protection of flora and fauna, animal welfare, agroforestry, conservation, by investing $42.04 Million in this sector
- **Food Security**- Mahindra and Mahindra invested $ 12.80 Million in micronutrient soil testing, dairy farming, permaculture farming, infrastructure development and capacity building resulting in improvement in agricultural productivity.
- **Energy Sector-** Infosys Ltd. Invested $1.83 Million in Biogas project, Ramanagaram, Karnataka.
- **Disaster Risk Reduction**- Bajaj Auto contributed $ 0.55 Million to disaster risk reduction and mitigation in Maharashtra

Table 17 shows the trends in investments across each of the study sectors. This trend provides evidence that the corporate sector spending through CSR in environmental and NbS related areas is increasing

TABLE 17: CHANGE IN INVESTMENT PROFILE OF PRIVATE FIRMS FROM 2014-15 TO 2018-19

Sector	Investment 2014-15 in Lakhs	Investment 2019-20 in Lakhs	% Change
Disaster Risk Reduction	150	400	166.66
Energy Security	4894.5	14137.5	188.8
Food Security	8882	5645.8	-36.4
Forest and Biodiversity	7268.9	51980	651
Sustainable Habitat	5758.5	5645.8	-2
Water Security	4941.7	26731.2	440
Total	**31895.563**	**104540.3**	**227**

6.2. Corporate Models (Non-CSR) that Enable NbS

An analysis of companies that directly or indirectly enable Nature-based Solutions through their core business operations and supply chains was conducted. The private sector has been investing in reducing dependency on fossil fuels by shifting to solar and wind power for their operations. Many firms have initiated measures like ground water recharge and water monitoring systems to reduce their water footprint throughout their operational systems chain.

Creating green and viable procurement regulations that help in sourcing sustainable products like FSC certified paper and boards and internalise manufacturing waste products like fly ash has also been seen to be a focal point of leading private firms throughout India.

Examples are:

1. **Ambuja Cement:** Almost 90% of their product portfolio is low carbon fly ash based PPC and Composite Cement. Other products like PuraSand, AAC Cool Wall Blocks, Ambuja Kawach, Ambuja Roof Plus, Composite Plus increase our portfolio of green products by using fly ash, slag, and other industrial wastes.
2. **Dr Reddy's Laboratories:** In partnership with Watershed Organisation Trust (WOTR), DRL embarked on a four-year project to build water harvesting structures within our site in Budhera to capture rainwater, reduce soil erosion and increase the infiltration of water into the aquifer below.
3. **Suzlon**: One Earth is Suzlon's state of art campus. Situated in Pune, India, it is the eco-friendly, self-sufficient headquarters of the company. The campus is spread across 10 acres and is completely powered by renewable energy, including hybrid wind turbines, solar panels and photovoltaic cells.
4. **Hindustan Unilever Ltd**: Committed to protecting the natural resources that help our business grow, in 2019, HUL sourced and used 100% sustainable paper and board for packing our products. Our resources come from Forest Stewardship Council (FSC) certified mills, thereby supporting our efforts to utilise lower grammage paper to reduce the overall consumption of paper and board.
5. **IKEA:** Since September 1st, 2015, all the cotton used for IKEA products has been responsibly sourced. It is called Cotton from More Sustainable Sources (CMSS) where

85% is Better Cotton and the rest is recycled cotton. This change in the supply chain took over a decade of determination and hard work. IKEA has also reached its 100% responsible sourcing target.

6. **DLF:** The business strategy revolves around fostering mutually beneficial relationships with all the stakeholders, including suppliers and contractors. It has designed an effective supply chain strategy, which is crucial to meet business objectives, DLF procures FSC- certified wood wherever required. Moreover, it procures locally extracted and recovered material to the maximum extent possible.
7. **Tata Chemicals Ltd:** Started Carbon Footprint ('CFP') and Water Footprint ('WFP') assessment for all its industrial sites. Based on these assessments, the Company has derived targets and strategies for climate change and water management.
8. **Toyota Bharat:** To reduce the environmental impact of its vehicles, Toyota introduced an Eco-Vehicle Assessment System to set environmental targets related to lifecycle carbon emissions and recyclability.
9. **JSW's**: Mining operations are strictly led by the mining plan submitted and approved by the Indian Bureau of Mines. It undertook fully scientific and environment-friendly mining practices, starting from topography development of the C-category mines. JSW currently installed a downhill conveyor, which significantly reduces the dust and other nuisances that may hinder community life around the sites.

According to the study "CSR and sustainability reporting practices in India: an in-depth content analysis of top-listed companies" by Aggarwal & Singh, 2018 GAIL Ltd, Cairn India Ltd. Tata Steel Ltd. Tata Motors Ltd., Tata Power Company Ltd. are the top five companies who have imbibed sustainability with in their business models. These are only a small selection to indicate that the corporate sector is ready for investments in Nature-based Solutions based on benefits that are generated for them as a result.

6.3. Financial Instruments for NbS

To assess different financial instruments used for NbS projects, 87 case studies were reviewed. It was found that the funding was largely dominated by Grants followed by loans and Green Bonds. Non-CSR funds from corporations have mostly contributed to energy security through renewable power generation, water harvesting and restoration of reservoirs and sustainable habitat creation.

It was found that a wide majority of all NbS case studies considered were funded through grants from state and national governments, grants and loans from public sector institutions like NABARD and IREDA and grants and low cost loans from international development finance institutions (DFIs) like USAID, World Bank, KFW, JICA, GEF etc.

In case of private sector financing, a bulk of the forestry and water related NbS were funded through CSR grants. Non-CSR funds from corporations have mostly contributed to energy security through renewable power generation.

Instruments such as equity financing used for funding solar power projects under the National Solar Mission and Indian rupee dominated Green Bonds like the one used by NTPC are also fast becoming mainstream instruments. Private companies like Tata Cleantech etc. have also raised money through issuing green bonds or obtaining concessional loans from banks to endow their environment projects.

In some cases, international DFIs provide capital to Indian financial institutions to setup dedicated lines of credit for specific NbS areas. Examples of this include the SIDBI-KFW energy efficiency scheme, NABARD-KfW credit for watershed development and soil conservation etc. In addition to the above, various multilateral and bilateral financing windows like GEF fund for environmental projects and GCF for climate adaptation and mitigation have also supported projects in India.

Private companies like Tata Cleantech etc. have raised money through issuing green bonds or obtaining concessional loans from banks to endow their environment projects.

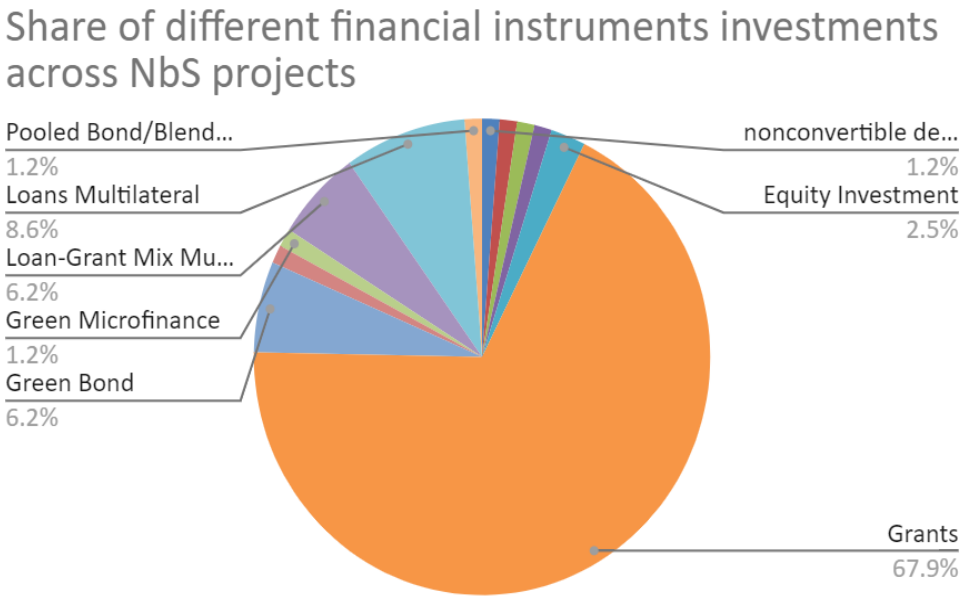


FIGURE 3:SHARE OF DIFFERENT INSTRUMENTS ACROSS NBS PROJECTS

Most energy projects have been focused on installation of solar power plants or ensuring energy efficiency for reducing GHG emissions. The water sector has received significant financial support in climate proof watershed development activities and water source protection by mitigating erosion and enabling harvesting. Investment in sustainable habitat initiatives include sustainable cities and urban transport, green waste management through segregation and bio-treatment and building resilience for agriculture and coastal livelihoods activities like inland fishing.

7. NbS Framework for Post-Covid-19 Recovery

The Covid-19 pandemic exposed the fragile dependency of human well-being on natural ecosystems and biodiversity and challenged global economies. Studies suggest that COVID-19 adversely affected all the sectors of the Indian economy in some degree or other[55]. The sectors that were affected the highest were manufacturing, tourism, aviation and retail, start-ups, MSME's, informal sector including migratory labour and agriculture. Reviving and rebuilding of economic activities are a key priority for post-COVID-19 recovery in India. The Government of India announced a $23.28 billion relief package in March 2020, and the Prime Minister added an additional $273 billion COVID relief package in May 2020 and yet another $ 31.72 billion comprehensive stimulus package in November 2020. Part of this stimulus package includes rural job creation through afforestation ($ 0.8 Billion), and production linked incentives for building domestic manufacturing capacity, such as battery storage ($2.67 Billion).

Creation of rural infrastructure assets through land, soil and water management as part of the MGNREGS, increased by 65 per cent to help migrant workers who have returned to their home states find livelihoods. The MGNREGA has been given an extra $ 5.4 billion, taking its allocation to $ 13.8 billion from the Budget figure of $8.4 billion. This package increased the total number of working days to 3 billion man-days, helping states provide increased employment opportunity. This program supports creating the basis for long-term climate resilience and environmental benefits.

Investment in agro-forestry and silvo-pastoral systems that can sustain a larger population and curb rural out-migration will aid in providing enhanced and inclusive livelihoods leading to food security. Investment in improved water infrastructure is a key priority for building resilience and it can also stimulate green growth, offering new jobs, and reduce the drain on the public purse from future epidemics.

The stimulus package, further introduced some measures to support renewable energy. It waived charges for interstate transmission of wind and solar power until December 2022, and the government of Andhra Pradesh has announced a Renewable Energy Export Policy, which establishes renewable energy equipment manufacturing facilities. Further, the government introduced 'Green Railway Initiative' which will increase electrification of trains, minimum thresholds for solar production from generators and bidders in the utility sector, loans to farmers to implement solar technologies on farms, incentives for solar panel and LED light manufacturing and the commissioning of new electric bus charging stations.

Other green stimulus measures include support for electric vehicles in Delhi, where the government is aiming to increase electric vehicles to 25% of all new vehicle registrations by 2024. India's Sustainable Alternative Towards Affordable Transportation (SATAT) initiative features $26.5 billion to set up 5,000 compressed bio-gas plants to boost the availability of

[55] *https://journals.sagepub.com/doi/full/10.1177/0972063420935541*

affordable and cleaner transport fuels. Currently, 1,500 of these plants have been approved and are at various stages of execution. India also committed to setting up 1,000 liquefied natural gas stations in the next three years. While liquefied natural gas generates less emissions than petroleum, it is not a renewable fuel.

As India continues to battle COVID-19, all these interventions and stimulus presents a renewed chance to move along a new 'greener' path of economic revival—one that will mitigate the negative consequences of climate change, and promote sustainable and inclusive development in the long run.

The role of government funding in the start-up sector or to support technology shifts to renewable energy is primary. Government expenditure on R&D has been stagnant for the past two decades at 0.6-0.7 percent of GDP. With the push for 'Aatma Nirbhar Bharat' (self-reliant India), developing such an ecosystem should be a priority. Scarce government resources can be used to support efforts in areas that may reap the highest social benefits.

India can invest in local manufacturing such as of solar modules which is currently heavily reliant on imports from China. India has also levied an import duty on solar cells, modules and inverters. Securing the supply chain in the solar industry would require focused and transparent policy affecting the entire value chain, from raw material, technological know-how, skilled personnel, strong R&D, quality of products to availability of low-cost finance. Skills development programmes such as 'Suryamitra' focus on the rural youth so they can access more opportunities for employment. Such programs could be enhanced to include hand-holding support to foster energy entrepreneurs.

Similarly, India's electric mobility plan requires large investments that would need tapping into sources such as green bonds and foreign funds. The vast size of the market that India offers could prove to be an opportunity to a green transition in mobility, with electric vehicles (EVs) as one of the central sectors. Public private partnership models in mobility can push for a path of faster adoption of EVs that can result in positive health and environmental outcomes. To begin with, India's entire passenger traffic is dominated by the road sector. Moreover, its urban population is expected to touch 50 percent by 2050. These twin patterns make it imperative for India to rethink mobility.

Advancement in agricultural productivity, infrastructural investments and efficiency have both economic and social benefits. The COVID-19 pandemic led to a disruption of supply chains in the food system. The government, in the third tranche of the stimulus package, announced the allocation of $13.69 billion for the creation of infrastructure for agriculture such as cold storage. Investment in infrastructure would help strengthen resilience for farmers against changes in demand and disruptions in supply chains.

The stimulus provided to NbS related areas needs to be supported with suitable technical capacity. Investments that flow into priority economic sectors can also be greened through NbS

approaches and greening of value chains, which will require further research and evidence generation.

8. Summary and Recommendations

Nature-based Solutions provide a unified framework for business and policy for restoring and enhancing the natural capital that is vital to protecting biodiversity, and combatting climate change. When nature is placed at the heart of economic, environmental and social decision making, various priorities of sustainable development can be met simultaneously.

The 134 NbS and Hybrid NbS approaches analysed in this study provide valuable insight into the extent of benefits NbS can generate across sectors. The scoring methodology allows decision-makers various options to assess the effectiveness of case studies and associated package of interventions across many direct and indirect benefit indicators. The indicators proposed have been mapped sectorally to ensure that the scores reflect all potential benefits and co-benefits a given project might yield. Decision makers can interpret a high score given to design and implementation of a case study (provided as a cumulative score in Annexure 3) to mean that such projects have the buy in of all stakeholders including marginalized communities, government and civil society, which collectively implies greater possibility for sustainable impact. A high cumulative score on benefits and indirect benefits can enable decision makers to see the wide range of benefits investment decisions in a given set of NbS interventions will generate. As stated earlier, the actual benefits derived from such case studies may extend beyond the list of benefits scored. Finally, interventions with the highest scores for contribution to climate change mitigation, adaptation, disaster risk reduction and biodiversity protection can enable decision makers to identity investments in such national and global priorities.

The criteria and indicators across six key sectors and case study scores, provide a new framework to ascertain the effectiveness of various Nature-based Solutions through qualitative indicators. This is especially useful when working with studies that provide limited quantitative data on costs and benefits. The study methodology proposed can also be expanded to other sectors such as public health etc. for further analysis.

For Forest (Including Land Restoration) and Biodiversity Conservation, and Water Security sectors, a range of Nature-based Solutions are already being implemented at large scale. However, given the challenges of monitoring and transparency of such investments. there is a need to invest in data-driven approaches that are cost effective, result oriented, and include robust monitoring of outcomes. This would require development of dynamic data portals such as the one developed for Sikkim to report on its GHG Inventory and climate actions—Sikkim Climate Inventory Monitoring System (SCIMS). The portal estimates and generates reports of the annual Greenhouse Gas (GHG) inventory by sources and sinks (CO_2, CH_4 and N_2O and their CO_2-eq. numbers) and monitors the impact of the mitigation or sequestration actions. Large-scale eco restoration projects could be taken up with the involvement of communities, Ensuring that industries that depend on natural ecosystems for their primary economic activity, such as ecotourism, are included in early support and recovery packages during and after

COVID-19 will discourage shifts to informal economic activity and the illegal extraction of natural resources, which undermine the long-term sustainability of these sectors.

Investments in agro-forestry and silvo-pastoral systems that can sustain more people and stem rural out-migration could aid in reducing sudden pressures on the agriculture sector due to challenges such as COVID-19 as unemployed and 'out of employment' labour force went back to their villages in a mass exodus from cities. More efficient value chains for agro-forestry products combined with higher quality planting material are needed. Cities could involve urban agriculture in their landscape planning as a means to improve food accessibility and to promote local markets, consumption and commerce.

The Food security sector contributes significantly to the overall national GHG emissions, its role in climate mitigation potential has been receiving increasing attention, particularly through improvements in land-use management, manure management, livestock management, Soil-based strategies etc. The adoption of NbS for just three activities—fertiliser use, zero-tillage and rice-water management—could provide more than 50% of the total climate mitigation potential of the agriculture sector. There is a need to generate region specific evidence of the effectiveness of these practices to support greater adoption and policy action.

India has ambitious clean energy targets and looking to achieve 450 GW capacity in renewables by 2030. India has also been promoting energy efficiency through various schemes and is making a major push for electric mobility vehicles and cooking appliances. However, there is still a need for extensive R&D (specially in various classes of EVs, including the battery, hybrid and fuel cell vehicles) and capacity building in development of renewable energy solutions coupled with the financing of these at the micro level.

The best way to tackle DRR is through prevention and adaptation response that minimizes disasters and their associated effects, such as - Scale up national Greening programmes; Wetland restoration and management and Protection of forest cover and landscape planning. The funding required to catalyse NbS at large scale specially to tackle immediate risk mitigation measures, remains a challenge in India. Leveraging local resource, traditional knowledge and know-how and promoting sustainable lifestyle through behaviour change should form an integrate part of overall NbS in India. This requires massive investment in capacity building and awareness programs.

Developing sustainable habitats requires cross-sectoral design, technology and process innovations to align shelter, transportation and livelihood services with conservation of natural resources upon which the habitat depends. Since India is one of the fastest growing economy in the world and is expected to be one of the top three economic players in the next 10-15 years, investing in development of roadmaps for blue and green spaces under NbS such as biophilic cities (cities that invest heavily in restoring and growing natural areas), real time mapping of carbon footprints, carbon sequestration potential of an area, and designing NbS targeted towards the societal challenges (following the latest IUCN standard for NbS) will be key to increasing urban resilience and opening new opportunities and green jobs. Shared public

transportation, designing of walkable cities and promotion of bicycle friendly infrastructure are also important investments to consider for long term sustainable development in India. As a country that leapfrogged into the smartphone revolution almost overnight from almost no telephone connectivity, India has the agility and the ability to embrace a new paradigm for sustainable development that is rooted in Nature-based Solutions.

Smart technologies to enable sustainable transitions, from IoT water sensors and monitors, to early warning systems, to on-demand Agri-advisory to smart energy meters are all an important facilitating ecosystem for hybrid NbS that should be considered when investing. A further analysis of which technologies are based suited to be aligned with NbS to derive maximum short term is warranted. Assessing the technological basis of an intervention to extrapolate its relationship to scalability and affordability, may also require a separate categorization of technologies.

The current investments by FCDO range across providing infrastructure reforms, research grants in health sector, and technical assistance in strengthening policy and regulatory framework to create financing solutions for infrastructure projects. In addition, FCDO is working to improve the impact of Government programs such as MGNREGS, CAMPA and Smart City Mission by helping develop climate-resilient infrastructure to increase income and build resilience to climate shocks, provide access to better quality transport, ecosystem conservation, clean energy, and basic urban services for households and businesses, through loans to private sector-led infrastructure projects. FCDO also has been providing technical assistant in delivering smart urbanisation, and removal of market access barriers for raising finance for urban infrastructure, and supporting structural reform in the Indian Power Sector to improve the efficiency, reliability, and sustainability of electricity supply.

This study would enable FCDO to align investments under a benefits-centric approach. It provides a clear understanding of the criteria that investments must meet in order to create positive environmental, social and economic benefits. As stated in sectoral analyses, a carefully planned strategy for intervention selection based on NbS can have multiple benefits.

9. Annexures

9.1. Summary of Expert Consultations

1.	Mr. Raj Kumar Srivastava IFS, APCCF NAP & Bamboo Mission, Karnataka Forest Department
	Key points : 1. He said that everything that aligns with nature and helps it regenerate can be termed as a nature-based solution. 2. Also stressing the grade of technology used in a project and evaluating whether a project is a good NbS or not, seemed redundant according to him. This is because everything then and now uses some kind of technology. Lastly, he gave us a closing insight into funding for NbS . 3. He discussed with the panel that development funding, public finance and CSR may not invest heavily in NbS projects as the aforementioned takes some time to create benefits for the environment and society. 4. However, both public and private players are interested in tangible gains in a short period of time which is generally less than 5 years. Hence, the approach for funding also needs to evolve.
2.	Dr P. P. Bhojvaid, Ex. PCCF & HoFF, Haryana
	Dr Bhojvaid advised to 1. Look at some past studies where clarity of indicators and criteria for every intervention can be brought therefore, he gave us some references of studies done by the Institute of Economic Growth. 2. Then he shed light on the regional aspect of a case study where a project may or may not capture different geographical zones at one go. Also, it depends on the reporting and backdrop of the project whether the regional impact was explicitly mentioned or not. 3. Further, he added that though policy document in every sector is a good reference to follow, how much of it has been converted to action on the ground and had made way for projects to take support from the policy infrastructure is a substantial comparative to take into account. 4. Finally, he concluded by suggesting that measuring the replicability of a project on a temporal or graphical basis can serve as an acid test of whether the intervention is scalable or not.
3.	Dr. Madhu Verma, Chief Economist, WRI India
	Dr Madhu Verma, after presenting our report and point of view for analysis, we asked for her inputs especially for the rigorous understanding of what a NbS is and whether our methodology captures everything relevant? 1. She added on strengthening policy, institutional and market references provided in the report based on classical economics approach. 2. She also emphasized to look deeply into the indirect or in her words the invisible benefits each intervention provides. 3. In her understanding, our scope of inclusivity criteria in the methodology was not clear and needed a better explanation. 4. She asked us to take the purview of the case studies in a holistic view, including a focus on various linkages in the system of the project with market and suitability for investment. 5. According to her there needed to be a quantification of the extent to which each project has complied with a given SDG, rather than just mentioning a loose association with the former.
4.	Archana Chatterjee, Project Manager at IUCN-India Country Office
	1. She suggested that we should use IUCN standard as the guiding document for selection of criteria and indicator. 2. Selection of technology can play a major role in scalability hence should be considered as one of the important aspects. 3. Giving low scores to technology might lead to a wrong precedence towards the use of technology in Nature based solutions 4. All the criteria and indicator may be given equal weightages to start with.

9.2. Policy frameworks enabling NbS

NAPCC	NDC	SDG	CBD-NBT	Specific Actions
National Solar Mission **National Mission for Enhanced Energy Efficiency**	Goal 3: Reducing Emission intensity of Gross Domestic Product (GDP) Goal 4: Promote non fossil fuel-based energy Goal 7: Mobilise funds for climate mitigation and adaptation	7: Affordable & Clean Energy 11: Sustainable Cities & Communities 13: Climate Action	NBT 1: By 2020, a significant proportion of the country's population, especially the youth, is aware of the values of biodiversity and the steps they can take to conserve and use it sustainably NBT 2: By 2020, values of biodiversity are integrated in National and State planning processes, development programmes and poverty alleviation strategies	1.“India Component” of the NDC – Transport Initiative for Asia (TIA) Objectives: Help promote electric mobility in India and support development of policies and regulations to promote electric vehicle charging infrastructure 2. Green Highway Policy 3. FAME India (Faster adoption and manufacturing of hybrid electric vehicles) 4. Promote "Sustainable Lifestyle" based on need-based consumption 5. 100 Smart Cities Mission 6. Atal Mission for Rejuvenation and Urban Transformation 7. National Adaptation Fund 8. Reduction in fossil fuel subsidies 9. Coal cess increased from INR 50 to INR 200 per ton 10. Tax free infrastructure bonds introduced for renewable energy
National Mission on Sustainable Habitat	Goal 3: Reducing Emission intensity of Gross Domestic Product	3: Good Health & Well-Being 6: Clean Water &	NBT 3: Strategies for reducing rate of degradation, fragmentation and loss of all natural habitats are finalized and actions put in	1. 100 Smart Cities Mission 2. Atal Mission for Rejuvenation and Urban Transformation

	(GDP) Goal 8: Create frameworks for innovative climate technology	Sanitation 7: Affordable & Clean Energy 11: Sustainable Cities & Communities	place by 2020 for environmental amelioration and human well-being.	3. National Adaptation Fund
National Water Mission	Goal 1: Promote healthy and sustainable living Goal 2: Adopt a climate friendly path Goal 6: Enhance investment in development programmes in vulnerable sectors	3: Good Health & Well-Being 6: Clean Water & Sanitation 10: Reduced Inequalities	NBT 5: By 2020, measures are adopted for sustainable management of agriculture, forestry and fisheries NBT 8: By 2020, ecosystem services, are enumerated and measures to safeguard them are identified	1. Jal Shakti Abhiyan 2. Jal Jeevan Mission
National Mission for Sustaining Himalayan Ecosystem	Goal 1: Promote healthy and sustainable living Goal 2: Adopt a climate friendly path Goal 3: Reducing Emission intensity of Gross Domestic Product (GDP) Goal 6: Enhance investment in development programmes in vulnerable sectors	13: Climate Action 14: Life Below Water 15: Life on Land	NBT 3: Strategies for reducing rate of degradation, fragmentation and loss of all natural habitats are finalized and actions put in place by 2020 for environmental amelioration and human well-being. NBT 4: By 2020, invasive alien species and pathways are identified and strategies to manage them developed so that populations of prioritized invasive alien species are managed NBT 5: By 2020, measures are adopted for sustainable management of agriculture, forestry and fisheries NBT 6: Ecologically representative areas on land and in inland waters, as well as coastal and marine zones, are conserved effectively	1. 100 Smart Cities Mission 2. Atal Mission for Rejuvenation and Urban Transformation 3. National Adaptation Fund 4. Pradhan Mantri Krishi Sinchayee Yojna - IWMP

			and equitably, covering over 20% of the geographic area of the country, by 2020 NBT 8: By 2020, ecosystem services, are enumerated and measures to safeguard them are identified NBT 9: By 2015, Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization as per the Nagoya Protocol are operational, consistent with national legislation NBT 11: By 2020, an effective, participatory and updated national biodiversity action plan is made operational at different levels of governance. NBT 12: By 2020, opportunities to increase availability of financial, human and technical resources to facilitate effective implementation of the Strategic Plan for Biodiversity 2011–2020 and national targets are identified and Strategy for Resource Mobilization is adopted	
National Mission for a Green India (GIM)	Goal 5: Create additional carbon sink through additional forest and tree cover	13: Climate Action 15: Life on Land	NBT 4: By 2020, invasive alien species and pathways are identified and strategies to manage them developed so that populations of prioritized invasive alien species are managed NBT5: By 2020, measures are adopted for sustainable management of agriculture, forestry and fisheries NBT 6: Ecologically representative areas on land and in inland waters, as well as coastal and marine zones, are conserved effectively and equitably, covering over 20% of the	1. Finance Commission (FC) Incentive for creation of carbon sink: devolution of funds to states from federal pool (attached 7.5% weight to area under forest) 2. Reduction in consumption of wood/ biomass as fuel 3. Funds from CAMPA: $ 6 billion proposed to be given to States 4. Other policies include: REDD-plus, National Agro-forestry Policy (NAP), JFM and National Afforestation Programme

			geographic area of the country, by 2020 NBT 9: By 2015, Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization as per the Nagoya Protocol are operational, consistent with national legislation	
National Mission for Sustainable Agriculture	Goal 1: Promote healthy and sustainable living Goal 2: Adopt a climate friendly path Goal 3: Reducing Emission intensity of Gross Domestic Product (GDP) Goal 5: Create additional carbon sink through additional forest and tree cover Goal 6: Enhance investment in development programmes in vulnerable sectors Goal 7: Mobilise funds for climate mitigation and adaptation	1: No Poverty 2: Zero Hunger 3: Good Health & Well-Being 12: Responsible Consumption & Production 13: Climate Action 14: Life Below Water 15: Life on Land	NBT 4: By 2020, invasive alien species and pathways are identified and strategies to manage them developed so that populations of prioritized invasive alien species are managed NBT 5: By 2020, measures are adopted for sustainable management of agriculture, forestry and fisheries NBT 7: By 2020, genetic diversity of cultivated plants, farm livestock and their wild relatives, including other socioeconomically as well as culturally valuable species, is maintained, and strategies have been developed and implemented for minimizing genetic erosion and safeguarding their genetic diversity NBT 8: By 2020, ecosystem services, are enumerated and measures to safeguard them are identified NBT 9: By 2015, Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization as per the Nagoya Protocol are operational, consistent with national legislation NBT 11: By 2020, an effective, participatory and updated national biodiversity action plan is made operational at different levels of governance.	1. Pradhan Mantri Krishi Sinchayee Yojna for efficient irrigation 2. Paramparagat Krishi Vikas Yojna for organic farming 3. Neeranchal-watershed development 4. National Initiative on climate Resilient Agriculture 5. Bureau for Water Use Efficiency 6. National Agroforestry Policy

			NBT 12: By 2020, opportunities to increase the availability of financial, human and technical resources to facilitate effective implementation of the Strategic Plan for Biodiversity 2011–2020 and the national targets are identified and the Strategy for Resource Mobilization is adopted	
National Mission on Strategic Knowledge for Climate Change	Goal 2: Adopt a climate friendly path Goal 6: Enhance investment in development programmes in vulnerable sectors Goal 7: Mobilise funds for climate mitigation and adaptation	13: Climate Action	NBT 1: By 2020, a significant proportion of the country's population, especially the youth, is aware of the values of biodiversity and the steps they can take to conserve and use it sustainably NBT 2: By 2020, values of biodiversity are integrated in National and State planning processes, development programmes and poverty alleviation strategies NBT 9: By 2015, Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization as per the Nagoya Protocol are operational, consistent with national legislation NBT 10: By 2020, an effective, participatory and updated national biodiversity action plan is made operational at different levels of governance NBT 12: By 2020, opportunities to increase the availability of financial, human and technical resources to facilitate effective implementation of the Strategic Plan for Biodiversity 2011–2020 and the national targets are identified and the Strategy for Resource Mobilization is adopted	1. Critical technologies need to be facilitated via GCF 2. Global Collaboration in R&D 3. Preliminary and illustrative list of selected technologies given in India's INDC

9.3. SCORING MATRIX

Water Security		Project Design						Project Implementation						
		Inclusive			Scalability			Governance			Cost Effectiveness			
Case Studies	Interventions	Stakeholder (Community) Engagement in planning	Equality- Key Stakeholder needs were included	Inclusion of marginalized communities and Gender	Replicability across geographies Nation-wide: 3 Regional: 2 Local: 1	Use of Technology to aid wider deployment (High-3)	Policy Driven	Local Government Buy-in	Monitoring body/ structure for implementation	Transparency: Third party assessment/Audits	Low-cost inputs	Local resources to offset implementation costs (Labour + Knowledge)	Leverages Public Private Partnership model	Total Score based on design and implementation indicators
East Godavari River Estuarine Ecosystem (EGREE) Foundation	-Employment generation and livelihoods enhancement, -Sustainable communities and disaster risk reduction, -Climate-resilient food and agriculture, -Coastal and marine biodiversity and conservation	1	1	1	2	2	1	1	1	1	0	1	1	13
Rukmavati River Basin Management Project – India	-Installed drip irrigation systems, -Training on composting; -De-silting carried out on 32 structures; -Moisture conservation measures carried out on 473 hectares of pasture,	1	1	1	2	2	1	1	1	1	1	1	1	14
Community-led Watershed Restoration in India, WOTR, WRI Maharashtra	-Harvest rainwater and capture it as soil-moisture, ground water, or surface water conservation dams, bunds, -Afforestation, -Crop rotation, -Intercropping, -Capacity building	1	1	1	3	1	1	1	1	1	1	1	1	14

Sustainable Land Water and Biodiversity Conservation and Management for Improved Livelihoods in Uttarakhand Watershed Sector	-Watershed planning through community participation -Controlling land degradation through the SLM approach at watershed level -Fostering markets for NTFPs	1	1	1	3	2	1	1	1	1	1	1	1	15
East Kolkata Wetlands (Managing wetlands for multiple purposes)	-Managing wetlands better -Cleaned water sustain fish farms and agriculture -Solid waste management and sewer treatment system	1	1	0	2	1	1	1	1	1	1	1	0	11
Rally for Rivers — A Movement to Revitalize India's Dying Rivers	-Community Mobilisation, -Soil and Water Conservation, -Biodiversity Conservation	1	0	0	2	2	1	0	0	1	1	1	1	10
Ground Water Recharge and Solar Micro Irrigation to Ensure Food Security and Enhance Resilience in Vulnerable Tribal Areas of Odisha	-Ground Water Recharge shafts) -Resilient crop planning(through irrigation), -Use of solar pumps for irrigation, -Capacity Building	1	1	1	2	3	1	1	1	1	1	1	0	14
Efficient Water Management and agriculture technology adoption for climate adaptive and	-SCI in paddy and wheat for 5500 farmers, -Adaptive agriculture practices in pulses , -Inter cropping of pulses, -Adaptive agriculture for cash crops, -Seed & Input, -Efficient water	1	1	1	2	2	1	1	1	1	1	2	0	14

resilient farming systems in 51 villages of Nandurbar and Buldhana districts of Maharashtra State	conservation measures, -Climate resilient appropriate technologies -- (Drip Irrigation,)													
Dhara Vikas-Reviving the springs of Sikkim	-Hydrogeological Modeling -Village Level Planning -Using MGNREGA funds to build water recharge ponds -Capacity Building	1	1	1	1	2	1	1	1	1	1	1	0	12
Spring-shed development works for rejuvenation of springs for climate resilient development in the water stressed areas of Meghalaya	-Capacity Building -Building Treatment of 306 spring sheds, Soil water Conservation, --Capacity Building and water conservation	1	1	1	1	2	1	1	1	1	1	1	0	12
Addressing Climate Change Vulnerability of Water Sector at Gram Panchayat level in Drought prone areas of Sikkim	-Training and Capacity Building, (Village Water Security Plan Training), -Roof top water harvesting structures, -Construction of solid waste recovery, -Horticulture and fodder development (Plantation)	1	1	1	2	1	1	1	1	1	1	1	0	12
Centre for Aquatic Livelihood Jaljeevika	-Technologies like cage fisheries, re-circulatory aquaculture systems, fish seed rearing, etc., using local resources are adopted by farmers. -Information technology-based products like fish farmers advisory app, -IVR system for voice call and solving problem for	1	0	0	3	2	1	1	1	1	0	1	0	11

	farmers, -Open source market linkages platform for farmers and market functionary													
Building Adaptive Capacities of Small Inland Fishermen Community for Climate Resilience and Livelihood Security, Madhya Pradesh, India	-Increase in water retention capacity - adaptive measure to address rainfall variability -Modifying technical specification of the tanks, -Diversification of fish species and temperature regulation of ponds, -Climate resilient small pond fisheries through productivity enhancement by capacity building and -Institutional linkages and preparation and dissemination of evidence based resilient climate change adaptation strategies	1	1	1	2	1	1	1	1	1	1	1	0	12
Restoration of lake using native plants and traditional methods	-Phytoremediation techniques & -Regular clean-up drives of plastic removal & recycle campaigns that resulted in increase in catchment area of lake. -Vegetable garden & papaya garden at lake, creating composts for all types of biodegradable materials, planting	1	0	0	2	2	0	0	0	1	1	2	1	10
Nature-based Solutions to conserve water in Rajasthan	-Rainwater Harvesting-RURAL	1	1	1	2	3	1	1	1	1	1	1	0	14
Enhancing climate resilience of India's coastal communities	-Developing Climate Resilient Urban Centers. coastal ecosystems – such as mangroves, seagrass beds, forested watersheds,dunes and coral reefs - "blue carbon" sequestered in intertidal ecosystem	1	1	1	2	1	1	1	1	1	0	1	0	11

	-Community-based conservation and restoration of coastal ecosystem, -Promote climate-adapted livelihood options.													
Conservation and Management of Coastal Resources as a Potential Adaptation Strategy for Sea Level Rise	-Stakeholder mobilization and organization, -Capacity building for coastal protection and livelihoods, Component - Restoration of degraded mangroves in 200 ha along the Krishna estuary ,, -Demonstration of Integrated mangrove based fishery livelihoods ,	1	0	1	2	1	1	1	1	1	1	1	0	11
Climate Proofing of Watershed Development Projects in the States of Tamil Nadu and Rajasthan	-Farm pond, catch pit, well recharge pit and other water harvesting structures.: -Increased availability of fodder/fuel through afforestation & pasture land development. -Better energy management through adoption of energy efficient systems. -Installation of Automatic Weather Stations and generation of agro advisories. -Improved risk mitigation measures with Geo-hydrological study and crop-water budgeting	1	0	1	2	2	1	1	1	1	1	1	0	12
Enhancing Adaptive Capacity and Increasing Resilience of Small and Marginal Farmers in Purulia and Bankura Districts of West Bengal	-Climate-adaptive livelihoods and value chains to increase the climate resilience	1	1	1	2	1	1	1	1	1	1	1	0	12

Hydroponic float-farming in Majuli	-Hydroponic tray cultivation, -Integrated aquafarming,	1	0	0	1	2	0	1	1	1	0	1	1	9
Nature based solutions to conserve water in Rajasthan	-Landscape restoration of local water cycles and water resources.	1	1	0	2	1	0	0	1	0	1	2	0	9

Water Security	Impact																					
	Direct and Indirect Benefits																					
Case Studies	Ground Water Recharge	Water Availability	Carbon Sequestration	GHG Emission Reduction	Decreased salinization	Reduced Water Pollution	Sustainable Supply Chains Created	Employment Generation	Capacity Building	Livelihood Enhancement	Soil and Water Conservation	Flood/Drought / Cyclone Management	Enhanced Aesthetic / Cultural Value	Erosion Control	Sediment Reduction	Biodiversity Conservation	Secure Habitat	Total Score on Benefits based on case study	Total	Climate Adaptation	Climate Change Mitigation	Disaster Risk Reduction	Biodiversity Protection
East Godavari River Estuarine Ecosystem (EGREE) Foundation	1	1	1	1	0	1	1	1	1	1	1	1	0	0	0	1	1	13	**26**	8	2	1	2
Rukmavati River Basin Management Project – India	1	1	1	0	0	0	1	1	1	1	1	1	0	1	1	0	1	12	**26**	4	1	1	1
Community-led Watershed Restoration in India, WOTR, WRI Maharashtra	1		1	0	0	1	1	1	1	1	1	1	0	1	1	0	0	11	**25**	5	1	1	0
Sustainable Land Water and Biodiversity Conservation and Management for Improved Livelihoods in Uttarakhand Watershed Sector	1	1	1	0	0	0	1	1	1	1	1	0	0	1	0	1	0	10	**25**	4	1	0	1
East Kolkata Wetlands (Managing wetlands for multiple purposes)	1	0	1	0	0	1	1	1	1	1	1	1	1	0	0	1	1	12	**23**	5	1	1	2

Rally for Rivers — A Movement to Revitalize India's Dying Rivers	1	1	1	1	0	1	0	1	1	1	1	1	0	0	0	1	1	12	**22**	4	2	1	2
Ground Water Recharge and Solar Micro Irrigation to Ensure Food Security and Enhance Resilience in Vulnerable Tribal Areas of Odisha	0	1	1	0	0	0	1	1	1	1	0	1	0	0	0	0	1	8	**22**	2	1	1	1
Efficient Water Management and agriculture technology adoption for climate adaptive and resilient farming systems in 51 villages of Nandurbar and Buldhana districts of Maharashtra State	1	1	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	8	**22**	5	0	0	0
Dhara Vikas- Reviving the springs of Sikkim	1	1	1	0	0	1	0	1	1	1	1	0	0	0	0	0	1	9	**21**	4	1	1	1
Spring-shed development works for rejuvenation of springs for climate resilient development in the water stressed areas of Meghalaya	1	1	1	0	0	1	0	1	1	1	1	0	0	0	0	0	1	9	**21**	4	1	0	1
Addressing Climate Change Vulnerability of Water Sector at Gram Panchayat level in Drought prone areas of Sikkim	1	1	0	0	0	1	0	1	1	1	1	1	0	0	0	0	0	8	**20**	4	0	1	0

Centre for Aquatic Livelihood Jaljeevika	0	1	1	0	0	0	1	1	1	1	0	0	1	0	0	1	1	9	**20**	2	1	0	2
Building Adaptive Capacities of Small Inland Fishermen Community for Climate Resilience and Livelihood Security, Madhya Pradesh, India	1	0	0	0	0	0	1	1	1	1	0	1	0	0	0	1	0	7	**19**	3	0	1	1
Restoration of lake using native plants and traditional methods	1	0	1	0	0	1	0	0	1	1	1	0	1	0	0	1	1	9	**19**	4	1	0	2
Nature-based Solutions to conserve water in Rajasthan	1	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	1	5	**19**	2	1	0	1
Enhancing climate resilience of India's coastal communities	0	0	1	0	0	0	1	1	1	1	0	1	0	0	0	0	1	7	**18**	2	1	1	1
Conservation and Management of Coastal Resources as a Potential Adaptation Strategy for Sea Level Rise	1		0	0	1	0	1	1	1	1	0	1	0	0	0	0	0	7	**18**	3	0	1	0
Climate Proofing of Watershed Development Projects in the States of Tamil Nadu and Rajasthan	1		0	0	0	0	1	1	1	1	0	1	0	0	0	0	0	6	**18**	3	0	1	0
Enhancing Adaptive Capacity and Increasing Resilience of Small and Marginal Farmers in Purulia and	1		0	0	0	0	1	1	1	1	0	1	0	0	0	0	0	6	**18**	3	0	1	0

Bankura Districts of West Bengal																						
Hydroponic float-farming in Majuli	0	1	1	0	0	0	1	1	1	1	0	0	0	0	0	1	0	7	**16**	2	1	0	1
Nature based solutions to conserve water in Rajasthan	1	1	0	1	0	0	0	0	1	0	1	1	0	0	0	0	0	6	**15**	2	1	1	0

Food Security		**Project Design**						**Project Implementation**						
		Inclusive			**Scalability**			**Governance**			**Cost Effectiveness**			
Case Studies	**Interventions**	**Stakeholder (Community)Engagement in planning**	**Equality-Key Stakeholder needs were included**	**Inclusion of marginalized communities and Gender**	**Replicability across geographies Nation-wide: 3 Regional: 2 Local: 1**	**Use of Technology to aid wider deployment (High-3)**	**Policy Driven**	**Local Government Buy-in**	**Monitoring body/ structure for implementation**	**Transparency: Third party assessment/Audits**	**Low-cost inputs**	**Local resources to offset implementation costs (Labour + Knowledge)**	**Leverages Public Private Partnership model**	**Total Score based on design and implementation indicators**
Climate Resilient Interventions in Dairy Sector in Coastal and Arid Areas in Andhra Pradesh	-Underground storage tanks, -Cattle hostels -Artificial insemination -Technical support/Weather stations	1	1	1	2	3	1	1	1	1	0	1	1	14
Increasing Adaptive Capacity to Climate Change through Development of Climate-Smart Villages in Select Vulnerable Districts of Madhya Pradesh	-Sowing drought tolerant variety of field crops -Crop diversification with cultivation of drought tolerant fodder crop and -Establish of Fodder bank at community level -Construction of lined farm pond -Cultivation of crops on Broad bed furrow -Direct seeded rice cultivation -Alternate wetting and drying irrigation in rice field -Crop residue management -Nutrient Management -Site and crop specific nutrient management based on green-seekers (Leaf	1	1	1	2	3	1	1	1	1	0	2	0	14

	colour chart) -Promotion of zero tillage -Application of macro and Micro-nutrients in farmers field -Promotion of crop residue mulching/plastic mulching -ICT- Insurance -Establishment of Agro-advisory -Weather based crop Insurance -Two-way Information Exchange -Installation of Automated Weather Monitoring station -ICT based value-added weather advisory													
Watershed development	-Water harvesting structures like check dams, percolation tanks, farm bunds, etc were built to store water from run-offs and rainfall.	1	1	1	2	2	1	1	1	1	0	2	1	14
Organic Farming	-No use of chemicals. -Used cow urine with neem extract as pesticide. -Organic waste as manure.	1	1	1	3	3	1	1	1	1	0	2	1	16
Ground Water Recharge and Solar Micro Irrigation to Ensure Food Security and Enhance Resilience in Vulnerable Tribal Areas of Odisha	Ground Water recharge system for concrete adaptation -Renovation of Community Tanks -Integration of solar pumps for Irrigation -Capacity Building of stakeholders -Quality Management and Monitoring -Knowledge management	1	1	1	3	3	1	1	1	1	1	1	0	15
Zero Budget Natural Farming in India	-Mixed cropping, -Inter-cropping, -Border cropping, and -Bund cropping techniques	1	1	1	3	2	1	1	1	1	1	2	1	16
Urban Farming	-Barren area into a new garden -Planted seeds in a pvc split channels. -Used drip irrigation, compost and other bio-fertilizers	1	1	1	3	3	1	1	1	1	0	1	1	15
Sustainable Livelihoods of Agriculture-Dependent Rural Communities in Drought Prone District of Himachal Pradesh through Climate Smart Solutions	-Inter cropping -Weather insurance -Capacity Building -SRi Cultivation	1	1	1	2	3	1	1	1	1	0	2	0	14
Sustainable Agriculture Development through Expansion, Enhancement and Modelling	-Soil Improvement, -Bunds -Rain water harvesting structures, -Restoration of community tanks	1	1	1	2	2	1	1	1	1	1	2	0	14

Soil protection and rehabilitation of degraded land in India	-Intercropping. -Crop intensification, -Composting, -Vermicomposting -Kitchen Garden, -Pasture Lana Management -Manure Management etc.	1	1	0	3	3	1	1	1	1	1	1	0	14
Promotion of Integrated Farming System of Kaipad and Pokkali in coastal wetlands of Kerala	-Traditional Rotional Farming -Mangrove Plantation -Shrimp/Fish seeds -Equipment -Bunds	1	1	1	2	3	1	1	1	1	0	2	0	14
Climate Resilient Sustainable Agriculture in Rain-Fed Farming (Kandi) Areas of Jammu and Kashmir	-Crop sowing across the slope, -Water conservation -Training	1	1	1	2	2	1	1	1	1	1	1	0	13
Ground Water Recharge and Solar Micro Irrigation to Ensure Food Security and Enhance Resilience in Vulnerable Tribal Areas of Odisha	-Installation of Ground Water Recharge Shaft (GWRS) in 10,000 tanks. -Use of solar pumps for irrigation	1	1	1	2	3	1	1	1	1	1	1	1	15
Gene Pool Conservation of Indigenous Rice Varieties under Traditional Integrated Rotational Farming System (Jhum Optimization) for Promoting Livelihood and Food Security as Climate Change Adaptation Strategy in Nagaland	-Develop alternative approach to shiftingcultivation -Conversion of waste land productive lands -Settled cultivation -Sustainable Jhum Cultivation practices	1	1	1	2	1	1	1	1	1	1	2	0	13
Integrated Project for Source Sustainability and Climate Resilient Rain-Fed Agriculture in Himachal Pradesh	-Improve water management practices -Support climate resilient agriculture	1	1	1	2	2	1	1	1	1	1	1	0	13
Solar Powered Community Lift-Micro Irrigation Project in Punjab	-Installation of Stand alone system completely works on solar	1	1	1	2	3	1	1	1	1	1	0	0	13
Improving food security through sustainable agricultural practices and strengthening local biodiversity management	Trainings on millets and vegetable cultivation techniques Grain Seed banks (GSBs) were setup Greenhouse nurseries were promoted; nurtured seedlings were sold by farmers	1	1	1	2	2	1	1	1	1	1	0	0	12

Multi-layer farming	-Three women planted four layers of vegetation via organic farming	1	1	1	2	2	1	1	1	1	0	2	0	13
Vermi composting	-Cattle dung and organic agricultural waste is decomposed using vermi composting	1	1	1	3	3	1	1	1	1	0	1	1	15
Climate smart actions and strategies in north western Himalayan region for sustainable livelihoods of agriculture-dependent hill communities	-Mobilization and Organization Introduction of Water -Resource Development and Climate Smart Farming Technology - Knowledge Management including Knowledge -Creation and Wider Dissemination Actions	1	1	1	2	2	1	1	1	1	1	0	0	12
Sustainable Agriscape Development	-Restoration and revival of ecosystem services. -Agriscape Plan for piloting. -Training modules and training output reports. -Monitoring frame and report on pilots.	1	1	1	2	2	1	1	1	1	1	0	0	12
Biofertilizers In Indian Agriculture	-Preparation of agriculturally useful microorganisms like nitrogen fixers, phosphorus solubilisers,	1	1	1	3	3	1	1	1	1	0	0	1	14
Community Underground Pipeline Project	-Increasing water use efficiency -To supply good quality irrigation water to fields. -To save soil and water which was earlier go waste through kacca water channels -Saving on labour cost, time and energy.	1	1	1	2	1	1	1	1	1	1	1	0	12
Increasing Irrigation Water efficiency through Box Outlet underground pipeline conveyance system	-Efficient use of water through pipeline Increase in the cultivated area and decrease the weeds. Avoid seepage from open broken channel	1	1	0	2	2	1	1	1	1	1	0	0	11
Andhra Pradesh Integrated Irrigation and Agriculture Transformation Project	-Improving Irrigated Agriculture Efficiency, - Promotion of Climate-Smart Agricultural Practices by supporting -Climate-Smart Crop Production and Diversification and Climate-Smart Aquaculture, -Post-harvest Management, -Market and Agribusiness Promotion, Capacity Building	1	1	1	2	2	1	1	1	1	1	0	0	12

Zero Budget Natural Farming, Andhra Pradesh	-Mixed cropping, -Inter-cropping, -Border cropping, and -Bund cropping techniques	1	1	1	2	3	1	1	0	0	1	1	0	12
Indo-German Environment Programme in Rural Areas (IGEP-RA)	-Resource-saving and climate-resilient agricultural practices -Technical Support for implementation of the Climate smart practices -Capacity Building	1	1	1	2	2	1	0	1	1	1	0	0	11
Towards Climate Resilient Livestock Production System in Punjab	-Ensure sustainable levels of livestock production -Weather linked insurance to compensate for loss -Capacity Building -Fodder production	1	1	0	2	2	1	1	0	0	0	1	0	9
Latur shows the way for Marathwada farmers	-Rejuvenation of river -Removal of silt obstructing -Improved Crop Management -Natural farming, -Afforestation, -Agroforestry, and -Climate resilient farming and seeding practices	1	1	1	2	2	0	0	0	0	1	2	0	10

Food Security	Impact																					
	Direct and Indirect Benefits																					
Case Studies	**Restoration of degraded land**	**Carbon Sequestration**	**GHG Emission Reduction**	**Increased Yield**	**Reduced Water/Air Pollution**	**Sustainable Supply Chains Created**	**Employment Generation**	**Capacity Buiding**	**Livelihood Enhancement**	**Soil and Water Conservation**	**Flood/Drought / Cyclone Management**	**Enhanced Aesthetic/ Cultural Value**	**Erosion Control**	**Weather Stations/Early Warning system**	**Biodiversity Conservation**	**Secure Habitat**	**Total Score on Benefits based on case study**	**Total**	**Climate Adaptation**	**Climate Change Mitigation**	**Disaster Risk Reduction**	**Biodiversity Protection**
Climate Resilient Interventions in Dairy Sector in Coastal and Arid Areas in Andhra Pradesh	0	1	0	1	1	1	1	1	1	1	1	0	1	1	1	1	14	**28**	12	1	2	2
Increasing Adaptive Capacity to Climate Change through Development of Climate-Smart Villages in Select Vulnerable Districts of Madhya Pradesh	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0	14	**28**	12	2	2	0
Watershed development	1	1	1	1	1	0	1	0	0	1	1	1	1	0	1	1	13	**27**	9	2	1	2
Organic Farming	1	1	1	1	0	1	1	0	0	0	1	1	1	0	0	1	11	**27**	7	2	1	1
Ground Water Recharge and Solar Micro Irrigation to Ensure Food Security and Enhance Resilience in Vulnerable	1	1	1	0	1	1	1	1	0	0	1	1	0	0	0	1	11	**26**	7	2	1	1

Tribal Areas of Odisha																					
Zero Budget Natural Farming in India	1	1	1	0	0	1	1	0	0	0	1	1	1	0	0	1	10	**26**	6	2	1	1
Urban Farming	1	1	1	1	0	1	1	0	0	0	1	1	1	0	0	1	11	**26**	7	2	1	1
Sustainable Livelihoods of Agriculture-Dependent Rural Communities in Drought Prone District of Himachal Pradesh through Climate Smart Solutions	0	1	1	1	0	1	1	1	1	1	1	0	1	1	0	0	12	**26**	10	2	2	0
Sustainable Agriculture Development through Expansion, Enhancement and Modelling	0	1	1	1	1	1	1	1	1	1	1	0	1	0	0	0	12	**26**	10	2	1	0
Soil protection and rehabilitation of degraded land in India	1	1	1	0	1	1	1	1	0	0	1	1	0	0	0	1	11	**25**	7	2	1	1
Promotion of Integrated Farming System of Kaipad and Pokkali in coastal wetlands of Kerala	0	1	1	1	0	1	1	1	1	1	1	0	1	0	0	0	11	**25**	9	2	1	0

Climate Resilient Sustainable Agriculture in Rain-Fed Farming (Kandi) Areas of Jammu and Kashmir		1	1	1	1	1	1	1	1	1	1	0	1	0	0	0	12	**25**	10	2	1	0
Ground Water Recharge and Solar Micro Irrigation to Ensure Food Security and Enhance Resilience in Vulnerable Tribal Areas of Odisha	1	1	1	1	0	1	1	0	0	0	1	0	0	0	0	0	1	9	**24**	6	2	1	1
Gene Pool Conservation of Indigenous Rice Varieties under Traditional Integrated Rotational Farming System (Jhum Optimization) for Promoting Livelihood and Food Security as Climate Change Adaptation Strategy in Nagaland	1	1		1	0	1	1	1	1	1	0	0	0	0	0	1	1	11	**24**	9	1	0	2
Integrated Project for Source Sustainability and Climate Resilient Rain-Fed Agriculture in Himachal Pradesh	1	1	1	0	1	1	1	1	0	0	1	1	0	0	0	0	10	**23**	7	2	1	0
Solar Powered Community Lift-Micro Irrigation Project in Punjab	1	1	1	0	1	1	1	1	0	0	1	1	0	0	0	0	10	**23**	7	2	1	0

Improving food security through sustainable agricultural practices and strengthening local biodiversity management	1	1	1	0	1	1	1	1	0	0	1	1	0	0	1	1	11	**23**	7	2	1	2
Multi-layer farming	1	1	1	0	0	1	0	0	0	1	1	1	1	0	0	1	10	**23**	6	2	1	1
Vermi composting	1	1	1	1	0	1	1	0	0	0	1	1	0	0	0	0	8	**23**	5	2	1	0
Climate smart actions and strategies in north western Himalayan region for sustainable livelihoods of agriculture-dependent hill communities	1	1	1	0	1	1	1	1	0	0	1	1	0	0	0	1	10	**22**	6	2	1	1
Sustainable Agriscape Development	1	1	1	0	1	1	1	1	0	0	1	1	0	0	0	1	10	**22**	6	2	1	1
Biofertilisers In Indian Agriculture	1	1	1	1	0	1	1	0	0	0	1	1	0	0	0	0	8	**22**	5	2	1	0
Community Underground Pipeline Project	1	1	1	0	1	1	1	1	0	0	1	1	0	0	0	0	9	**21**	6	2	1	0

Increasing Irrigation Water efficiency through Box Outlet underground pipeline conveyance system	1	1	1	0	1	1	1	1	0	0	1	1	0	0	0	0	10	**21**	7	2	1	0
Andhra Pradesh Integrated Irrigation and Agriculture Transformation Project	1	1	0	0	1	1	1	1	0	0	1	1	0	0	0	0	8	**20**	6	1	1	0
Zero Budget Natural Farming, Andhra Pradesh	0	1	1	1	0	1	1	0	1	0	0	0	0	0	0	0	7	**19**	5	2	0	0
Indo-German Environment Programme in Rural Areas (IGEP-RA)	1	1	0	0	1	1	1	1	0	0	1	1	0	0	0	0	8	**19**	6	1	1	0

Towards Climate Resilient Livestock Production System in Punjab	0	0	1	1	0	1	0	1	1	0	0	0	0	1	0	0	6	**15**	5	1	1	0
Latur shows the way for Marathwada farmers	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	15	**25**	12	2	1	1

Energy Security		**Project Design**						**Project Implementation**						
		Inclusive			**Scalability**			**Governance**			**Cost Effectiveness**			
Case Studies	**Interventions**	**Stakeholder (Community)Engagement in planning**	**Equality-Key Stakeholder needs were included**	**Inclusion of marginalized communities and Gender**	**Replicability across geographies Nation-wide: 3 Regional: 2 Local: 1**	**Use of Technology to aid wider deployment (High-3)**	**Policy Driven**	**Local Government Buy-in**	**Monitoring body/ structure for implementation**	**Transparency: Third party assessment/Audits**	**Low-cost inputs**	**Local resources to offset implementation costs (Labour + Knowledge)**	**Leverages Public Private Partnership model**	**Total Score on Benefits based on case study**
Ground Water Recharge and Solar Micro Irrigation to Ensure Food Security and Enhance Resilience in Vulnerable Tribal Areas of Odisha	-Construction of groundwater recharge system through use of solar pumps.	1	0	1	2	3	1	1	1	1	0	1	1	13
National Solar Mission	-Installation of solar power plants pan india	0	0	1	3	3	1	1	1	1	1	0	1	9
Rural Electrification by Jatropha , Goa	-Using Jatropha seeds to make biofuel, production of electricity -Training on oil expelling, filter press and other techniques. -Power plant with a capacity of 11 kW started functioning	1	1	0	2	2	1	1	1	1	1	1	1	8

Country's first decentralised 100 MW solar convergence project in Goa	-100 MW of decentralised ground-mounted solar power projects for agricultural pumping -16 lakh LED bulbs for rural domestic households	0	0	1	2	3	1	1	1	1	1	0	1	9
Energy Conservation in Small Sector Tea Processing Units in South India	-Energy efficiency equipments, energy efficiency management, Fuel testing facilities for monitoring	1	1	1	2	2	0	1	1	1	0	0	1	9
Line of Credit for Solar rooftop segment for commercial, industrial and residential housing sectors	-Installing around 250 MW of solar rooftop capacity in the initial phase.	0	0	1	3	3	1	1	1	1	0	0	1	8
Biomass Energy for Rural India	-500 kW gasifier-based power plant is operational in the Kabbigere cluster -Bore wells with submersible pump sets -Drip irrigation have been set up in the village cluster sites. -Tree plantations grown on 2,930 hectares of land. -Thirty people employed in tree-based farming (TBF)	1	1	1	3	1	1	1	1	1	1	2	0	5
Energy Efficiency in Steel Re-rolling Mills (SRRM)	-Identification and popularization of 10 technology packages -Intervention in the re-heating furnace and 19 eco-tech options to enable greater energy efficiency in rolling mill processes. -Implemented energy-efficient technologies in 29 SRRM units	0	0	0	2	3	1	1	1	1	1	0	1	7
Innovation in Solar Power and Hybrid Technologies Project for India	-Increased electricity supply, -Avoided GHG emissions from displacement of thermal generation -Cumulative installed capacity of 300MV – -Stand-alone plants for solar PV with storage, -Large-scale floating solar PV	0	0	0	3	3	1	1	1	1	0	0	1	5

	power plants with a cumulative capacity of about 20 MW. -Project sites yet to be identified for storage and floating solar technologies.													
Global solar water heating (GSWH) project: Transformation and Strenghtening Initiative	-Over 200 small tea processing units have implemented energy efficiency measures in both thermal and electrical energy	0	0	1	3	3	1	1	1	1	0	0	1	4
Potential of Electric Vehicles in India	-Establishing EV market to reduce reliance on fossil fuel	0	0	0	3	3	1	1	1	1	0	0	1	3
Perform Achieve and Trade (PAT)	-Establishing market-trade mechanisms to reduce carbon emmisions and increase accountability	0	0	0	3	2	1	1	1	1	0	0	1	1

Energy Security	Impact																					
	Direct and Indirect Benefits																					
Case Studies	**Ground Water Recharge**	**Temperature Regulation**	**Carbon Sequestration**	**GHG Emission Reduction**	**Reduced Air Pollution**	**Reduced Water Pollution**	**Sustainable Supply Chains Created**	**Employment Generation**	**Capacity Building**	**Livelihood Enhancement**	**Water Conservation**	**Reduced Costs**	**Enhanced Aesthetic / Cultural Value**	**Increased Energy Access**	**Ease of maintenance**	**Biodiversity Conservation**	**Secure Habitat**	**Total Score on Benefits based on case study**	**Total**	**Climate Adaptation**	**Climate Change Mitigation**	**Disaster Risk Reduction**	**Biodiversity Protection**
Ground Water Recharge and Solar Micro Irrigation to Ensure Food Security and Enhance Resilience in Vulnerable Tribal Areas of Odisha	1	1	0	1	1	1	1	1	1	1	1	1	0	0	1	0	1	13	**26**	11	1		1
National Solar Mission	0	1	0	1	1	0	1	1	1	1	0	0	0	0	1	0	1	9	**22**	7	1		1
Rural Electrification by Jatropha , Goa	0	0	1	1	1	0	1	1	1	1	0	0	0	0	0	0	1	8	**21**	5	2		1
Country's first decentralised 100 MW solar convergence project in Goa	0	1	0	1	1	0	1	1	1	1	0	0	0	0	1	0	1	9	**21**	7	1		1

Energy Conservation in Small Sector Tea Processing Units in South India	0	1	0	1	0	1	0	1	1	1	1	0	0	0	1	0	1	9	**20**	7	1		1
Line of Credit for Solar rooftop segment for commercial, industrial and residential housing sectors	0	1	0	1	1	0	1	1	1	0	0	0	0	0	1	0	1	8	**20**	6	1		1
Biomass Energy for Rural India	0	0	1	0	0	0	1	0	0	1	0	0	0	0	1	0	1	5	**19**	3	1		1
Energy Efficiency in Steel Re-rolling Mills (SRRM)	0	1	0	1	1	0	1	0	1	0	0	0	0	0	1	0	1	7	**18**	5	1		1
Innovation in Solar Power and Hybrid Technologies Project for India	0	1	0	1	1	0	0	0	1	0	0	0	0	0	0	0	1	5	**16**	3	1		1
Global solar water heating (GSWH) project: Transformation and Strenghtening Initiative	0	1	0	0	0	0	1	0	1	0	0	0	0	0	1	0	0	4	**16**	4	0		0

Potential of Electric Vehicles in India	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	3	**14**	2	1		0
Perform Achieve and Trade (PAT)	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	**11**	0	1		0

Forest and Biodiversity		**Project Design**						**Project Implementation**						**Total Score based on design and implementation indicators**
		Inclusive			**Scalability**			**Governance**			**Cost Effectiveness**			
Case Studies	**Interventions**	**Stakeholder (Community)Engagement in planning**	**Equality-Key Stakeholder needs were included**	**Inclusion of marginalized communities and Gender**	**Replicability across geographies Nation-wide: 3 Regional: 2 Local: 1**	**Use of Technology to aid wider deployment (High-3)**	**Policy Driven**	**Local Government Buy-in**	**Monitoring body/ structure for implementation**	**Transparency: Third party assessment/Audits**	**Low-cost inputs**	**Local resources to offset implementation costs (Labour + Knowledge)**	**Leverages Public Private Partnership model**	
Afforestation Project - Tamil Nadu	-Afforestation, the projects focused on new -Geographical information system(GIS), -Human resource development and research -Forest extension and infrastructure development	1	1	1	2	3	1	1	1	1	0	1	1	14
Climate Adaptation Strategies in Wetlands along Mahanadi River Catchment areas in Chhattisgarh	-Climate Smart Agriculture Practices. -Plantation. -Better healthcare facilities and sanitation for -Climate knowledge building and management for 10,000 community members	1	1	1	2	2	1	1	1	1	1	2	0	14
State Forest Plantation/Afforestation Programs	-Plantation -Agroforestry(Distribution of Seedlings) -Soil and water conservation (LBCD, Trenches, Check Dams), -Van Suraksha Samiti, -Distribution of fuel efficient Chullahs	1	1	0	3	3	1	1	1	1	1	2	0	15
REDD+ Pilot in Mizoram	-Sustainable land management and cropping pattern -Adoption of horticulture crops -Creating habitat mosaic for biodiversity conservation -Livelihood Improvement -Forest fire control and management	1	1	1	2	3	1	1	1	1	1	1	1	15

	-Sustainable energy supply -Market linkages for agriculture produce -Demonstrations of private plantation and agroforestry													
Combined reforestation and sustainable development project, in India TIST Program in India, VCS 001	-Improve the biodiversity of the area by adding canopy and indigenous trees. -Sustainable fuel wood supply for the members, -Livelihood enhancement -Provide training in important social and health related subjects	1	1	0	2	2	1	1	1	1	1	1	0	12
Umiam Sub-watershed REDD project	-Fire Lines/Watchers -Fuel efficient stoves -Total ban on Animal exchange & Stall feeding -Vegetative check dams & afforestation -Rehabilitation & protection of habitats of rare orchids & amphibians	1	1	0	2	3	1	1	1	1	0	1	1	13
Integrated Natural Resource Management and Poverty Reduction Project, Haryana	-Afforestation, soil and moisture conservation, -Poverty reduction programmes, -Publicity and extension, -Human resource development, -Management Information System (MIS), -Geographical Information System (GIS) for Mapping	1	1	1	2	3	1	1	1	1	1	1	1	15
Integrated Watershed Management Project, Swan River, Himachal Pradesh	-Afforestation, -Civil works for soil and river management, -Soil protection and land reclamation, and -Livelihood improvement activities	1	1	0	2	2	1	1	1	1	0	1	1	12
Mangrove forest restoration in Andhra Pradesh, India	-Restoration by digging canals perpendicular to the main river, -Plantation (Mangrove native Species)	1	1	0	2	2	1	1	1	1	1	1	0	12
Himachal Pradesh Reforestation Project – Improving Livelihoods and Watersheds	-Reforest degraded land through the plantation of native improve the productive potential of the degraded land or watershed -Capacity Building	1	1	1	2	2	1	1	1	1	1	0	0	12
Ecosystem Services based Adaptation to Climate Change in Bundelkhand Region of Uttar Pradesh	-JFMC Plantation in 732 ha. area, -Distributed about 15,000 plants per village covering 30 ha. area. -Community based restoration of degraded forest areas 800 ha of agricultural area under drip irrigation, -Live hedge fencing, -Spring development, -Fodder storage	1	1	0	2	2	1	1	1	1	1	2	0	13
Management and rehabilitation of coastal habitats and biodiversity for Climate Change Adaptation and Sustainable	-Improve coral & sea grass cover (4sq km), -Promote sustainable fisheries management and livelihood d-diversification, -Improve biodiversity (6000 artificial reef deployment),Sea-grass transplantation and -Capacity Building	1	1	1	2	2	1	1	1	1	1	1	0	13

Livelihood in Gulf of Mannar, Tamil Nadu, India														
Management of Ecosystem of Kaziranga National Park by Creating Climate Resilient Livelihood for Vulnerable Communities through Organic farming and Pond Based Pisciculture	-Organic farming, -Promotion of fisheries -Capacity Building	1	1	1	3	2	1	1	1	1	1	0	0	13
Reforestation of degraded land in Chhattisgarh, India	-Rehabilitation of degraded lands by plantation of indigenous species -Enhance carbon sink through reforestation -Sustainable Land Management	1	1	0	2	2	1	1	1	1	1	1	0	12
Improving Rural Livelihoods Through Carbon Sequestration By Adopting Environment Friendly Technology based Agroforestry Practices	-Develop plantation and agro forestry models Plantation	1	1		2	1	1	1	1	1	0	1	1	11
Management and Biodiversity Conservation Project, Karnataka	-Afforestation, -Farm forestry, -Soil and water conservation works, -Conservation of rich biodiversity and improvement of the management of protected areas	1	1		2	2	1	1	1	1	0	1	1	12
Improving Rural Livelihoods Through Carbon Sequestration By Adopting Environment Friendly Technology based Agroforestry Practices	-Mobilize resource-poor farmers to raise tree plantations on farmlands -Sustainable supply chain by linkage between resource poor farmers and end users of wood products -Rainfed subsistence agriculture -Building capacity of various stakeholders to benefit from global mechanisms	1	1	1	2	2	1	1	1	1	1	1	0	13
Forestry Sector Development Project, Odisha	-Sustainable forest management including plantations through JFM -Preparation of comprehensive micro plans -Capacity Building	1	1	1	2	2	1	1	1	1	0	1	1	13
Reforestation of severely degraded landmass in Khammam District of Andhra Pradesh, India under ITC	-Raising plantations with Eucalyptus. -Soil Moisture Conservation through LBCD, Bunds, Trenches etc.	1	1	0	2	2	1	1	1	1	1	1	0	12

Social Forestry Project														
Forestry and Biodiversity Project, Rajasthan	-Afforestation, -Biodiversity conservation, -Soil and moisture conservation	1	1	0	2	1	1	1	1	1	0	1	1	11
Himachal Pradesh Reforestation Project – Improving Livelihoods and Watersheds	-Planting and protection of native tree species, -Reduction in soil erosion and prevention of downstream siltation of water bodies. (check dams, soil stabilisation etc.)	1	1		2	1	1	1	1	1	0	1	1	11
India Sundarbans Mangrove Restoration	-Mangrove plantations and conservation, -Community Mobilization, -Capacity Building	1	1	0	2	2	1	1	1	1	1	0	0	11
Implementation of REDD+ Pilot Project at Raid Umket, Ri-bhoi district	-Creating Awareness in the community, -Forest Cover Mapping and Inventory, Baseline of Forest Cover, -Tree plantation activity, -Forest Fire Management, -Introduction of Improved Chulhas, -Bamboo based Enterprise, -Installation of Solar Lights within the Umket Raid.	1	1	1	2	2	1	1	1	1	1	0	0	12
Forest Environmental Improvement and Poverty Alleviation Project, Tripura	-Plantation -Agroforestry -Check-dams for soil and water conservation -Vocational Training Centres -Handloom	1	1	0	2	3	1	1	1	1	0	1	1	13
Protected Area (NTCA Case Study)	-Ecosystem Services Valuation of Tiger Reserves in India	1	1	1	3	2	1	1	1	1	1	0	0	13
Enhancing Climate Resilience of Forests and its Dependent Communities in Two Landscapes of Jharkhand	-Capacity building of the forest dependent communities, -Construction of contour trench, -Gully plugging for soil & moisture conservation works, -Water harvesting, -Promote gender sensitive and climate resilient livelihood systems. -Energy use- efficiency and alternative energy, cook stoves, Bio gas plants, solar lamps/lights and kitchen garden	1	1	1	2	3	1	1	1	1	1	1	0	14

Integrated Land and Ecosystem Management to Combat Land Degradation and Deforestation in Madhya Pradesh	-Construction of micro check dams in Ambada and Tamiya -Improved protection and management of forests through greater community involvement	1	1	1	2	3	1	1	1	0	1	2	0	14
Gujarat Afforestation and Development Project	-Afforestation -Development of wildlife conservation facilities -Infrastructure (buildings, roads, -Telecommunications, exhibition facilities, -Habitat environment enhancement facilities -Forest fire prevention facilities, etc.	1	1	1	2	2	1	1	1	1	1	1	1	14
Building Adaptive Capacities of Communities, Livelihoods and Ecological Security in the Kanha-Pench Corridor of Madhya Pradesh	-Integrated socio-economic-ecological planning and assessment -Community mobilization for building adaptive capacities -Ecosystem resilience and sustainable livelihoods as a means for adaptation -Knowledge management	1	1	0	2	2	1	1	1	0	1	1	0	11
Plantation Project on wastelands by Sun Plant Agro Limited	-Establish and manage commercial timber and Jatropha plantations. -Sequester CO2 an through forest planting in barren, degraded -Reclaim the degraded land through soil and water conservation activities. -Economic and social upliftment of native rural population through employment generation.	1	1	0	2	2	1	1	1	1	1	0	0	11
REDD+ Pilot in Mizoram & preparation of SRAP	-Planting bamboo, -Share coffee plantation. -Solar dryer (150 kg capacity) installed at Reiek to promote turmeric cultivation. -Creation of shaded coffee plantations at Reiek & Ailawng villages (20 ha.) in coordination with SFD.	1	1	0	2	2	1	1	1	1	1	0	0	11
Uttarakhand REDD+ ICFRE Project	-Improved Cook Stove and LPG -Plantation of fodder grasses. -Pirul collection contributes reduction in fire incidence. -Small water reservoirs to store the rain water . -Check Dam construction to control the flow of water and soil erosion.	1	1	0	2	2	1	1	1	1	1	0	0	11
Reforestation of degraded land in Chhattisgarh, India	-Afforestation -Drip Irrigation	1	1	1	2	3	1	1	1	0	1	1	0	13
Conservation of Amur Falcons	-Established a Community Conservation Area (CCA) primary stopover roosting sites in the state for Amur falcons -Restriction on hunting and shifting cultivation	1	1		2	1	1	1	1	1	0	1	1	11
Urban forestry in Jaipur	-Fencing, -Protection, -Enrichment planting, -Interval irrigation, -Weed removal	1	1	0	2	2	1	1	1	1	1	0	0	11

	-Native species were planted mainly which have medicinal and aesthetic values.													
Andhra Pradesh Forestry Project: Forest Restoration and Joint Forest Management in India	-Funding of training and study tours for village leaders -Support for improved drinking water facilities -Introduction of alternative energy technologies to reducing fuel-wood consumption -Helping to meet priority development needs identified during initial negotiations -Providing development assistance to tribal groups -Fostering NGO participation.	1	1	1	2	2	1	1	1	0	1	2	0	13
Restoration of Mansagar Lake in Jaipur	-Public-private model to clean the lake -Wetland waste water treatment	1	1	1	1	3	1	1	0	0	0	0	1	10

Forest and Biodiversity	Impact																					
	Direct and Indirect Benefits																					
Case Studies	**Ground Water Recharge**	**Restoration of degraded land**	**Carbon Sequestration**	**GHG Emission Reduction**	**Increase in Green Cover**	**Reduced Water/ Air Pollution**	**Sustainable Supply Chains Created**	**Employment Generation**	**Capacity Buiding**	**Livelihood Enhancement**	**Soil and Water Conservation**	**Flood/Drought/Cyclone Management**	**Enhanced Aesthetic/Cultural Value**	**Erosion Control**	**Sediment Reduction**	**Biodiversity Conservation**	**Secure Habitat**	**Total Score on Benefits based on case study**	**Grand Total**	**Climate Adaptation**	**Climate Change Mitigation**	**Disaster Risk Reduction**	**Biodiversity Protection**
Afforestation Project - Tamil Nadu	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	16	30	10	2	1	1
Climate Adaptation Strategies in Wetlands along Mahanadi River Catchment areas in Chhattisgarh	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	16	30	9	2	1	2
State Forest Plantation/Afforestation Programs	1	1	1	1	1	0	1	1	1	1	1	0	1	1	1	1	1	15	30	8	2	0	2
REDD+ Pilot in Mizoram	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	1	1	15	30	10	2	1	2
Combined reforestation and sustainable development project, in India TIST Program in India, VCS 001	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	17	29	10	2	1	2
Umiam Sub-watershed REDD project	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	16	29	10	2	1	1
Integrated Natural Resource Management and Poverty Reduction Project, Haryana	1	1	1	0	1	0	1	1	1	1	1	1	1	1	1	1	0	14	29	9	1	1	1

Integrated Watershed Management Project, Swan River, Himachal Pradesh	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	16	28	10	2	1	1
Mangrove forest restoration in Andhra Pradesh, India	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	16	28	9	2	1	2
Himachal Pradesh Reforestation Project – Improving Livelihoods and Watersheds	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	16	28	9	2	1	2
Ecosystem Services based Adaptation to Climate Change in Bundelkhand Region of Uttar Pradesh	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	15	28	9	1	1	2
Management and rehabilitation of coastal habitats and biodiversity for Climate Change Adaptation and Sustainable Livelihood in Gulf of Mannar, Tamil Nadu, India	1	0	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	15	28	8	2	1	2
Management of Ecosystem of Kaziranga National Park by Creating Climate Resilient Livelihood for Vulnerable Communities through Organic farming and Pond Based Pisciculture	1	0	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	15	28	8	2	1	2
Reforestation of degraded land in Chhattisgarh, India	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	0	15	27	10	1	1	1
Improving Rural Livelihoods Through Carbon Sequestration By Adopting Environment Friendly Technology based	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	16	27	10	2	1	1

Agroforestry Practices																							
Management and Biodiversity Conservation Project, Karnataka	1	1	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1	15	27	9	1	1	2
Improving Rural Livelihoods Through Carbon Sequestration By Adopting Environment Friendly Technology based Agroforestry Practices	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	14	27	8	2	1	1
Forestry Sector Development Project, Odisha	1	0	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	14	27	8	2	1	1
Reforestation of severely degraded landmass in Khammam District of Andhra Pradesh, India under ITC Social Forestry Project	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1	1	0	14	26	9	1	1	1
Forestry and Biodiversity Project, Rajasthan	1	1	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1	15	26	9	1	1	2
Himachal Pradesh Reforestation Project – Improving Livelihoods and Watersheds	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	15	26	9	2	1	1
India Sundarbans Mangrove Restoration	1	0	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	15	26	8	2	1	2

Implementation of REDD+ Pilot Project at Raid Umket, Ri-bhoi district	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	14	26	8	2	1	1
Forest Environmental Improvement and Poverty Alleviation Project, Tripura	1	0	1	0	1	0	1	1	1	1	1	1	1	1	1	1	0	13	26	8	1	1	1
Protecteed Area (NTCA Case Study)	0	0	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1	13	26	7	1	1	2
Enhancing Climate Resilience of Forests and its Dependent Communities in Two Landscapes of Jharkhand	1	0	1	0	0	0	1	1	1	1	1	1	1	1	0	1	1	12	26	7	1	1	2
Integrated Land and Ecosystem Management to Combat Land Degradation and Deforestation in Madhya Pradesh	1	1	1	1	1	0	0	1	1	1	1	1	0	0	0	1	1	12	26	8	2	1	2
Gujarat Afforestation and Development Project	1	1	1	1	1	0	0	1	1	1	1	1	0	0	0	1	1	12	26	8	2	1	2
Building Adaptive Capacities of Communities, Livelihoods and Ecological Security in the Kanha-Pench Corridor of Madhya Pradesh	1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	14	25	8	1	1	2
Plantation Project on wastelands by Sun Plant Agro Limited	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	14	25	8	2	1	1
REDD+ Pilot in Mizoram & preparation of SRAP	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	14	25	8	2	1	1

Uttarakhand REDD+ ICFRE Project	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	14	25	8	2	1	1
Reforestation of degraded land in Chhattisgarh, India	1	1	1	1	1	0	1	1	1	1	1	1	0	0	0	0	1	12	25	9	2	1	1
Conservation of Amur Falcons	1	0	1	0	1	0	1	1	1	1	1	1	1	1	1	1	0	13	24	8	1	1	1
Urban forestry in Jaipur	0	0	1	1	0	1	1	1	1	1	1	1	1	1	1	1	0	13	24	7	2	1	1
Andhra Pradesh Forestry Project: Forest Restoration and Joint Forest Management in India	1	1	1	1	1	0	1	1	1	1	1	1	0	0	0	0	0	11	24	9	2	1	0
Restoration of Mansagar Lake in Jaipur	0	1	1	1	0	1	0	1	1	1	1	0	1	0	0	1	1	11	21	6	2	0	2

Disaster Risk Reduction		Project Design						Project Implementation						
		Inclusive			Scalability			Governance			Cost Effectiveness			
Case Studies	Interventions	Stakeholder (Community)Engagement in planning	Equality-Key Stakeholder needs were included	Inclusion of marginalized communities and Gender	Replicability across geographies Nation-wide: 3 Regional: 2 Local: 1	Use of Technology to aid wider deployment (High-3)	Policy Driven	Local Government Buy-in	Monitoring body/ structure for implementation	Transparency: Third party assessment/Audits	Low-cost inputs	Local resources to offset implementation costs (Labour + Knowledge)	Leverages Public Private Partnership model	Total Score based on design and implementation indicators

Maharashtra Project on Climate Resilient Agriculture	-Preparation of Land & Water use master plan -Reducing climate risks through timely and appropriate early warning in local language -Climate resilient technology transfer for enhancing the adaptive capacity of the community -Learning and Knowledge Management	1	1	1	2	2	1	1	1	1	1	1	1	14
Enhancing Adaptive Capacity and Increasing Resilience of Small and Marginal Farmers in Purulia and Bankura Districts of West Bengal	-Introduced drought tolerant/ resistant crop like millets, -Crops having less water requirement, -Local and traditional varieties of rice seeds. -Rain Water Harvesting through pond excavation, ditch digging, dug well, -Roof Top Rain Water Harvesting, -River lift irrigation, check dam construction. -Increasing soil moisture by application of organic carbon. - -Weather specific agro-advisory services. -Integrated pest management, -Agroforestry, -Installation of biogas units, -Energy efficient ovens, -Roof top water harvesting etc	1	1	1	1	2	1	1	1	1	1	2	1	14
Integrated Urban Flood Management for the Chennai-Kosasthalaiyar Basin Project	-Integrated storm water drain network in which -Building climate-resilient, -Urban flood protection infrastructure	1	1	1	2	2	1	1	1	1	1	1	1	14

	-Rehabilitation of community rainwater harvesting structures to -Improve groundwater recharge and -Reduce coastal salinity intrusion and -Construction of two energy-efficient water pumping stations													
Conservation and Management of Coastal Resources as a Potential Adaptation Strategy for Sea Level Rise	-Restoration and conservation of existing mangroves with the participation of community. -Development of seawater water based agro-aqua farming system	1	1	1	2	2	1	1	1	1	1	1	0	13
Climate smart actions and strategies in north western Himalayan region for sustainable livelihoods of agriculture-dependent hill communities	-Climate smart agriculture technologies e.g. Recharging of natural springs-through site specific mechanical and vegetative measures -Roof top rainwater harvesting -Innovative water use efficiency demonstrations -Ways for creating in situ natural water reserves in hills and farm diversification options, improved potential of livestock resources and knowledge generation based on field actions.	1	1	1	2	2	1	1	1	1	1	1	0	13
Enhancing Climate Resilience of India's Coastal Communities across Andhra, Maharashtra and Odisha, GCF-GOI	-Developing Climate Resilient Urban Centres. coastal ecosystems -Expected to achieve "blue carbon" sequestered in -Community -based conservation -Restoration of coastal ecosystem,	1	1	1	2	2	1	1	1	1	1	1	0	13

	-Promote climate-adapted livelihood options													
FLOOD MANAGEMENT AND BORDER AREAS PROGRAMME (FMBAP)	-Critical Anti-erosion works in Ganga Basin States (a Centrally Sponsored Scheme) -Critical Flood Control and Anti Erosion Schemes in Brahmaputra and Barak Valley States (a State Sector Scheme), -Improvement of Drainage in critical areas in the country (a State Sector Scheme) and -Critical Anti-erosion Works in Coastal and other than Ganga Basin States (a State Sector Scheme)	1	1	1	2	2	1	1	1	1	1	1	0	13
Prevention of flood using nature-based solution in Gorakhpur	-Strengthening urban flood protection infrastructure -Recharging groundwater, -Improving capacity of communities on planning and urban flood management, and -Improving operational and financial capacity of community zonal offices.	1	1	1	1	1	1	1	1	1	1	2	0	12
Climate Change Adaptation in Nimar district, MP by UNDP	-Sustainable development and reverse the loss of environment resources. -Participatory ground water aquifer mapping and -Preparation of integrated water use action plan undertaken in	1	1	1	2	2	1	1	1	1	1	0	0	12

	Madhya Pradesh. -Climate related vulnerability assessments in Madhya Pradesh and Odisha.													
Community driven Mangrove resource management conservation and restoration in selected villages around the Bhitarkanika mangrove areas	-Empowering the local communities for sustainable managing and Conservation of the mangrove resources Promote climate resilient livelihood for mangrove dependent families Capacity Building	1	1	1	2	1	1	1	1	1	1	2	0	13

Disaster Risk Reduction	Impact																					
	Direct and Indirect Benefits																					
Case Studies	Reduced flood/drought / cyclones	Reduced soil erosion	Reduction in vector borne diseases	Water availability	Food security	Preparedness	Better land use /terrain conservation	Reduce cost for mitigation	Decreased lifeloss/ migration	Containment of impact	Livelihood Enhancement	Water Recharge	Decreased Salinization	Sediment Reduction	Conservation of Cultural and Biological diversity	Market Access	Secure Habitat	Total Score on Benefits based on case study	Total	Climate Adaptation	Climate Change Mitigation	Disaster Risk Reduction	Biodiversity Protection
Maharashtra Project on Climate Resilient Agriculture	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	1	15	29	11	1	4	2
Enhancing Adaptive Capacity and Increasing Resilience of Small and Marginal Farmers in Purulia and Bankura Districts of West Bengal	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	1	15	29	11	1	4	2
Integrated Urban Flood Management for the Chennai-Kosasthalaiyar Basin Project	1	1	1	1	0	1	1	1	1	1	0	1	1	1	1	0	1	14	28	9	1	4	2
Conservation and Management of Coastal Resources as a Potential Adaptation Strategy for Sea Level Rise	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	0	1	15	28	10	1	4	2

Climate smart actions and strategies in north western Himalayan region for sustainable livelihoods of agriculture-dependent hill communities	1	1	0	1	1	1	1	1	1	1	1	1	0	1	1	0	1	14	27	9	1	4	2
Enhancing Climate Resilience of India's Coastal Communities across Andhra, Maharashtra and Odisha, GCF-GOI	1	1	0	1	1	0	1	1	1	1	0	1	1	1	1	0	1	13	26	8	1	3	2
FLOOD MANAGEMENT AND BORDER AREAS PROGRAMME (FMBAP)	1	1	0	1	1	0	1	1	1	1	0	1	1	1	1	0	1	13	26	8	1	3	2
Prevention of flood using nature-based solution in Gorakhpur	1	1	0	1	1	1	1	1	1	1	1	1	0	0	1	0	1	13	25	9	1	4	2
Climate Change Adaptation in Nimar district, MP by UNDP	1	1	0	1	1	0	1	0	1	1	0	1	1	1	1	0	1	12	24	8	0	3	2
Community driven Mangrove resource management conservation and restoration in selected villages around the Bhitarkanika mangrove areas	1	0	0	0	1	1	1	1	1	1	1	0	0	0	1	1	1	11	24	7	1	4	2

	Project Design	Project Implementation

Mobility		Inclusive			Scalability			Governance			Cost Effectiveness		
Case Studies	**Interventions**	**Stakeholder (Community)Engagement in planning**	**Equality-Key Stakeholder needs were included**	**Inclusion of marginalized communities and Gender**	**Replicability across geographies Nation-wide: 3 Regional: 2 Local: 1**	**Use of Technology to aid wider deployment (High-3)**	**Policy Driven**	**Local Government Buy-in**	**Monitoring body/ structure for implementation**	**Transparency: Third party assessment/Audits**	**Low-cost inputs**	**Local resources to offset implementation costs (Labour + Knowledge)**	**Leverages Public Private Partnership model**
Smart Janpath/Soft Mobility	-Rehabilitation and construction of walkways -Roads to promote bicycling	0	0	1	2	2	1	1	1	1	1	1	1
BS6 standards/Improving GHG emission Standards/fuel economy	-Making stringent fuel standards for automobile compliance -Increasing fuel economy and reducing GHG emissions through better engines in car	0	0	1	3	3	1	1	1	1	0	0	1
Bhubaneshwar E-Mobility Plan/Electric Mobility	-Promoting e-mobility to cut down on fossil fuel driven vehicles	0	0	1	2	3	1	1	1	1	0	0	1
Pedestrian Friendly road/Walkability	-Increasing access to walkability through building convenient walking paths	0	0	1	2	2	1	1	1	1	1	1	1

Mobility	Direct and Indirect Benefits																				
Case Studies	**Reduced Congestion**	**Reduced Noise Pollution**	**Carbon Sequestration**	**GHG Emission Reduction**	**Decreased Air pollution**	**Reduced Water Pollution**	**Sustainable Supply Chains Created**	**Employment Generation**	**Capacity Buiding**	**Livelihood Enhancement**	**Energy Conservation**	**Avoided Costs (infra, energy)**	**Enhanced Aesthetic / Cultural Value**	**Ease of living (Convenient Access)**	**Health Benefits**	**Biodiversity Conservation**	**Secure Habitat**	**Total Score on Benefits based on case study**	**Grand Total**	**Climate Adaptation**	**Climate Change Mitigation**	**Disaster Risk Reduction**	**Biodiversity Protection**
Smart Janpath/Soft Mobility	1	0	0	1	1	0	0	1	1	1	1	1	1	1	1	0	1	**12**	**24**	5	2	0	1

BS6 standards/Improving GHG emission Standards/fuel economy	0	0	0	1	1	0	0	0	0	0	1	1	0	0	1	0	0	**5**	**17**	2	1	0	0
Bhubaneshwar E-Mobility Plan/Electric Mobility	0	0	0	1	1	0	1	1	1	1	1	0	0	0	1	0	0	**8**	**19**	6	1	0	0
Pedestrian Friendly road/Walkability	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	0	1	**14**	**26**	6	2	0	1

Water Management		**Project Design**						**Project Implementation**					
		Inclusive			**Scalability**			**Governance**			**Cost Effectiveness**		
Case Studies	**Interventions**	**Stakeholder Engagement**	**Equality**	**Intended Impact**	**Replicability (Nation-wide: 3 Regional: 2 Local: 1**	**Technology aided wider deployment (High: 3, Medium: 2, Low: 1)**	**Policy Driven**	**Local Government Buy-in**	**Monitoring body/ structure for implementation**	**Transparency: Third party assessment/Audits**	**Low-cost inputs**	**Local resources to offset implementation costs (Labour + Knowledge)**	**Leverages Public Private Partnership model**
Jal Shakti Abhiyaan afforestation/Afforestation for water management	-Water conservation and rainwater harvesting -Renovation of traditional and other water bodies -Reuse and recharge of bore well structures -Watershed development -Intensive afforestation	1	0	1	3	2	1	1	1	1	1	2	0

Community-led Watershed Restoration/Integrating green-grey Infrastructure	-Integrating ecosystem based solutions (Green) and water management built structures (grey) -Construction of check dams, farm bunding, and loose boulder structures -Afforestation, reforestation, agro-forestry and on-farm contour	1	1	1	2	2	1	1	1	1	0	2	0
Dhara Vikas /Natural Infrastructure and Source Protection	-Rainwater harvesting -Geohydrology and Geographical Information System (GIS) techniques for revival.	1	1	1	2	2	1	1	1	1	1	2	0
Development of Gaulana Talaab/Water reservoir Restoration	-Desilting and DE-weeding to rejuvenate flow of lake water -Provision of diversion sewers for stopping wastewater flow -Aeration through bioremediation to improve water quality	0	0	1	2	3	1	1	1	1	0	0	0
Rain Water Harvesting Surat/Water Harvesting	-Checking upon air and water quality for industries and private utilities -Rain water harvesting	0	0	1	2	2	1	1	1	1	1	0	0

Waste Management		Project Design						Project Implementation					
		Inclusive			Scalability			Governance			Cost Effectiveness		
Case Studies	Interventions	Stakeholder (Community)Engagement in planning	Equality-Key Stakeholder needs were included	Inclusion of marginalized communities and Gender	Replicability across geographies Nation-wide: 3 Regional: 2 Local: 1	Use of Technology to aid wider deployment (High-3)	Policy Driven	Local Government Buy-in	Monitoring body/ structure for implementation	Transparency: Third party assessment/Audits	Low-cost inputs	Local resources to offset implementation costs (Labour + Knowledge)	Leverages Public Private Partnership model
Surat Biogas Plant/Waste to Energy	-Reducing landfilling of municipal waste -Energy generation from waste	0	0	1	3	3	1	1	1	1	0	0	1
Vermi-Composting Kanpur/Composting	-Promotion of agricultural and household composting	1	1	1	1	2	1	1	1	1	1	2	0
ACTS Eco friendly toilet/Dry toilets	-Better access to toilets -Manure creation from human excreta	1	1	1	3	3	1	1	1	1	1	1	1
East Kolkata Wetlands/Wetlands/Mangroves for waste management	-Bioremediation of waste water through mangroves/wetlands -Increasing livelihood and aquatic habitat through sustaining fisheries and agriculture	0	0	1	2	2	1	1	1	1	1	1	0
Bioremediation of oil sludge ONGC/Bioremediation	-Bioaugmentation and mitigating marine habitat hazard through microbial remediation	0	0	1	2	2	1	1	1	1	1	0	0
		Project Design						Project Implementation					
Pollution		Inclusive			Scalability			Governance			Cost Effectiveness		
Case Studies	Interventions	Stakeholder Engagement	Equality	Intended Impact	Replicability (Nation-wide: 3 Regional: 2 Local: 1	Technology aided wider deployment (High: 3, Medium: 2, Low: 1)	Policy Driven	Local Government Buy-in	Monitoring body/ structure for implementation	Transparency: Third party assessment/Audits	Low-cost inputs	Local resources to offset implementation costs (Labour + Knowledge)	Leverages Public Private Partnership model

Air quality and Water Quality Monitoring in Smart City Area/Monitoring systems for pollution	-Checking upon Air and Water quality for industries and private utilities through smart systems	0	0	1	3	3	1	1	1	1	0	0	1
Biodiesel from Jatropha/Biofuels	-Creating fuel from biomass to cut reliance on fossil fuel and reduce emissions	1	1	1	1	3	1	1	1	1	0	2	1
Biofertilizers for Soil Productivity/organic soil enhancers	-Promoting natural manure systems to cut down on chemical fertilizer use -Using microbial activity to enhance soil quality	1	1	1	3	2	1	1	1	1	1	1	0
Fixed Film Biofilter Technology (FFBT) at Residential Household Building/Biofilters	-Water conservation through wastewater bioremediation	0	0	1	1	3	1	1	1	1	1	0	0
Traffic noise abatement through vegetation /Noise Reduction through plantation	-Reducing noise pollution through street plantation	0	0	1	2	2	1	1	1	1	1	0	0
Land Reclamation of Mining Sites Assam/Reclamation through plantation	-Reclamation of degraded land through vegetation Curbing toxicity by phytoremediation -Introducing ecosystem-based management through gully channels linkages and split dams	1	1	1	2	2	1	1	1	1	1	1	0

		Project Design						Project Implementation					
Green Infrastructure		Inclusive			Scalability			Governance			Cost Effectiveness		
Case Studies	Interventions	Stakeholder (Community)Engagement in planning	Equality-Key Stakeholder needs were included	Inclusion of marginalized communities and Gender	Replicability across geographies Nation-wide: 3 Regional: 2 Local: 1	Use of Technology to aid wider deployment (High-3)	Policy Driven	Local Government Buy-in	Monitoring body/ structure for implementation	Transparency: Third party assessment/Audits	Low-cost inputs	Local resources to offset implementation costs (Labour + Knowledge)	Leverages Public Private Partnership model
Environment Park/Open and green spaces	-Increasing green cover across urban area through provision of parks between residential spaces	0	0	1	2	1	1	1	1	1	0	0	1
Green Roofs CII-Godrej/ Green Roofing	Plantation on roofs and natural turfing on buildings	0	0	1	1	2	1	1	1	1	1	0	1
Vertical Gardens CSC/Vertical Greening	-Integrating plantations on roads at limited spaces like pillars	0	0	1	2	2	1	1	1	1	0	0	1
Karpoor Chand Kulish Smriti Van/Urban Forestry	-Increasing green cover and enrichment of land through indigenous plantation -Conserving biodiversity through land protection and fencing	0	0	1	2	1	1	1	1	1	1	1	0
Pervious Concrete Pavement/Permeable Infrastructure in street Design	Recharging ground water through allowing water percolation	0	0	1	2	2	1	1	1	1	0	1	1

Water Management	Direct and Indirect benefits																					
Case Studies	**Ground Water Recharge**	**Water Availability**	**Carbon Sequestration**	**GHG Emission Reduction**	**Decreased Salinization**	**Reduced Water Pollution**	**Sustainable Supply Chains Created**	**Employment Generation**	**Capacity Building**	**Livelihood Enhancement**	**Soil and Water Conservation**	**Flood/Drought/ Cyclone Management**	**Enhanced Aesthetic/ Cultural Value**	**Erosion Control**	**Sediment Reduction**	**Biodiversity Conservation**	**Secure Habitat**	**Total Score on Benefits based on case study**	**Total Score**	**Climate Adaptation**	**Climate Change Mitigation**	**Disaster Risk Reduction**	**Biodiversity Protection**
Jal Shakti Abhiyaan afforestation/Afforestation for water management	1	1	1	1	0	1	0	0	0	0	1	1	1	1	1	1	1	**12**	**26**	4	2	1	2
Community-led Watershed Restoration/Integrating green-grey Infrastructure	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	**17**	**30**	9	2	1	2
Dhara Vikas /Natural Infrastructure and Source Protection	1	1	0	0	1	1	1	0	1	1	1	1	1	1	1	1	1	**14**	**28**	8	0	1	2
Development of Gaulana Talaab/Water reservoir Restoration	1	1	0	1	1	1	1	0	0	0	1	1	1	1	1	0	1	**12**	**22**	6	1	1	1
Rain Water Harvesting Surat/Water Harvesting	1	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1	**5**	**15**	3	0	0	1

Direct and Indirect Benefits																							
Waste Management Case Studies	**Ground Water Recharge**	**Water Availability**	**Carbon Sequestration**	**GHG Emission Reduction**	**Reduced Vector Borne Diseases**	**Reduced Water Pollution**	**Sustainable Supply Chains Created**	**Employment Generation**	**Capacity Buiding**	**Livelihood Enhancement**	**Soil and Water Conservation**	**Avoided Costs (infra, energy)**	**Enhanced Aesthetic/Cultural Value**	**Erosion Control**	**Sediment Reduction**	**Biodiversity Conservation**	**Secure Habitat**	**Total Score on Benefits based on case study**	**Total Score**	**Climate Adaptation**	**Climate Change Mitigation**	**Disaster Risk Reduction**	**Biodiversity Protection**
Surat Biogas Plant/Waste to Energy	0	0	1	1	1	1	1	1	0	1	1	0	1	1	0	0	1	**11**	**23**	6	2	1	1
Vermi-Composting Kanpur/Composting	0	0	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	**14**	**27**	7	2	0	2

ACTS Eco friendly toilet/Dry toilets	1	1	0	1	1	0	1	1	0	0	1	1	0	1	0	0	0	**9**	**25**	6	1	0	0
East Kolkata Wetlands/Wetlands/Mangroves for waste management	1	1	0	1	1	1	1	0	0	0	1	0	1	1	1	1	1	**12**	**23**	6	1	1	2
Bioremediation of oil sludge ONGC/Bioremediation	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**1**	**1**	**1**	**1**	**1**	**1**	**0**	**1**	**1**	**10**	**20**	5	0	1	2
Pollution	**Direct and Indirect benefits**																						
Case Studies	**Reduced Air Pollution**	**Water Availability**	**Carbon Sequestration**	**GHG Emission Reduction**	**Decreased salinization**	**Reduced Water Pollution**	**Sustainable Supply Chains Created**	**Employment Generation**	**Capacity Buiding**	**Livelihood Enhancement**	**Soil and Water Conservation**	**Land upgradation**	**Enhanced Aesthetic/Cultural Value**	**Erosion Control**	**Sediment Reduction**	**Biodiversity Conservation**	**Secure Habitat**	**Total Score on Benefits based on case study**	**Total Score**	**Climate Adaptation**	**Climate Change Mitigation**	**Disaster Risk Reduction**	**Biodiversity Protection**
Air quality and Water Quality Monitoring in Smart City Area/Monitoring systems for pollution	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	**3**	**15**	3	0	0	0
Biodiesel from Jatropha/Biofuels	1	0	0	1	0	0	1	1	1	1	0	0	0	1	0	0	0	**7**	**21**	5	1	0	0
Biofertilizers for Soil Productivity/organic soil enhancers	0	0	1	0	1	1	1	1	1	1	1	1	0	1	0	0	1	**11**	**25**	8	1	1	1
Fixed Film Biofilter Technology (FFBT) at Residential Household Building/Biofilters	0	1	0	0	0	1	1	0	0	0	1	0	0	0	1	0	0	**5**	**15**	4	0	0	0
Traffic noise abatement through vegetation	0	0	1	1	0	0	0	0	0	0	1	1	1	1	0	0	1	**7**	**17**	2	2	0	1

/Noise Reduction through plantation																						
Land Reclamation of Mining Sites Assam/Reclamation through plantation	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	**16**	**29**	9	2	1	2

Green Infrastructure	**Direct and Indirect benefits**																					
Case Studies	**Ground Water Recharge**	**Water Availability**	**Carbon Sequestration**	**GHG Emission Reduction**	**Energy Savings**	**Reduced Water Pollution**	**Ease of living (Convenient Access)**	**Employment Generation**	**Capacity Building**	**Livelihood Enhancement**	**Soil and Water Conservation**	**Flood/Drought/Cyclone Management**	**Enhanced Aesthetic/Cultural Value**	**Erosion Control**	**Sediment Reduction**	**Biodiversity Conservation**	**Secure Habitat**	**Total Score on Benefits based on case study**	**Total Score**	**Climate Adaptation**	**Climate Change Mitigation**	**Disaster Risk Reduction**	**Biodiversity Protection**
Environment Park/Open and green spaces	1	0	1	1	0	1	1	1	0	1	1	1	1	1	1	1	1	**14**	**23**	5	2	1	2
Green Roofs CII-Godrej/ Green Roofing	0	0	0	1	1	0	0	1	1	1	1	0	1	1	0	0	1	**9**	**19**	4	2	0	1
Vertical Gardens CSC/Vertical Greening	0	0	0	1	0	0	0	1	1	1	1	0	1	1	0	1	1	**9**	**19**	4	1	0	2
Karpoor Chand Kulish Smriti Van/Urban Forestry	1	1	1	1	0	1	0	1	0	1	1	1	1	1	1	1	1	**14**	**24**	6	2	1	2
Pervious Concrete Pavement/Permeable Infrastructure in street Design	0	0	0	0	0	1	0	1	1	1	0	0	1	0	1	0	1	**7**	**18**	4	0	0	1

9.4. Post COVID recovery sector wise analysis

Key Sectors	Challenges	Post Covid Scenario
Water	The pandemic's rapid spread and global extent highlighted the importance of clean, safe water for washing hands, clothes, food and contaminated sites, but the increased use of sanitizers and cleaning materials raised the risk of sanitation systems breaking down under an increased load of possibly contaminated waste. New projects in the water sector are likely to be delayed as government sets out to tackle health, economic and other challenges posed by the pandemic. COVID-19's economic costs will be felt for years in government budgets, where cost cutting may affect spending on water resource protection, wastewater treatment, environmental management and afforestation.	Addressing historic gaps in water supply. Covid has reinforced the importance of access to safe and reliable water. Investment in improved water infrastructure will stimulate economies and generate new jobs after the pandemic, and reduce the drain on the public purse from future epidemics. Support and upscale waste water re-use and cost-effective solutions to water scarcity by strengthening upstream activities protecting water systems Covid has given lasting lessons on crisis management and resilience of systems, hence it is all the more important to invest in sustainable and green infrastructure and associated livelihoods. Invest in more programmes for coastal management and protection; Mangrove protection; integrated mangrove and fishery farming systems to enhance livelihoods and address climate challenges NbS projects in and around urban areas that protect forests, wetlands, soils and crops can reduce sediment loads, capture and retain pollutants, and enhance recycling of nutrients, improving water quality. Developing Nature-based Solutions projects that, for example, increase the size of floodplains, can increase water filtration and store and convey floodwaters, reducing flood risks Restoring floodplains and wetlands are labour intensive jobs that have the potential to employ large number of people Payment for Ecosystem services to address the demand and supply dynamics between regions and provide revenue for people involved in protection of water resources.

Food	Sudden pressure on the agriculture sector as un-employed and 'out of employment' labour force went back to their villages in a mass exodus from cities Food supply chains suffered due to pandemic related restrictions with reports of perishable foods going to waste and not enough storage space for food Demand for functional foods that contain bio-active ingredients increased as people aspired to eat healthy in order to maintain their health Food security became a concern as people lost jobs and their ability to purchase took a hit Shortage of labour in agriculture resulted in delayed harvesting of crops, transport and supply Centralised processing and distribution caused disruptions in food chains	More Investment in agro-forestry and silvo-pastoral systems that can sustain more people and stem rural outmigration Investments in urban agriculture to reduce pressure on the hinterland Cities could involve urban agriculture in their landscape planning as a means to improve food accessibility and to promote local markets, consumption and commerce Promote diverse portfolios of nature-based income benefits to local and national economies Emphasis on Localised food production and Direct consumption (Invest in/)Leverage local NRM and job programmes like the MGNREGA to develop resilient farming structures, restore degraded ecosystems and increase climate resilience Improve local supply chains and de-centralize food storage and processing

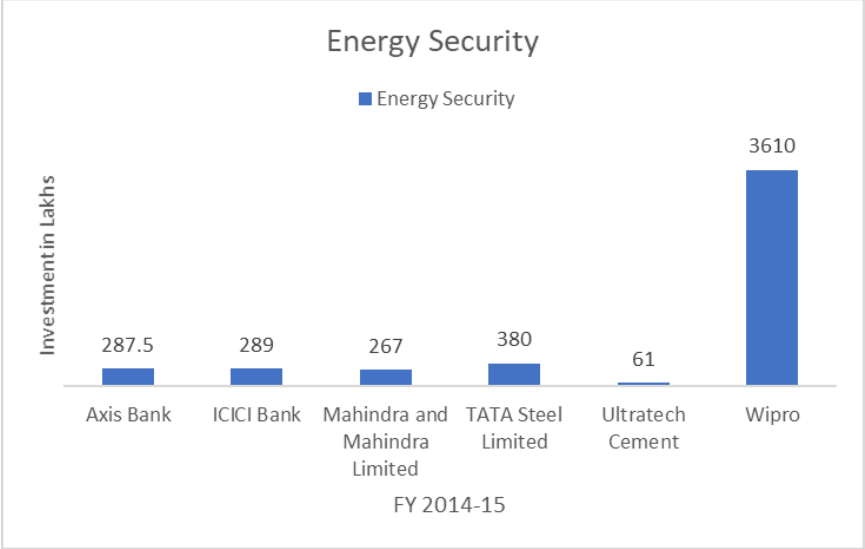
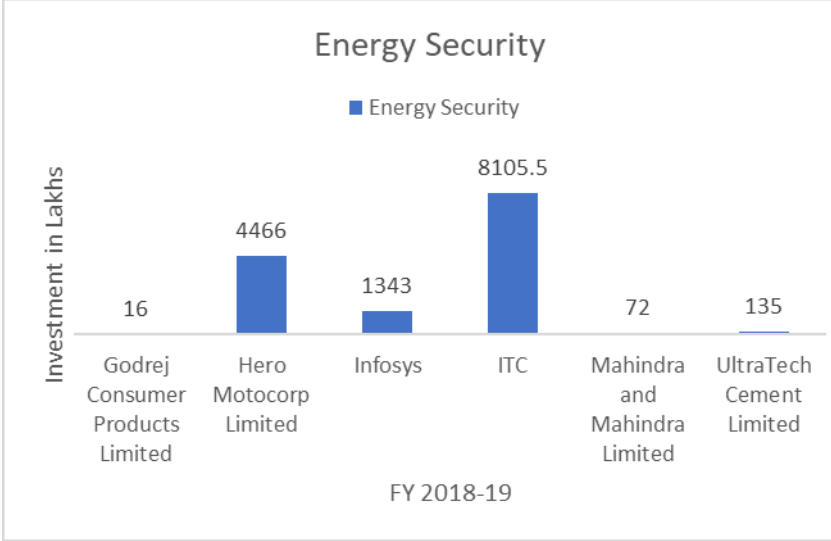
Energy	With the pandemic related lockdown price of oil fell to a historic low Issues of storage of fuels as well as energy generated from renewables Global energy investment was expected to shrink by an unparalleled 20% in 2020. The energy demand has diminished with the enormous economic contraction that followed the global pandemic outbreak of COVID-19 Need for Decentralised Renewable energy is larger than ever before as more people look to locally available livelihoods and increased availability of energy	Invest in gray-green infrastructure by increasing 'shade' plants/ trees to reduce energy needs in buildings and prioritising renewables at the household level Invest more in energy recovery technologies in energy intensive industries Invest in storage technologies for renewables Promote efficiency in use, electric mobility; cleaner fuels Promote energy exchange (credits sold by Indian energy exchange (IEX); companies set their fuel reduction targets) Accelerate the deployment of low-carbon electricity sources like new wind and solar, and the expansion and modernisation of electricity grids Improve the energy efficiency of buildings and appliances Enhance the efficiency of equipment used in industries such as manufacturing, food and textiles Make the production and use of fuels more sustainable Boost innovation in crucial technology areas including hydrogen, batteries, carbon capture utilisation and storage, and small modular nuclear reactors.
Forest and Biodiversity	Shortage of staff for forest management activities Decline in availability of resources for forest based industries affecting prices of products and livelihoods of people in the sector The pandemic, more than ever, emphasized the need to conserve forests and biodiversity as people looked to	Control and reduce invasive species by providing people direct contracts to remove them (employment benefits along with ecological benefits) Creation and maintenance of urban and peri-urban forests Link economic support with environmental management - provide direct incentives for sustainable land practices and link landscape management and planning to forest management Investments in fire management, including employing more people to work in this domain.

	various natural means to boost immunity and cure diseases The pandemic has clearly changed the value placed on urban and peri-urban green spaces and forests as recreational and leisure areas at a time when travel is severely restricted. Natural ecosystems and protected species are at risk due to illegal deforestation, fishing and hunting	
Land Restoration	Volumes of unrecyclable waste have risen Severe cuts in agricultural and fishery export levels have led to the generation of large quantities of organic waste Maintenance and monitoring of natural ecosystems have been temporarily halted Local waste problems emerged as many municipalities suspended their recycling activities over fears of virus propagation in recycling centres Due to larger economic issues at play, it is likely that land restoration activities will take a backseat as emphasis will be on increasing production at the earliest (intensive activities) With livelihood losses in the tourism sector people would be turning to use of natural resources for sustenance impacting conservation	Large scale eco restoration projects could be taken up with the involvement of communities Ensure that industries that depend on natural ecosystems for their primary economic activity, such as ecotourism, are included in early support and recovery packages during and after COVID-19. This will discourage shifts to informal economic activity and the illegal extraction of natural resources, which undermine the long-term sustainability of these sectors.

Disaster Risk Management	Covid-19 will affect disaster preparedness as new standards that allow for physical distancing and ensure provision of personal protective equipment in response shelters for disasters will be needed. Special provisions would be required to be made for elderly populations and those with disabilities Hospitals are already overwhelmed with Covid patients, additional casualties due to disasters and related issues will flood an already strained health care system Resources for first responders in disasters will be strained due to the pandemic	Government should embolden their national and local strategies for disaster risk reduction to account for challenges posed by biological hazards like COVID-19 and to include migrants and displaced persons in their long-term disaster risk reduction and recovery plans The best way to tackle DRR is through prevention and adaptation response that minimizes disasters and their associated effects, such as - Scale up national Greening programmes Wetland restoration and management Protection of forest cover and landscape planning Investing in innovative means to reduce disasters - Eg. China's sponge cities to tackle floods (https://www.theguardian.com/artanddesign/2018/mar/21/turning-cities-into-sponges-how-chinese-ancient-wisdom-is-taking-on-climate-change) Ecosystem protecting infrastructure and communities - locally adapted bio-engineering methods (EPIC, Nepal) https://www.iucn.org/theme/ecosystem-management/our-work/environment-and-disasters/ecosystems-protecting-infrastructure-and-communities-epic
Sustainable Habitat (urban and rural)	The COVID-19 health crisis has expanded to a crisis of urban access, urban equity, urban finance, safety, joblessness, public services, infrastructure and transport, all of which are disproportion- ally affecting the most vulnerable in society Urban areas have become the epicentre of the pandemic. The size of their populations and their high level of global and local interconnectivity make them particularly vulnerable to the spread of the virus. On the other hand, there is no evidence to	Spatial mapping and analysis of inequalities at urban and neighbourhood levels and disaggregated by gender and age could be conducted to assess health, wealth and wellbeing in order to reshape national and local development policies, in particular in deprived areas and slums and at the most local of levels. Combine gray-green approaches for infrastructure development - green highways, increase solar energy instillations, Plan to de-congest cities by improving housing norms, infrastructure and promoting public transportation, creating traffic free zones Consider how cities can shift from urban planning to social planning. In recent years urban planning has revolved around principles of shared spaces e.g. shared offices,

	suggest that density per se correlates to higher virus transmission Large population resides in in-adequate housing - slums and informal settlements thus increasing the risk during pandemics Several new scientific studies suggest that poor air quality is correlated with higher COVID-19 mortality rates	vehicles, city squares and parks, and available transport to help people travel to urban centres so that they can access goods and services. COVID-19 has required cities to re-evaluate these in light of radically changed human behaviour that relies on distancing from one another. Spaces therefore need to be thought about differently, not just as the physical spaces we inhabit, but as complex realities that can meet a variety of functions. Consider how social planning can: - Relieve loneliness and allow for spending time with friends and family in the open air - Facilitate alternative safe work environments e.g. moving meetings from offices to outdoor spaces - Renovating urban spaces to meet new multifunctional requirements while considering the need for green space Consider also, that social planning may require increased investment in infrastructure and services such as: - Free and reliable Wi-Fi in outdoor spaces to help meet the requirements of spaces as places that can accommodate work - Localising 'downtown' areas e.g. ensuring every neighbourhood is serviced with essential shops and services to avoid unnecessary travel
Private Sector Investments	Contracting sales and employment have led to a change in priorities with availability of capital going down Many large businesses have risen to the occasion by volunteering capital investment in innovative solutions to counter the pandemic and also in manufacturing essential supplies to combat the crisis	Invest in existing community based eco-projects such as eco-tourism Invest and promote clean fuels, electric vehicles, drive innovation across sectors Invest in leapfrogging technologies - use of alternative/ green materials for construction, recycling of waste

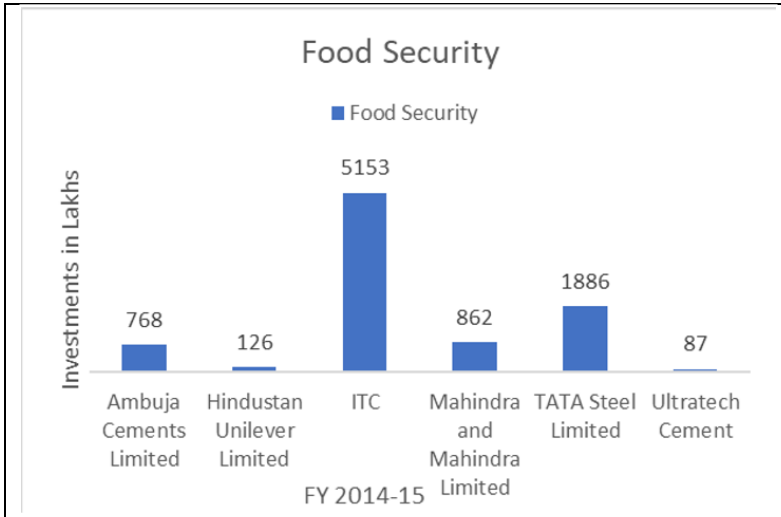
9.5. Private Sector Investment Analysis (CSR)

Investment in 2014-15	Investment in 2018-19
	
Total Investment = 4894.5 Lakhs (Indian Rupees)	**Total Investment = 14137.5 Lakhs (Indian Rupees)**

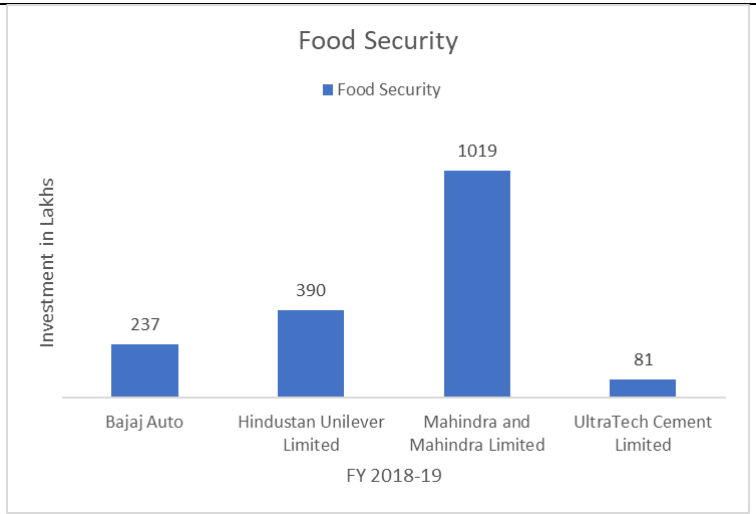
The exponential growth in the investment by private firms in the energy sector is led by the initiatives made by Government of India which has made huge strides to ensure full access to electricity, implementing reforms towards a secure, affordable and sustainable energy system to power a robust economic growth. India has one of the most ambitious renewable energy programmes (175 GWs by 2022) in the world and is likely to meet its target in terms of establishing 40% non-fossil fuel based capacity for electricity generation. As of October 2018, India has already established 124 GW[56] of renewable power generation capacity (from large & small hydro, solar, nuclear, wind and bio-mass), representing 35.8%[57] of its total installed electricity generation capacity of 346.05 GW. The share of new renewables which was only 2.15% of total electricity generation in 2005, has risen to 20.8% in 2018.

[56] Large hydro 45.487 GW, Small hydro 4.5 GW, Wind 34.6 GW, Biomass: 8.9 GW, Solar 24 GW. Data source: CEA, Govt of India

[57] If large hydro power is excluded from this capacity addition, the achievement ratio is 20.7%.

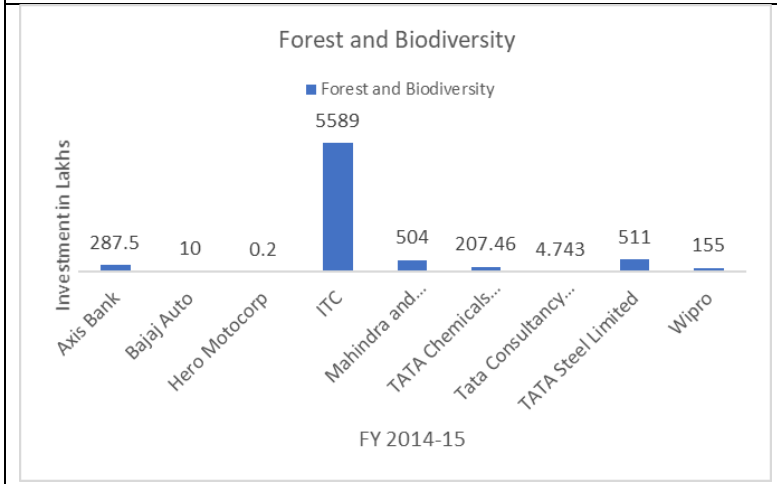


Total Investment = 8882 Lakhs (Indian Rupees)

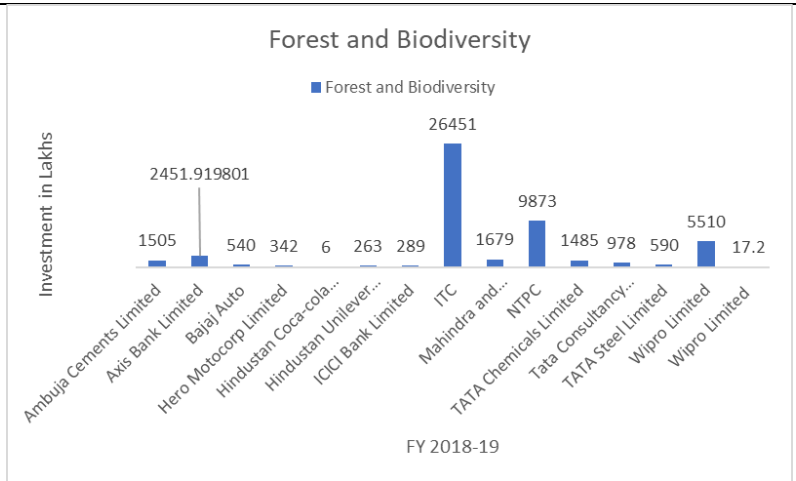


Total Investment = 1727 Lakhs (Indian Rupees)

Development of Agriculture continues to remain critical for India's economic growth, poverty reduction and ensuring food security of the country, as over 58 per cent of the rural households depend on agriculture as their principal means of livelihood. Private investment in Nature-based Solutions along with govermental programs and subsidies in agricultural sector can lead to sustainable livelihood and better market access to the marginal farmer.

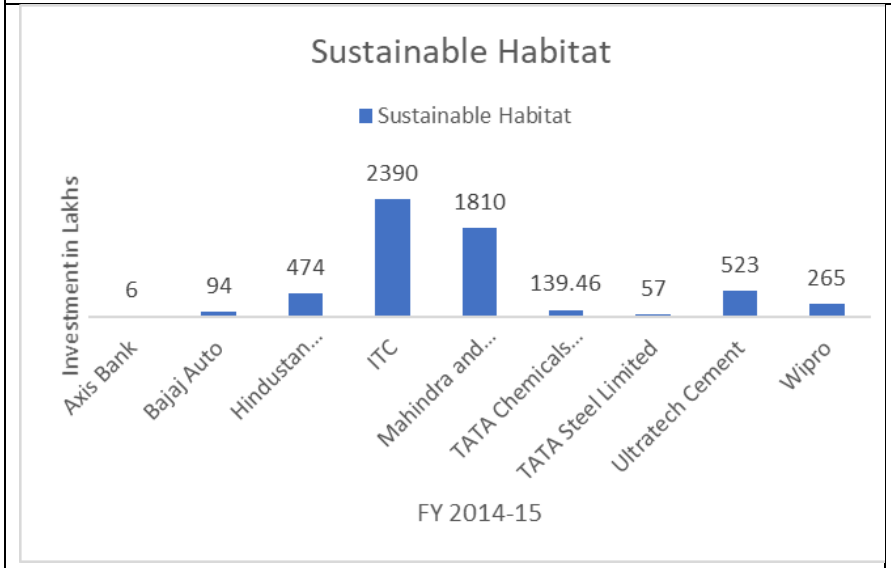


Total Investment = 7268 Lakhs (Indian Rupees)

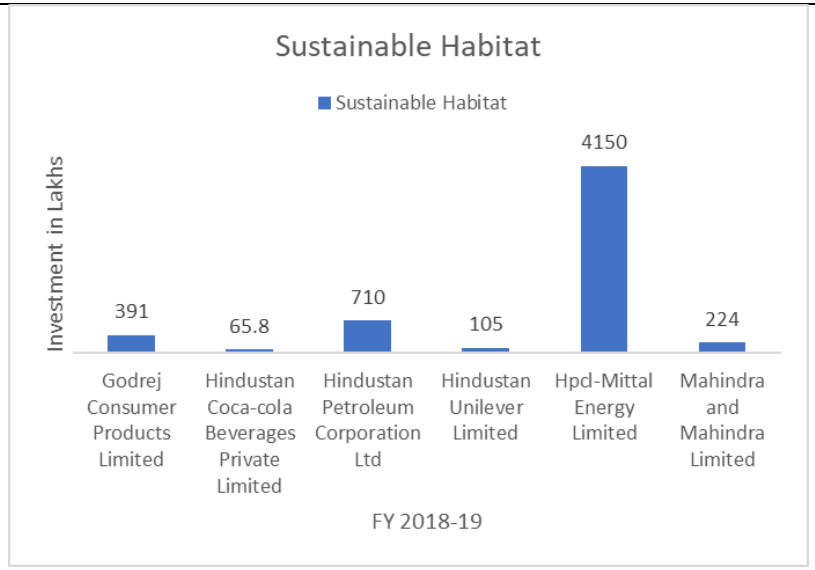


Total Investment = 51980.2 Lakhs (Indian Rupees)

India is amongst the few countries of the world where forests are growing despite tremendous population and livestock pressures. India's forests act as a net carbon sink; about 12% of India's GHG emissions are offset by the LULUCF sector. India has a target of raising its existing 21.54% forest cover to 33% of the total geographical area through aggressive afforestation and green cover in Trees Outside Forests (ToF). This includes the goal of adding 2.5 to 3 bn tons of carbon stock to the existing stock of 7 bn tons. It was observed that private firms have been following the footsteps of Government in order to achieve the National Forest and Biodiversity targets and hence the sector has maximum contribution and investments. It is expected that the investment will see a positive growth in future also due the length of benefits and co-benefits it offers.

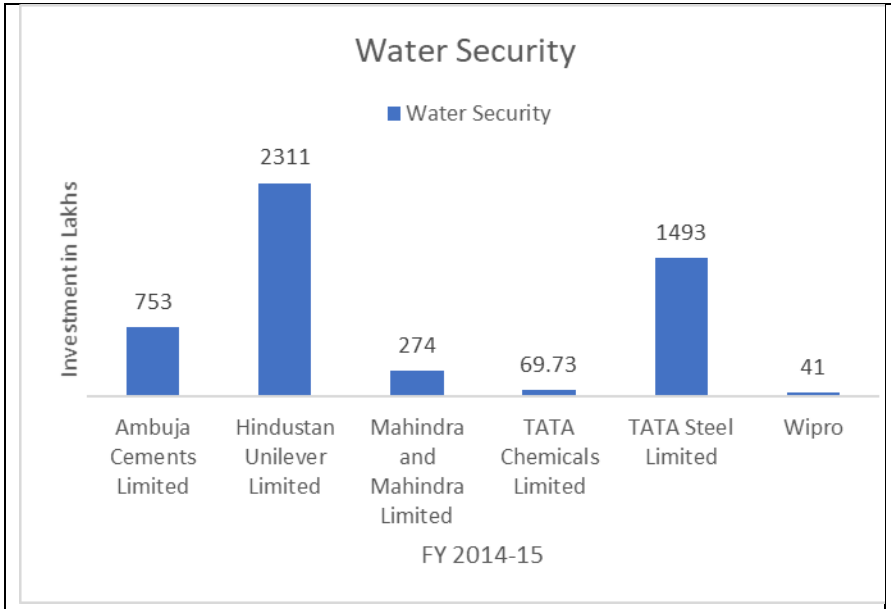


Total Investment = 5758 Lakhs (Indian Rupees)

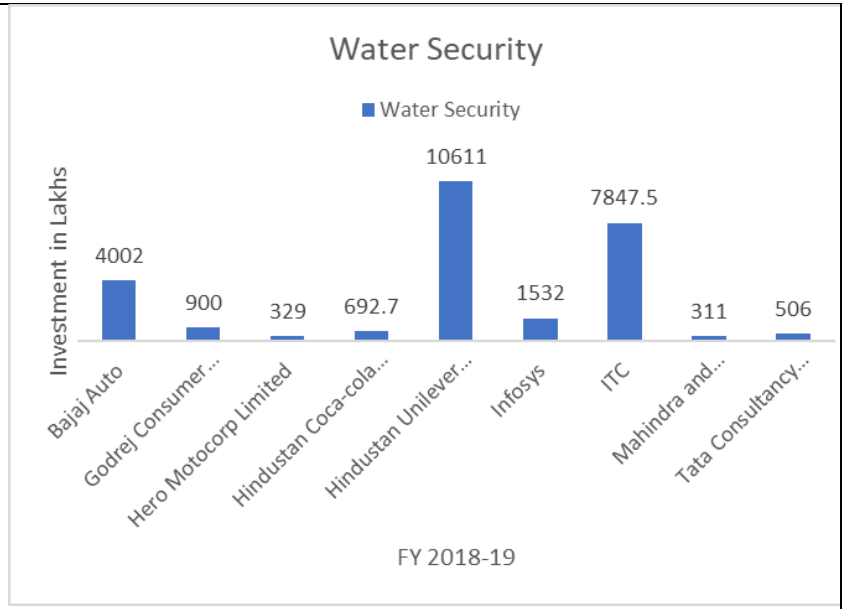


Total Investment = 5645.8 Lakhs (Indian Rupees)

Sustainable habitat sector has seen constant growth with rise in the problems related to Urban waste, air pollution, challenges in the transport, green infrastructure and wastewater management.



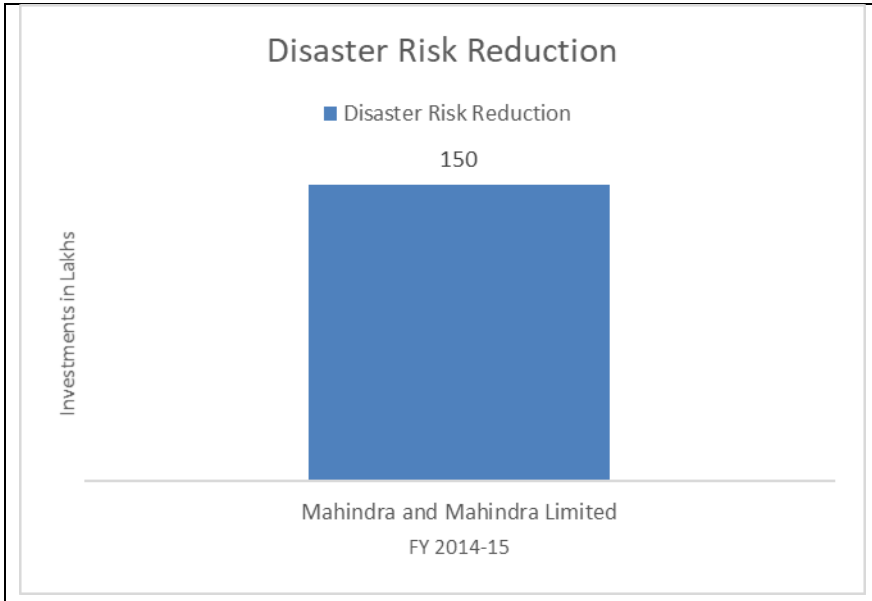
Total Investment = 4942 Lakhs (Indian Rupees)



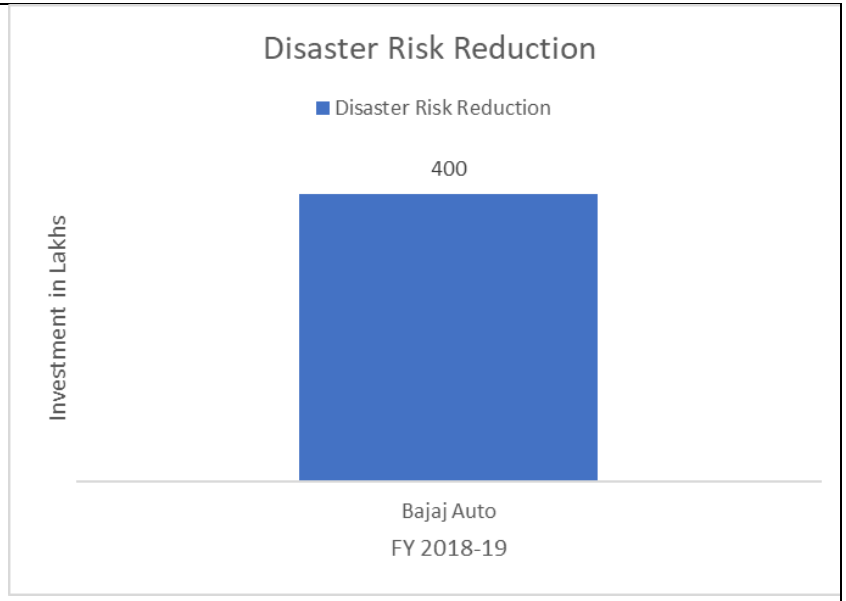
Total Investment = 26731 Lakhs (Indian Rupees)

With several successful example of Payment for ecosystem service, watershed development, rainwater harvesting and water conservation programs the sector has offered tremendous rate of returns upon investment in terms of direct and indirect benefits. Hence, the investment in the sector has grown exponentially.

The trend points to an overall increase in corporate investment towards Water Security and an overall 6x increase in investments in this sector. In the case of HUL alone, we see a 5x increase in investments in Water Security. Working with the private sector to bolster investments that contribute to water security will be an important part of scaling up NbS efforts in India.



Total Investment = 150 Lakhs (Indian Rupees)



Total Investment = 400 Lakhs (Indian Rupees)

The sector still hasn't gotten the needed attention fron private firms, however after the COVID-19 pandemic the sector is expected to have positive investment in coming years.