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Network India

STATE OF THE SECTOR REPORT 2025

Business and Biodiversity in India

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STATE OF THE SECTOR REPORT 2025

Business and Biodiversity in India

CONTENTS

MESSAGE

Ratnesh Jha
Executive Director, UN Global Compact Network India

India's natural ecosystems—from forests and coasts to grasslands, wetlands, and cultivated landscapes—form the ecological foundation of our economy, our food systems, and our climate resilience. As environmental challenges intensify, biodiversity loss has emerged as a critical business risk, but also a powerful opportunity for corporate leadership. This State of the Sector Report 2025 – Business and Biodiversity in India comes at a pivotal time, offering an in-depth analysis of how Indian businesses across key sectors are responding to this complex and urgent agenda.

The report presents a sector-wise mapping of biodiversity dependencies, impacts, and opportunities, with insights drawn from agriculture, fisheries, energy, mining, manufacturing, and packaging industries. Through case studies and emerging good practices, it showcases how companies are beginning to embed biodiversity considerations into their ESG frameworks, CSR strategies, and operational models. These actions reflect a growing recognition that biodiversity is not just a matter of compliance or philanthropy—it is essential to long-term business resilience and sustainable value creation. I am thankful to all colleagues and technical experts who have contributed to developing this important document. I am especially thankful to BVLGARI for their generous financial support in developing this publication.

This publication also aligns with India's policy ambitions, including the Biological Diversity Act, the National Biodiversity Action Plan, and the evolving Business Responsibility and Sustainability Reporting (BRSR) requirements. It emphasizes the importance of aligning corporate strategies with global frameworks like the Kunming-Montreal Global Biodiversity Framework, TNFD, and SDGs, helping Indian businesses prepare for the emerging global nature economy.

As we move forward, it is imperative that the private sector acts as a co-creator in biodiversity-positive development. This report serves as a strategic roadmap and a call to action—for businesses to adopt nature-positive principles, invest in ecosystem restoration, strengthen supply chain responsibility, and collaborate across sectors for collective impact. By doing so, we can ensure that India's economic growth advances hand in hand with ecological stewardship, securing a more resilient and inclusive future for all.

ACKNOWLEDGEMENTS

The **"State of the Sector Report 2025 – Business and Biodiversity in India"** is the outcome of rigorous research, multi-stakeholder collaboration, and a shared commitment to advancing nature-positive practices within India's corporate sustainability landscape.

This report has been made possible through the visionary leadership, unwavering encouragement, and sustained support of Mr. Ratnesh Jha, Executive Director, United Nations Global Compact Network India (UNGCNI). His strategic guidance and strong commitment to embedding sustainability into corporate discourse provided the foundation for this timely and important exploration at the intersection of business and biodiversity.

Special recognition is due to Mr. Suneel Padale, Senior Technical Advisor, UNGCNI, whose intellectual leadership and clarity of vision were instrumental in shaping this initiative. His deep understanding of ecological systems, institutional frameworks, and biodiversity governance in India significantly influenced the report's conceptual framework, scope, and thematic direction. His tireless efforts in compiling, editing, and finalizing this document were pivotal to its successful completion.

This report has also greatly benefited from the contributions of subject-matter experts who brought sectoral insights and analytical rigour to its development. The chapters on Agriculture and Agri-Business, Fisheries and Marine, and Food and Beverages sectors were authored by Mr. Peeyush Sekhsaria, with valuable research support from Ms. Devashree Degwekar. The sections on Mining and Energy sectors were prepared by Dr. Somnath Bandyopadhyay. The chapters on Textiles, Automobiles, and Plastics and Packaging were authored by Ms. Sakshi Grover. Additional thematic sections of the report were drafted by Ms. Pavithra Ganesh, Technical Specialist – Biodiversity, UNGCNI. Sincere thanks are extended to each of them for their dedication, technical expertise, and outstanding contributions, which have added depth and quality to this publication.

UNGCNI extends its gratitude to the donor BVLGARI for its generous financial support and belief in the value of this research. Their investment in biodiversity and sustainable development enabled the comprehensive sectoral assessments presented in this report and reflects their broader commitment to ecological restoration and responsible business practices.

EXECUTIVE SUMMARY

The “State of the Sector Report 2025 – Business and Biodiversity in India”, developed by the United Nations Global Compact Network India (UNGCNI) with financial support from BVLGARI, presents a comprehensive analysis of how Indian businesses interact with biodiversity and the vital role they play in its conservation. As India stands at a critical ecological juncture, this report emphasizes that biodiversity is not just a natural heritage or moral responsibility, it is an economic imperative and a strategic lever for long-term

business resilience. The report makes a compelling case for integrating biodiversity into core business strategies, ESG frameworks, CSR investments, and financial instruments, positioning biodiversity-positive action as important to India's sustainable development trajectory.

India's diverse ecosystems - from the Himalayas and mangroves to arid zones and coral reefs, are the foundation of numerous ecosystem services that power its economy. These include pollination, carbon sequestration, water purification, and flood mitigation, which underpin sectors such as agriculture, energy, infrastructure, and pharmaceuticals. However, these ecosystems are under growing pressure from unsustainable practices, climate change, and industrial expansion. The report illustrates how industries are both dependent on and impactful to biodiversity, and how this interdependence must inform business decisions moving forward.

A core component of the report is its sector-wise analysis, covering eight key sectors with high biodiversity relevance: Agriculture and Agri-business, Fisheries and Marine, Food and Beverages, Mining, Energy, Textiles, Automobiles, and Plastics and Packaging. Each sector is assessed for its biodiversity footprint, current initiatives, policy context, and opportunities for further action. While some industries have begun adopting nature-positive practices such as regenerative sourcing, circular manufacturing, and habitat restoration, there remain significant gaps in data, integration, and long-term accountability.

The report also explores the evolving policy and regulatory landscape in India, including instruments such as the Biological Diversity Act (2002), the CSR mandate under the Companies Act (2013), the BRSR framework by SEBI, and recent developments such as the National Biodiversity Strategy and Action Plan (2024–30) and the Green Credit Programme (2023). In parallel, it highlights India's alignment with global frameworks such as the Kunming-Montreal Global Biodiversity Framework, TNFD, SDGs, and the Nagoya Protocol, underscoring the convergence of national priorities with international biodiversity commitments.

Looking ahead, the report offers a vision for accelerating corporate biodiversity leadership through technical innovation, biodiversity-linked disclosures, and collaborative partnerships. It advocates for enhanced corporate capacity, sectoral benchmarks, and inclusive stakeholder engagement, including with communities, biodiversity boards, and local institutions.

Ultimately, this report calls on Indian businesses to move beyond compliance and adopt biodiversity as a lens for strategic decision-making, risk management, and value creation. By doing so, companies can not only safeguard natural ecosystems but also future proof their operations, enhance stakeholder trust, and contribute to a regenerative economy. The "State of the Sector Report 2025" is both a mirror and a map - reflecting where we stand and pointing to where we must go to ensure that business and biodiversity thrive together in India's development journey.

1. INTRODUCTION

India, with its unparalleled biodiversity, stands as one of the world's most significant repositories of natural wealth. Just 17 of the world's 190 or so countries contain 70 percent of its biodiversity, earning them the title "megadiverse." India is one of these megadiverse countries with 2.4% of the land area, accounting for 7-8% of the species of the world, including about 91,000 species of animals and 45,500 species of plants, that have been documented in its ten bio-geographic regions. Its ecosystems span across majestic Himalayas, rich deciduous forests, sprawling wetlands, fertile agricultural plains, and vibrant coral reefs. This diversity not only symbolizes India's ecological richness but also reflects centuries of co-existence and reverence for nature that are deeply rooted in its cultural and spiritual heritage.

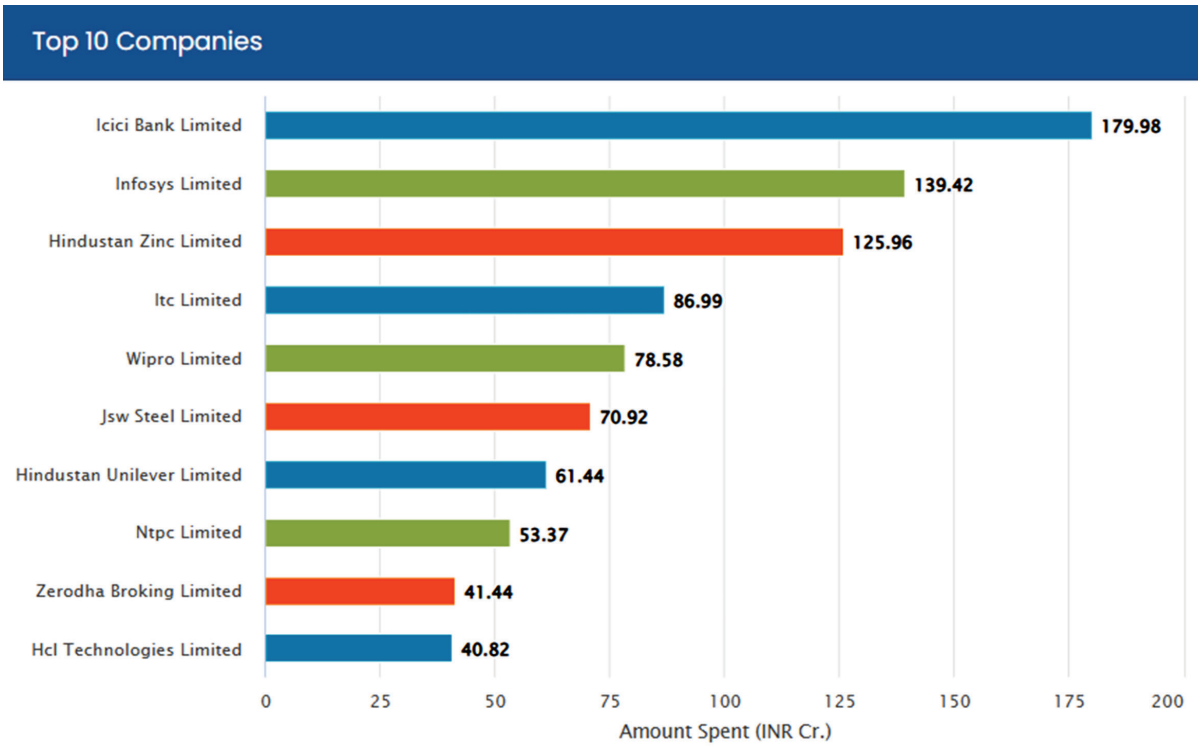
This wealth of biodiversity is not merely a natural endowment but also a critical economic engine for India. Businesses across diverse sectors—from agriculture and fisheries to pharmaceuticals, manufacturing, and tourism—derive immense benefits from ecosystem services. Pollination ensures the productivity of cash crops; water filtration secures clean resources for manufacturing industries; and carbon sequestration by forests mitigates climate risks that directly impact sectors like infrastructure, real estate, and insurance. India's economy is deeply linked to this natural foundation, with ecosystem services contributing billions annually.

However, this natural capital faces mounting pressures from anthropogenic activities and the growing impacts of climate change. The country has already experienced a 0.7°C increase in average temperature over the last century, with predictions indicating a rise of 2–4°C by the end of the century. Erratic monsoon patterns, increasing frequency of floods, droughts, and cyclones, and a rise in sea levels are not just environmental warnings but economic risks. For instance, industries relying on predictable monsoons and stable ecosystems are increasingly vulnerable to disruptions caused by climate irregularities.

As businesses stand to gain immeasurable value from biodiversity, they also bear the responsibility to protect it. For example, agro-industries depend on healthy pollinator populations, while coastal industries benefit from mangroves acting as natural barriers against storm surges. Companies embracing biodiversity-positive practices can unlock new opportunities—ranging from financial instruments like biodiversity credits to the competitive advantage of aligning with consumer demand for sustainable practices. This interdependence between businesses and biodiversity underscores the urgent need for collaborative action to address ecological challenges and secure long-term resilience.

Further, India's CSR mandate, outlined in Section 135 of the Companies Act, requires businesses with certain financial thresholds to allocate 2% of their average net profits toward social causes, with environmental sustainability among them. According to the Ministry of Corporate Affairs (MCA), Indian businesses contributed roughly ₹30,000 crore to CSR activities in FY 2022-2023 and around ₹2,900 crore (less than 10%) directed toward environmental sustainability initiatives. This CSR framework creates a structured avenue for private sector contributions to biodiversity and climate action, allowing companies to fund projects that support ecosystem restoration, conservation education, and sustainable livelihood generation.

Top 10 Companies - CSR Spent on-Environment, Animal Welfare and Conservation of Resources



Source: National CSR Portal

1.1 Objectives of the report

1. **Understand Business-Biodiversity Interactions** Analyze how businesses depend on and impact biodiversity in India.
2. **Sector-Specific Review of Impacts** Assess biodiversity footprints, conservation efforts, and emerging trends in selected sectors.
3. **Evaluate the Policy and Regulatory Landscape** Examine India's biodiversity policies and their alignment with global frameworks.
4. **Address Barriers to Corporate Biodiversity Action** Identify challenges such as financial, operational, and awareness gaps hindering action.
5. **Align Corporate Strategies with Global and National Goals** Bridge corporate initiatives with India's biodiversity commitments and global targets.

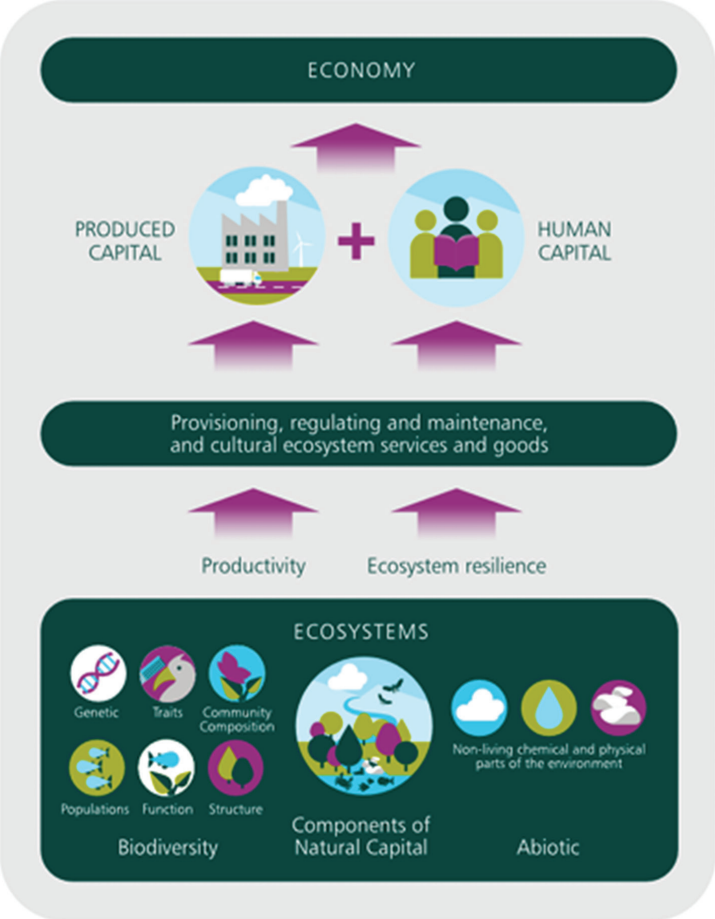
6 **Promote Collaboration Across Stakeholders** Highlight opportunities for partnerships, blending traditional knowledge with innovation.

7 **Incentivize Conservation Through Financial Tools** Explore mechanisms like biodiversity credits and green bonds for corporate engagement.

8 **Develop Actionable Recommendations** Indicate strategies for businesses, policymakers, and investors to advance biodiversity goals.

1.2 Importance of biodiversity for businesses

Biodiversity – the intricate web of life encompassing ecosystems, species, and genetic diversity – is facing an alarming rate of destruction. This fact is widely recognised. However, what is less commonly acknowledged is the profound impact that biodiversity loss has on businesses. Biodiversity is the cornerstone of essential services—such as pollination, clean water, and climate stability—that businesses rely on. Take agriculture, for example: it depends on pollinators like bees, which contribute an impressive $235–$577 billion annually to global food production. Similarly, forests play a critical role as carbon sinks, absorbing around 7.6 billion metric tons of CO2 every year. According to the Economic Survey of India 2023–24, India has already created a carbon sink of 1.97 billion tonnes of CO_2 equivalent between 2005 and 2019, primarily through forest and tree cover. The country aims to expand this further, targeting an additional 2.5 to 3 billion tonnes of CO_2 equivalent by 2030. In the Indian Context, the economic value of pollinators is not well studied, but indications from the limited available studies suggest that it is high. Therefore, the values for the entire country are likely to be much higher



Source: The economics of biodiversity: the dasgupta review (abridged version)

and could be up to Rs. 2,250 crores annually. This not only helps stabilize the climate but also supports industries like timber and tourism. However, the degradation of these ecosystems introduces significant risks.

For instance, declining soil fertility and water scarcity could drive up operational costs for sectors such as agriculture and manufacturing. The material natural risks for biodiversity from businesses can be linked to the following,

Dependency: When a business relies directly on nature - such as fresh water, pollination, or fertile soils—as part of its operations, any disruption to these natural resources can significantly affect financial performance. For example, beverage companies depend on a consistent supply of clean water, food companies require stable crop yields and arable land, and biopharma companies look to ecosystems for discovering new medicinal sources.

Impact: Business activities that harm nature, whether directly or indirectly, can lead to reputational damage, financial losses, or even legal repercussions. With growing awareness, stakeholders, including employees, consumers, investors, policymakers, and communities are increasingly expecting companies to take responsibility for their biodiversity impact. Effectively managing this impact is crucial to maintaining their social license to operate and safeguarding long-term success.

Embracing biodiversity within business strategies is more than a protective measure. It is a powerful growth opportunity. The World Economic Forum estimates that a nature-positive approach could unlock $10.1 trillion in business opportunities and create up to 395 million jobs by 2030. By prioritizing biodiversity, businesses can secure their future while also tapping into the competitive advantages of meeting the demands of environmentally conscious consumers. It's a win-win that aligns profitability with sustainability.

1.3 Scope and Methodology

This report is a comprehensive examination of corporate actions and their interplay with biodiversity conservation, focusing on India. It aims to assess challenges, identify opportunities, and propose actionable strategies for enhancing biodiversity-positive business practices. The expanded scope includes:

1. Sector-Specific Analysis:

Evaluating biodiversity dependencies, impacts, and conservation initiatives across the following key sectors:

- **Mining and Extractives:** Analyzing the effects of land-use changes, resource depletion, and habitat restoration practices.
- **Energy (Oil, Gas, Coal, and Renewables):** Exploring biodiversity impacts from both traditional fossil fuels and renewable energy projects.

- **Infrastructure and Real Estate:** Assessing biodiversity loss due to urban expansion and examining green infrastructure solutions.
- **Agriculture and Agribusiness:** Investigating sustainable farming practices, pesticide impacts, and agroforestry models.
- **Fisheries and Marine Sector:** Exploring issues like overfishing, coral reef degradation, and sustainable aquaculture practices.
- **Food and Beverage:** Assessing biodiversity impacts along the supply chain and examining sustainable sourcing strategies.
- **Manufacturing and Heavy Industry:** Studying emissions, resource extraction, and green manufacturing practices.
- **Pharmaceuticals and Biotechnology:** Focusing on bioprospecting, Access and Benefit Sharing (ABS) compliance, and the use of genetic resources.
- **Textiles, Plastics, and Packaging:** Analyzing waste management, pollution control, and the role of circular economy initiatives.

2. Policy and Regulatory Landscape:

- Mapping India's regulatory frameworks, including the **Biological Diversity Act, 2002, Access and Benefit Sharing (ABS)** mechanisms, **Business Responsibility and Sustainability Reporting (BRSR)** framework, **Corporate Social Responsibility (CSR) provisions under the Companies Act, 2013, and Environmental Protection Act, 1986.**
- Highlighting linkages of potential corporate with relevant **global frameworks such as Global Biodiversity Framework (GBF), Taskforce on Nature-related Financial Disclosures (TNFD), United Nations Sustainable Development Goals, Nagoya Protocol, Global Reporting Initiative (GRI),** and **Sustainability Accounting Standards Board (SASB).**

3. Corporate Biodiversity Practices:

- Reviewing ESG disclosures, CSR activities, and biodiversity-linked financial mechanisms like biodiversity credits, green bonds, and conservation trust funds.
- Identifying emerging biodiversity-positive business models, voluntary commitments, and industry-specific practices.

4. Stakeholder Collaboration:

Incorporating perspectives from businesses, policymakers, financial institutions, environmental experts, and community representatives, including Biodiversity Management Committees (BMCs).

5. Global Benchmarking and Alignment:

Comparing corporate biodiversity practices in India with global standards and identifying actionable opportunities for improvement.

METHODOLOGY

A. Literature Review The report employs a systematic review of existing research, reports, and frameworks:

1. Sectoral Literature:

- Reviewing academic research, government policies, and industry white papers across the listed sectors to assess biodiversity dependencies and impacts.
- Documenting best practices, emerging trends, and challenges in biodiversity conservation within each sector.

2. Review of Policies and Frameworks:

- Analyzing biodiversity-related Indian laws and regulations, such as the Biological Diversity Act, BRSR framework, CSR provisions, ABS mechanisms, and Environmental Protection Act.
- Benchmarking against global standards like TNFD, CBD, Nagoya Protocol, SDG 15, and Ramsar Convention for Wetland Conservation.

3. Corporate Reports and Disclosures:

- Evaluating sector-specific sustainability reports, ESG disclosures, and annual CSR activities from leading Indian corporations.
- Identifying gaps and opportunities for better integration of biodiversity in corporate strategies.

4. Emerging Business Innovations:

- Highlighting cutting-edge innovations such as nature-based solutions, and circular economy practices that align corporate profitability with conservation goals.

B. Data Collection and Analysis

1. Quantitative Metrics:

- Measuring biodiversity impacts through indicators like species decline, habitat loss, pollution levels, and forest restoration.
- Mapping financial contributions to conservation through CSR funding, ESG allocations, and biodiversity-linked financial instruments.

2. Qualitative Assessment:

- Documenting case studies of successful biodiversity-positive initiatives, highlighting replicable practices and conservation outcomes.
- Analyzing stakeholder perspectives to identify challenges, gaps, and opportunities for action.

3. **Comparative Studies:** Benchmarking India's corporate biodiversity actions against global practices to evaluate alignment and identify areas for improvement.

C. Stakeholder Engagement

Key Informant Interviews (KIIs): Seeking perspectives from business leaders, policymakers, conservation experts, and financial institutions to validate findings and gather actionable insights.

D. Report Development

1. **Integration of Insights:** Consolidating research findings, stakeholder inputs, and quantitative data into a structured narrative.
2. **Actionable Recommendations:** Proposing sector-specific and cross-cutting biodiversity strategies, focusing on regulatory compliance, technological innovation, and stakeholder collaboration.
3. **Alignment with Frameworks:** Ensuring that all recommendations align with India's national priorities and international commitments, such as the Kunming-Montreal Global Biodiversity Framework.

2. OVERVIEW OF BUSINESS AND BIODIVERSITY IN INDIA

India's commitment to achieving its climate and biodiversity goals finds a powerful ally in the private sector, which has the potential to translate environmental promises into actionable outcomes. The nation's private enterprises span a broad spectrum of industries—including agriculture, energy, manufacturing, pharmaceuticals, and technology—each uniquely influencing and relying on ecosystems. By embedding climate and biodiversity

priorities into their business strategies, CSR initiatives, ESG frameworks, and philanthropic efforts, companies can make significant strides towards advancing both national and global environmental objectives.

2.1 The role of businesses in biodiversity conservation

Businesses hold a profound responsibility in the arena of biodiversity conservation, given their reliance on natural ecosystems and their capacity to influence ecological outcomes. In India, this responsibility is even more critical due to the nation's immense ecological wealth, which supports not only economic activities but also the cultural and environmental fabric of the country.

India's biodiversity directly sustains numerous industries. The agricultural sector, for instance, depends on the intricate balance of ecosystems for services such as pollination, nutrient cycling, and water regulation. Similarly, sectors such as mining, textiles, and automobiles draw significantly from the country's natural resources. However, this reliance comes with an inherent responsibility: the need to protect and conserve these ecosystems for their sustained functionality.

Operational Changes

Operational changes within companies can significantly reduce ecological footprints, drive sustainable resource use, and foster biodiversity protection. Indian companies are increasingly recognizing that environmental sustainability is not just a corporate responsibility but also a driver of long-term value. According to a 2021 survey by the Confederation of Indian Industry (CII), approximately 43% of surveyed companies identified biodiversity as a material issue in their operations, and many expressed interests in adopting practices that contribute to ecosystem conservation.

Building on this recognition, companies are implementing specific measures to align their operations with biodiversity goals. Whether it is rethinking supply chains to prioritize sustainable raw materials, transitioning to renewable energy sources, or adopting circular economy models for waste and water management, these actions demonstrate a tangible commitment to reducing their environmental impact. Such efforts not only protect ecosystems but also enhance operational efficiency, create long-term resilience, and position businesses as leaders in sustainable growth. The following examples illustrate how Indian companies are turning these aspirations into reality.

Supply Chain Sustainability: By prioritizing sustainably sourced raw materials, companies mitigate negative impacts on biodiversity. For example, the apparel sector is shifting towards organic and sustainably harvested cotton, which reduces pesticide use and preserves soil health. Reliance Industries has adopted sustainable sourcing practices by investing in biodegradable and recycled materials, reducing the ecological impact of raw material extraction.

Energy and Emission Reductions: As part of the renewable energy transition, Indian companies are increasingly investing in solar, wind, and other renewable sources. Tata Power, for example, has set a target to become net-zero by 2045 through initiatives like renewable energy expansion and forestation projects. The company's Project Aranya has planted millions of trees in Maharashtra and Jharkhand, enhancing carbon sequestration and supporting local biodiversity.

Waste and Water Management: Indian businesses are adopting circular economy models to minimize waste. Hindustan Unilever, through its 'Sustainable Living Plan,' has committed to reducing plastic waste and has collaborated with NGOs and local communities to improve plastic collection and recycling. Additionally, water stewardship initiatives by companies like ITC Limited aim to create water-positive sites in drought-prone regions, benefiting both biodiversity and local communities.

Corporate Social Responsibility (CSR)

Under the Companies Act of 2013, India is among the very few countries with mandatory CSR for businesses meeting certain financial thresholds, requiring them to allocate 2% of their average net profits over the past three years to social initiatives. Environmental sustainability, one of the eligible CSR categories, provides a structured avenue for companies to invest in biodiversity and climate action. In FY 2022-2023, CSR contributions in India reached approximately ₹30,000 crore (USD 3.75 billion), with a significant portion directed toward environmental projects (Ministry of Corporate Affairs, 2024).

1. **Ecological Restoration Projects:** Indian Oil Corporation's (IOC) CSR initiatives focus on ecological restoration through projects like reforestation, water conservation, and mangrove restoration. By 2022, IOC had restored over 2,000 hectares of degraded land, which helps enhance carbon capture and protect biodiversity.

2. **Sustainable Livelihood Programs:** Companies are also investing in sustainable livelihood programs to support communities that depend on natural resources. The Mahindra Group's Project Hariyali has planted millions of trees and promoted agroforestry, which not only sequesters carbon but also provides livelihoods to rural communities, reducing deforestation pressures.

3. **Protected Area Support:** Some corporations fund conservation efforts in protected areas through CSR. For example, the JSW Group has invested in the conservation of tigers and biodiversity in Karnataka's Bhadra Tiger Reserve, reinforcing the protection of critical habitats and endangered species.

Environmental, Social, and Governance (ESG) Practices

As global investors demand higher sustainability standards, ESG has become a major focus for Indian companies aiming to attract capital and manage risk. ESG frameworks encourage companies to include environmental metrics in their reporting, fostering accountability in biodiversity and climate commitments. According to a 2022 study by MSCI, the total assets under management incorporating ESG factors in India are expected to grow by 20% annually through 2025, driven by demand from both domestic and international investors.

1. **Biodiversity Metrics:** Integrating biodiversity indicators into ESG reporting is a growing trend. Companies such as Infosys have started including biodiversity risks in their ESG disclosures, addressing impacts on natural habitats and species and setting measurable biodiversity goals.

2. **Sustainable Finance and Investment:** The financial sector plays a critical role in driving biodiversity-positive investments. In 2021, HDFC Bank launched India's first green deposit program, encouraging investment in projects that support environmental goals, including biodiversity conservation. Similarly, SBI Green Bonds channel funds into sustainable projects, including those that restore ecosystems or support green infrastructure.

3. **Sustainable Supply Chains and Certifications:** Companies like ITC Limited and Tata Steel have adopted the Science Based Targets initiative (SBTi) to reduce greenhouse gas emissions in line with climate science, with additional measures for sustainable sourcing and biodiversity-friendly practices. Certifications, such as the Forest Stewardship Council (FSC) and Rainforest Alliance, are becoming more prevalent as companies aim to demonstrate sustainability in their supply chains.

Philanthropic Initiatives

Beyond CSR and ESG, corporate philanthropy provides Indian companies with a flexible avenue to fund conservation, restoration, and community-focused projects. Philanthropic initiatives can support innovative models of conservation financing, bridge funding gaps in critical projects, and provide direct financial support to biodiversity and climate causes.

1. Private Foundations: Large Indian corporations often have foundations that support biodiversity-related work. The Tata Trusts, one of the oldest philanthropic institutions in India, has invested in wildlife conservation, marine ecosystem research, and community-based environmental programs.

2. Funding for Research and Innovation: Corporate philanthropy also supports research and capacity-building efforts. For example, the Wipro Foundation funds initiatives in sustainable agriculture and biodiversity education, fostering awareness and equipping local communities with the skills needed for conservation.

3 Community Conservation Projects: Philanthropic contributions frequently go toward community-based conservation projects, which combine environmental and social benefits. The Aditya Birla Group supports local NGOs in creating community forests, which help mitigate deforestation and promote biodiversity-friendly practices among local communities.

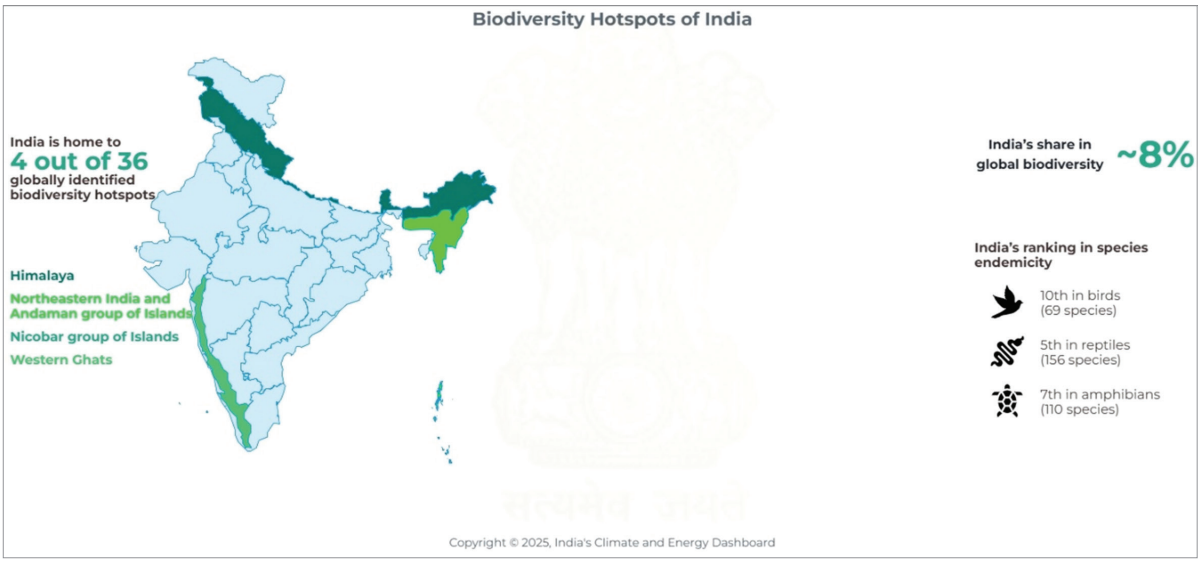
2.2 Global and national trends in corporate biodiversity action

Corporate biodiversity action is no longer a peripheral concern but a central pillar of sustainable development. As businesses worldwide grapple with the dual challenges of economic growth and environmental stewardship, the integration of biodiversity considerations into corporate strategies has emerged as a transformative approach. In India, where biodiversity is both a national treasure and a critical economic resource, the private sector is stepping up with innovative initiatives that not only mitigate ecological risks but also unlock new opportunities for growth and resilience.

The Global Context

Globally, the economic value of biodiversity is staggering. Ecosystem services such as pollination, water purification, and climate regulation underpin over $44 trillion of global GDP—more than half of the world's economic output. Yet, biodiversity loss continues at an alarming rate, driven by habitat destruction, climate change, and unsustainable practices. Recognizing this, frameworks like the Kunming-Montreal Global Biodiversity Framework (GBF) have set ambitious targets, including restoring 30% of degraded ecosystems by 20302. Businesses are increasingly aligning with these goals, spurred by investor pressure and the realization that biodiversity is not just an ethical imperative but a business necessity.

The Indian Landscape



Biodiversity conservation is no longer an optional part of corporate social responsibility—it has become central to the sustainability and longevity of businesses in India. Across industries, Indian corporations are stepping forward to repair, restore, and protect ecosystems, proving that economic growth and ecological preservation can go hand in hand. From dense forests and thriving wetlands to barren mined-out landscapes, companies are demonstrating innovation and responsibility in addressing biodiversity loss.

In resource-rich areas such as Jharkhand and Odisha, corporations are leading large-scale reforestation efforts. These lands, once left scarred by industrial and mining activities, are being transformed into vibrant ecosystems. Millions of saplings, specifically native species, are being planted to mimic the local habitat, ensuring not just green cover but the revival of wildlife corridors and ecological balance. But it's not only about planting trees—these initiatives involve the people who live in the region. Tribal communities, who depend heavily on the land for their livelihoods, are being engaged to nurture the forests. This empowers them while ensuring sustained conservation. The ecological benefits are evident: enhanced soil quality, stabilization of degraded land, and an impressive annual carbon sequestration that offsets significant emissions.

Further afield, along India's coastal belts, businesses have turned their focus to mangrove restoration. Mangroves are nature's frontline defenders, safeguarding coastal communities against storms, erosion, and rising sea levels. The restoration of these wetlands not only brings back biodiversity but also provides a protective buffer that reduces the economic and human costs of natural disasters. Community involvement has been key, with locals trained and employed in mangrove planting and monitoring, creating livelihood opportunities in areas that often lack them.

The mining sector, often viewed as a threat to biodiversity, is showing how even extractive industries can leave a positive legacy. Once mining operations are complete, companies are investing in progressive land reclamation, turning barren mine sites into lush green zones. These reclaimed lands are being rehabilitated with native vegetation that supports wildlife and restores the ecological balance of the region. Water conservation has also become a priority, with measures to prevent mining by-products from contaminating local water sources—an initiative that benefits both biodiversity and neighbouring communities.

Indian companies are also addressing challenges in the agricultural heartlands through watershed programs that protect and regenerate water resources. By implementing holistic strategies, corporations are enhancing water security for hundreds of thousands of farmers, increasing agricultural productivity while promoting sustainable farming practices. The improved water availability also benefits local flora and fauna, underscoring the link between biodiversity and food security.

Driving Change Through Collaboration

These success stories underscore the transformative potential of integrating biodiversity into business strategies. However, achieving meaningful progress requires multi-stakeholder collaboration. Investors, policymakers, and communities must work together to create

enabling frameworks, provide financial support, and ensure long-term stewardship of natural resources. Frameworks like the Taskforce on Nature-related Financial Disclosures (TNFD) and the Finance for Biodiversity Foundation are paving the way by providing metrics and guidelines for assessing and managing biodiversity risks.

Corporate biodiversity action in India is a testament to the power of innovative thinking and collective responsibility. From afforestation to coastal conservation, businesses are proving that economic growth and ecological preservation are not mutually exclusive. As India aligns its corporate strategies with global biodiversity goals, it is setting an example for the world to follow. The journey ahead demands sustained effort, robust policies, and a commitment to balance profit with purpose. By protecting biodiversity, companies are not just safeguarding nature—they are investing in the resilience and prosperity of future generations.

2.3 Key drivers for business engagement (regulation, consumer demand, investor interest)

Businesses today are navigating a rapidly evolving landscape where sustainability is no longer a choice but a necessity. This shift is driven by a confluence of factors—regulatory frameworks, investor priorities, consumer expectations, and technological advancements—all of which are reshaping the way companies operate and engage with the world.

Regulatory Frameworks: The Backbone of Accountability

Governments and international bodies are setting the stage for a sustainable future through stringent regulations. In India, the Environment Protection Act (1986) and the Forest Conservation Act (1980) ensure that businesses adhere to environmental standards, while the Wildlife Protection Act (1972) safeguards biodiversity. The Business Responsibility and Sustainability Reporting (BRSR) framework, mandated by SEBI, compels the top 1000 listed companies to disclose their environmental, social, and governance (ESG) practices, emphasizing biodiversity conservation and ecosystem protection.

Globally, the Paris Agreement and the Taskforce on Nature-related Financial Disclosures (TNFD) are pushing businesses to integrate climate and nature-related risks into their strategies. These frameworks are not just about compliance; they are about embedding sustainability into the DNA of corporate operations. For instance, the EU Green Deal aims to make Europe climate-neutral by 2050, setting a benchmark for global sustainability efforts.

Corporate Social Responsibility: Beyond Compliance

Corporate Social Responsibility (CSR) has evolved from a philanthropic add-on to a strategic imperative. In India, the Companies Act (2013) mandates CSR activities for certain companies, ensuring that businesses contribute to societal well-being. Initiatives like community-based

conservation projects and investments in education and healthcare are creating shared value for businesses and society.

Investor Interest: The Financial Case for Sustainability

Investors are increasingly viewing sustainability as a marker of resilience and long-term profitability. ESG-focused investments are on the rise, with assets under management expected to represent half of all professionally managed assets globally by 2024. This shift is driven by the understanding that companies with strong ESG practices are better equipped to navigate risks and seize opportunities in a changing world.

Industries like renewable energy, sustainable agriculture, and green technology are attracting significant capital. For example, green bonds and sustainability-linked loans are becoming popular financial instruments, enabling businesses to fund eco-friendly projects while demonstrating their commitment to sustainability. Investors are not just looking for financial returns; they are seeking alignment with their values, making sustainability a key criterion for investment decisions.

Consumer Demand

Consumers are wielding their purchasing power to drive change. Sustainability is no longer a "nice-to-have"; it is a baseline expectation. Research shows that consumers, especially younger generations, are willing to pay a premium for products that align with their values.

This shift is not limited to niche markets. Mainstream consumers are demanding transparency and accountability, pushing companies to adopt sustainable practices across their supply chains. For instance, the rise of plant-based diets and the popularity of electric vehicles reflect a broader societal shift towards sustainability.

Technological Advancements: Enabling the Transition

Technology is a powerful enabler of sustainability. Innovations in renewable energy, such as high-efficiency solar panels and advanced wind turbines, are making clean energy more accessible and affordable. In agriculture, precision farming techniques and vertical farming are reducing resource use while increasing yields.

Digital tools like blockchain are enhancing transparency in supply chains, allowing consumers to trace the origins of products and verify their sustainability credentials. Artificial intelligence and big data are helping businesses optimize resource use, reduce waste, and predict environmental impacts. These advancements are not just improving efficiency; they are redefining what is possible in the realm of sustainability.

3. THE POLICY & REGULATORY LANDSCAPE FOR BUSINESS AND BIODIVERSITY IN INDIA

India's policy and regulatory landscape for climate action and biodiversity conservation is shaped by both its global commitments and national priorities. As a signatory to major international agreements—such as the United Nations Framework Convention on Climate Change (UNFCCC), United Nations Convention on Biological Diversity (UNCBD), and United Nations Convention to Combat Desertification (UNCCD)—India has adopted policies that

support an integrated approach to environmental protection, with the private sector increasingly seen as a key partner in achieving these goals. This section outlines India's international commitments, and the domestic policies developed to meet these obligations.

3.1 Key national and international regulatory frameworks

Regulatory frameworks form the backbone of biodiversity and sustainability efforts, driving meaningful action across industries and societies. These frameworks act as catalysts for innovation and accountability, ensuring that science, policy, and practice converge to tackle critical environmental challenges. They provide the structure needed to protect ecosystems, address biodiversity loss, and foster sustainable growth. By aligning global and national priorities, these frameworks empower leaders to take bold, collaborative steps toward a resilient and balanced future.

3.1.1 National Commitments and Frameworks

India has developed a comprehensive suite of policies to address climate and biodiversity issues, aiming to harmonize economic development with environmental sustainability. Key policies include the following:

The Biological Diversity Act, 2002

India's Biological Diversity Act, 2002, serves as the nation's foundational legal framework for protecting its rich natural heritage. The Act is designed to conserve biological resources, ensure their sustainable utilization, and promote the fair and equitable sharing of benefits derived from these resources, especially with the communities that have nurtured them for generations.

To implement its provisions effectively, the Act established a multi-layered governance structure. At the apex, the National Biodiversity Authority (NBA) oversees national-level compliance and approvals. Complementing this are State Biodiversity Boards (SBBs) at the state level and Biodiversity Management Committees (BMCs) at the local level, ensuring grassroots participation and the integration of traditional knowledge into conservation efforts. A critical component of the Act is its regulation of access to biological resources and traditional knowledge to prevent biopiracy. By enforcing strict guidelines, it safeguards the rights of indigenous communities while promoting their invaluable knowledge. The Access and Benefit Sharing (ABS) mechanism is a standout feature, providing fair rewards to communities and reinvesting resources into conservation programs. This mechanism has empowered local communities, fostering their role as custodians of biodiversity while incentivizing preservation efforts.

National Biodiversity Action Plan (NBAP):

India's National Biodiversity Action Plan (NBAP) serves as a comprehensive strategy for biodiversity conservation, aiming to reduce biodiversity loss, manage resources sustainably,

and ensure that benefits are shared equitably. The updated 2014 version aligns closely with the Aichi Biodiversity Targets, focusing on critical habitat conservation and sustainable natural resource management. One of the key actions under the NBAP is the expansion of protected areas, which is pivotal to conserving biodiversity hotspots and safeguarding endangered species. India currently boasts over 900 protected areas, covering around 5% of its total land area, and continues to work toward increasing this network to protect vital ecosystems. At the local level, Biodiversity Management Committees (BMCs) play an instrumental role in community-driven conservation efforts. These committees not only manage biodiversity but also document local biological resources through People's Biodiversity Registers (PBRs), fostering collaboration between communities and conservationists. The NBAP stands as a model of how national policies can harmonize biodiversity protection with sustainable development. Based on the framework of the NBAP, State Governments have also been developing their respective State Biodiversity Action Plans.

Environmental Protection Act, 1986

Enacted in response to the Bhopal Gas Tragedy, the Environment Protection Act serves as an overarching framework for safeguarding India's environment. This critical legislation empowers the central government to take extensive measures to improve and protect air, water, and soil quality. By providing such authority, the Act addresses the pressing need for stronger environmental governance and accountability. One of its pivotal contributions is the introduction of regulatory tools like the Environment Impact Assessment (EIA). The EIA process ensures that industrial and developmental projects undergo thorough evaluation of their environmental risks before receiving approvals. This mechanism not only helps identify potential ecological impacts—such as habitat destruction or pollution—but also enforces mitigation measures to minimize harm. Through its comprehensive scope, the Act has laid the foundation for creating a more sustainable and environmentally conscious framework for industrial growth and development in India.

Wildlife Protection Act, 1972

India's Wildlife Protection Act stands as a defining framework for conserving the country's wildlife and their natural habitats. This landmark legislation facilitates the establishment of protected areas such as National Parks, Wildlife Sanctuaries, and Community Reserves, offering crucial spaces for endangered species to thrive undisturbed. Under its provisions, flagship conservation programs like Project Tiger and Project Elephant have been launched, targeting the revival of populations of these keystone species. By focusing on habitat restoration, population monitoring, and community involvement, these programs exemplify proactive approaches to protecting vulnerable wildlife.

The Act also strictly regulates hunting and curbs the trade of wildlife products to safeguard endangered species from exploitation. This comprehensive protection ensures India's rich biodiversity is preserved while promoting a balance between conservation efforts and sustainable development.

Forest Conservation Act, 1980

The Forest Conservation Act was introduced with a clear mission: to combat deforestation and ensure that forest resources are used sustainably. A key provision of this legislation requires businesses to obtain prior approval from the central government before diverting forest land for non-forest purposes, such as mining or infrastructure development. This ensures that ecological considerations are integral to decision-making. Over the years, the Act has been instrumental in curbing forest loss and mitigating the environmental impacts of development. One of its most significant contributions has been the promotion of compensatory afforestation, where alternative forest land is developed to make up for any loss. This approach not only offsets environmental damage but also helps restore biodiversity and maintain ecological balance. Through these measures, the Act continues to play a vital role in protecting India's forests while balancing the country's development needs.

National Green Tribunal Act, 2010

The establishment of the National Green Tribunal (NGT) marked a significant step in addressing environmental challenges with urgency and expertise. As a specialized judicial body, the NGT was created to resolve environmental disputes efficiently, offering a platform dedicated exclusively to ecological concerns. The NGT has played a crucial role in holding polluters accountable by expediting environmental cases and imposing penalties for violations. These measures have not only promoted compliance but also driven efforts toward ecosystem restoration, reinforcing the importance of environmental responsibility. Its landmark decisions have also left a profound impact on biodiversity conservation. By halting projects that posed significant threats to sensitive ecosystems, the NGT has safeguarded critical habitats and species, ensuring that development does not come at the cost of India's rich biodiversity. This proactive approach has positioned the tribunal as a vital guardian of environmental justice.

Coastal Regulation Zone (CRZ) Notification

India's Coastal Regulation Zone (CRZ) Notification plays a vital role in protecting the country's fragile coastal ecosystems by regulating development activities along the coastline. This regulation is designed to preserve critical habitats such as mangroves, coral reefs, and nesting sites for marine species, ensuring these ecosystems thrive for future generations. Beyond conservation, the CRZ also supports sustainable coastal livelihoods, like fishing and eco-tourism, creating a balance between environmental protection and economic development. By fostering responsible use of coastal resources, this regulation demonstrates how ecological preservation, and human well-being can coexist harmoniously.

National Action Plan on Climate Change (NAPCC):

Launched in 2008, the National Action Plan on Climate Change (NAPCC) represents India's holistic strategy for tackling climate change while embracing sustainable development. Through its eight missions, the plan creates targeted frameworks to address critical areas such as energy efficiency, water management, forestry, and sustainable agriculture. One of its key missions, the Green India Mission (GIM), aims to expand forest and tree cover to sequester

carbon and enhance biodiversity. By targeting the restoration of 5 million hectares of degraded forest land, this mission promotes ecosystem services while empowering communities through participatory forest management.

Another vital component, the National Mission for Sustainable Agriculture (NMSA), focuses on climate-resilient farming practices. From organic farming to crop diversification and water conservation, the mission drives sustainable agricultural practices that benefit biodiversity, protect soil health, and build resilience against climate variability. What sets the NAPCC apart is its integrated approach, recognizing the interdependencies between water, agriculture, forestry, and energy. By aligning climate action with biodiversity conservation, the NAPCC demonstrates the power of collaboration and systemic thinking in driving meaningful change.

National Forest Policy and Compensatory Afforestation Fund Act (CAMPA):

India's National Forest Policy underscores the importance of forests as essential carbon sinks and reservoirs of biodiversity, placing their conservation at the heart of sustainable development. This policy emphasizes the need to maintain and expand forest cover, ensuring ecosystems continue to thrive while combating climate change. To reinforce this commitment, the Compensatory Afforestation Fund Act (2016) mandates industries to compensate for forest land diverted for development projects. The funds collected are directed towards afforestation and biodiversity enhancement in affected areas, ensuring that ecological balance is restored even in the face of industrial expansion. A major enabler of these efforts is the Compensatory Afforestation Fund Management and Planning Authority (CAMPA), which has mobilized over ₹75,000 crore for afforestation and forest restoration projects. This robust financial mechanism supports large-scale biodiversity initiatives, reflecting India's dedication to preserving its natural heritage while balancing developmental priorities.

Green Credits Programme by Government of India

The Green Credit Program is a pioneering initiative by the Government of India, launched in October 2023 under the Ministry of Environment, Forest and Climate Change. It is designed to incentivize sustainable practices in afforestation, water conservation, and eco-restoration across India. By creating a digital platform, the program streamlines the registration, verification, and trading of Green Credits, ensuring transparency and accountability. This innovative mechanism encourages businesses, public sector organizations, and local communities to take proactive steps in restoring degraded forest lands and water bodies. Over 25,000 hectares of land have been registered for eco-restoration across key states such as Madhya Pradesh, Tamil Nadu, and Maharashtra. Out of this total, more than 3,500 hectares are actively selected and undergoing restoration projects. The Indian Council of Forestry Research and Education plays a crucial role in overseeing the verification process, together with designated environmental agencies. By awarding Green Credits for successful projects, the initiative creates a market-based incentive that not only enhances ecosystem services but also boosts corporate ESG profiles. This approach helps participating entities align with India's ambitious Net Zero targets while contributing directly to biodiversity conservation.

The program has garnered robust support at the state level, with local NGOs and community groups actively involved in project implementation. It fosters community engagement by involving local stakeholders in sustainable land management and restoration efforts.

Digital tools integrated into the registry allow for real-time monitoring of environmental outcomes, including improved water retention and increased carbon sequestration. The Green Credit Program serves as a blueprint for incorporating market mechanisms into environmental policy, effectively merging economic goals with sustainability. It highlights how targeted policy interventions can drive both ecological restoration and sustainable development in India. Ultimately, this initiative exemplifies a forward-thinking strategy where environmental conservation is rewarded, paving the way for a resilient, green future.

Corporate Social Responsibility (CSR) Under Companies Act, 2013

India's Companies Act, 2013, through Section 135, was one of the earliest legislations globally to mandate CSR activities for qualifying companies. Businesses are required to allocate at least 2% of their average net profits over the past three years toward CSR initiatives, fostering accountability and measurable impact.

1. CSR investments under Schedule VII explicitly prioritize biodiversity conservation, ecological balance, afforestation, and environmental sustainability.
2. In FY 2022-23, Indian companies collectively spent ₹29,986 crore on CSR, with a significant portion directed toward environmental initiatives such as habitat restoration, afforestation, and climate resilience projects.
3. Companies are required to disclose details of CSR projects, expenditures, and outcomes in their annual reports, ensuring transparency and stakeholder confidence.
4. This approach has positioned India as a global leader in making environmental sustainability an essential part of corporate strategy.

Business Responsibility and Sustainability Reporting (BRSR)

The Business Responsibility and Sustainability Reporting (BRSR) framework, introduced by SEBI, has set a new benchmark for corporate accountability in India. From FY 2022-23 onwards, the framework requires the top 1000 listed companies to disclose their Environmental, Social, and Governance (ESG) performance. This move enhances transparency and ensures businesses take responsibility for their sustainability practices. What makes BRSR particularly impactful is its alignment with global standards such as the Global Reporting Initiative (GRI), Sustainability Accounting Standards Board (SASB), and Task Force on Climate-related Financial Disclosures (TCFD). By adopting these globally recognized

benchmarks, Indian companies can not only evaluate their sustainability performance but also position themselves competitively on the international stage.

The framework's three key areas of disclosure—General, Management, and Principle-wise Performance—are designed to provide measurable metrics that reflect a company's commitment to sustainability. SEBI has also issued a guidance note to assist businesses in implementing the framework effectively. This ensures that companies integrate sustainability into their core operations and adopt initiatives that contribute to biodiversity preservation and ecosystem restoration.

Extended Producer Responsibility (EPR) Under Plastic Waste Management Rules, 2016 (Amended 2022)

Extended Producer Responsibility (EPR) regulations are designed to ensure that businesses play a proactive role in managing the lifecycle of the plastic products they produce or sell. These regulations hold producers, importers, and brand owners accountable for the collection, recycling, and proper disposal of plastic waste, effectively shifting the focus from consumers to those at the top of the supply chain.

To comply, companies are adopting sustainable packaging solutions, such as biodegradable materials and reusable designs, to minimize waste generation. Many are also integrating circular economy principles into their operations, creating systems where plastic is reused, recycled, and reintegrated into production cycles rather than ending up in landfills or oceans.

By reducing plastic pollution, EPR regulations are making a tangible impact on protecting both marine and terrestrial ecosystems. Cleaner rivers, oceans, and natural habitats ensure not only biodiversity preservation but also healthier communities and sustainable business practices. These measures symbolize a critical step toward a more responsible and regenerative approach to resource use.

State-Specific Action Plans and Initiatives:

In addition to national efforts, Indian states have taken proactive steps to address regional environmental challenges through State Action Plans on Climate Change (SAPCCs). These plans reflect localized strategies, tackling issues unique to each state while aligning with broader national goals. States like Maharashtra, Tamil Nadu, and Uttarakhand have integrated priorities such as ecosystem restoration, sustainable agriculture, and biodiversity conservation into their SAPCCs.

For instance, Maharashtra's state-level climate adaptation plan places a strong emphasis on mangrove conservation, recognizing their critical role in coastal protection and carbon storage. The plan also promotes sustainable fisheries to support livelihoods while safeguarding marine ecosystems, alongside community-based conservation initiatives that actively involve local stakeholders in preserving biodiversity. These efforts highlight how states are translating climate goals into actionable strategies that balance development with ecological preservation.

3.1.2 Global Commitments and Frameworks

Global commitments and frameworks serve as the foundation for coordinated efforts to address biodiversity loss and sustainability challenges. They provide a shared vision and structured approach for aligning international goals with national policies and corporate strategies, ensuring cohesive action across all levels. By fostering transparency, accountability, and collaboration, these frameworks empower governments, businesses, and communities to transition from intent to impactful outcomes. Ultimately, they enable the integration of biodiversity and sustainability into decision-making processes, creating pathways for resilient ecosystems and a thriving future.

UN Convention on Biological Diversity (UNCBD)

India has been a proactive participant in global biodiversity initiatives, beginning with its ratification of the United Nations Convention on Biological Diversity (UNCBD) in 1994. This commitment extends to the Post-2020 Global Biodiversity Framework, under which India aims to contribute to the ambitious target of conserving 30% of land and water ecosystems by 2030. Domestically, India has taken significant steps through its National Biodiversity Action Plan (NBAP), first developed in 2008 and updated in 2014. The NBAP integrates biodiversity objectives into national development strategies and aligns with the 12 National Biodiversity Targets. These targets focus on key areas such as enhancing ecosystem services, safeguarding genetic resources, and fostering conservation awareness among stakeholders. Through these measures, India underscores its dedication to preserving biodiversity while ensuring sustainable progress.

Key Agreements include,

1. **Aichi Biodiversity Targets (2011–2020):** Provided specific global goals for biodiversity protection, such as reducing habitat loss and safeguarding ecosystems.

2. **Kunming-Montreal Global Biodiversity Framework (GBF) (Post-2020):** Focuses on halting biodiversity loss, achieving ecosystem restoration, and integrating biodiversity into all levels of decision-making.

Kunming-Montreal Global Biodiversity Framework (GBF)

Adopted under the Convention on Biological Diversity (CBD), the Global Biodiversity Framework (GBF) sets ambitious goals to address the urgent challenge of biodiversity loss and ecosystem degradation, aiming for significant progress by 2030. Among its key targets, the GBF emphasizes the need to protect 30% of global land and marine areas, ensuring the conservation of critical ecosystems and habitats worldwide. It also calls for the reduction of harmful subsidies by $500 billion annually, promoting a shift towards sustainable practices. Furthermore, the GBF aims to mobilize $200 billion in biodiversity funding, enabling countries to finance conservation initiatives effectively. India, committed to global biodiversity goals, has aligned its updated National Biodiversity Strategy and Action Plan (NBSAP) with the objectives

of the GBF. This alignment ensures that national strategies contribute to the global vision of halting biodiversity loss and restoring ecosystems for the benefit of both nature and humanity

UN Framework Convention on Climate Change (UNFCCC):

India's commitment to global climate action is reflected in its role as a signatory to the United Nations Framework Convention on Climate Change (UNFCCC) and its landmark agreements, including the Kyoto Protocol (1997) and the Paris Agreement (2015). As part of its Nationally Determined Contributions (NDCs) under the Paris Agreement, India has pledged to significantly lower its emissions intensity by 45% from 2005 levels by 2030, alongside achieving 50% of its cumulative electric power capacity from non-fossil-fuel sources. Additionally, the country aims to create a substantial carbon sink of 2.5 to 3 billion tons of CO_2 equivalent through expanded forest and tree cover by 2030.

To support these ambitious goals, the government launched the National Action Plan on Climate Change (NAPCC) in 2008, providing a strategic roadmap for addressing climate challenges through sustainable development. This plan encompasses eight national missions, including the Green India Mission (GIM), which focuses on forest expansion and biodiversity enhancement, and the National Solar Mission, which promotes renewable energy solutions. Together, these efforts position India as a proactive leader in climate mitigation and sustainable growth.

UN Convention to Combat Desertification (UNCCD):

India became a party to the United Nations Convention to Combat Desertification (UNCCD) in 1996, taking a significant step toward addressing issues like land degradation, desertification, and drought, especially in vulnerable regions like arid, semi-arid, and dry sub-humid areas. This commitment reflects India's dedication to restoring degraded landscapes and ensuring sustainable land use practices.

As part of the Bonn Challenge, India has pledged to restore 26 million hectares of degraded land by 2030. To achieve this ambitious target, the government has implemented notable initiatives, including the Desertification and Land Degradation Atlas, which provides critical data for monitoring and planning land restoration efforts. Additionally, state-specific programs focusing on watershed management and land restoration have been launched to combat land degradation at a local level, ensuring effective implementation and community involvement.

These international commitments play a pivotal role in shaping India's policy direction by aligning national priorities with global biodiversity and sustainability goals. They provide a structured framework for implementing conservation strategies, addressing climate challenges, and fostering sustainable development. Many of these commitments emphasize the critical role of the private sector, encouraging businesses to contribute through innovative solutions, financing mechanisms, and active participation. For instance, India's corporate sector has been instrumental in advancing sustainability goals, with over 1,000 companies mandated to report on ESG impacts under SEBI's BRSR framework. Additionally, initiatives like the 30x30 target under the Kunming-Montreal Global Biodiversity Framework highlight the need for collaborative efforts to protect 30% of global land and marine areas by

2030, further underscoring the importance of private sector involvement in achieving these ambitious targets.

Nagoya Protocol on Access and Benefit Sharing (ABS)

The Nagoya Protocol complements the Convention on Biological Diversity (CBD) by ensuring the fair and equitable sharing of benefits derived from the use of genetic resources. This framework guarantees that indigenous communities and countries of origin are fairly compensated for their contributions, fostering a sense of justice and encouraging biodiversity conservation. At its core, the protocol relies on two key principles: Prior Informed Consent (PIC), which requires users to obtain approval from the country of origin before accessing genetic resources, and Mutually Agreed Terms (MAT), which ensure clear benefit-sharing agreements between providers and users.

India has seamlessly integrated these Access and Benefit Sharing (ABS) principles into its Biological Diversity Act, creating a robust mechanism for compliance. This ensures that communities sharing their traditional knowledge and biological resources are not only acknowledged but also fairly rewarded, promoting both equity and sustainability.

Ramsar Convention on Wetlands

The Ramsar Convention stands as a global treaty dedicated to the conservation and sustainable use of wetlands, acknowledging their critical role in supporting biodiversity and providing ecological services. It protects over 2,500 Ramsar sites worldwide, spanning an impressive 257 million hectares.

India is home to 89 Ramsar sites as of February 2025, covering more than 13 lakh hectares. These include iconic ecosystems such as the Sundarbans and Loktak Lake, as well as recently designated sites like the Sakkarakottai Bird Sanctuary and Therthangal Bird Sanctuary in Tamil Nadu, Khecheopalri Wetland in Sikkim, and Udhwa Lake in Jharkhand. At its core, the Ramsar Convention promotes the wise use of wetlands, aiming to prevent habitat destruction while supporting migratory species and other wildlife. By fostering sustainable practices, this treaty highlights the importance of wetlands as vital ecosystems for biodiversity and human well-being alike

Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) plays a vital role in preventing overexploitation and ensuring the survival of endangered species. By regulating international trade, CITES fosters the sustainable management of biodiversity, including species like medicinal plants and exotic animals. The framework classifies species under three appendices, reflecting varying levels of trade vulnerability. This categorization ensures that conservation efforts are tailored to the specific risks faced by different species, helping strike a balance between trade and ecological protection. Through these measures, CITES empowers countries to manage biodiversity responsibly, contributing to global efforts to preserve endangered species and safeguard ecological health.

Convention on the Conservation of Migratory Species of Wild Animals (CMS)

The Convention on the Conservation of Migratory Species of Wild Animals (CMS), often called the Bonn Convention, is a vital international treaty focused on protecting migratory species and their habitats across borders. It addresses the unique challenges these species face, such as habitat loss and poaching, as they traverse multiple countries during their life cycles. The CMS includes dedicated treaties for species like marine turtles, Siberian cranes, and Dugongs, prioritizing their conservation through targeted action plans. It actively promotes habitat restoration, efforts to mitigate threats like poaching and habitat degradation, and collaborative research to enhance conservation strategies.

Currently, the CMS safeguards over 650 species, encompassing terrestrial mammals, migratory birds, and aquatic species, ensuring their survival amid growing human-induced pressures. By fostering international cooperation, the Bonn Convention plays a crucial role in securing a future for migratory species worldwide.

Global Reporting Initiative (GRI)

The Global Reporting Initiative (GRI) standards provide a comprehensive framework for businesses to disclose their environmental, social, and governance (ESG) impacts, with a notable focus on biodiversity. These standards encourage organizations to transparently report on their efforts in areas such as habitat conservation, species protection, and ecosystem restoration, offering stakeholders a clear view of their sustainability initiatives. Additionally, the GRI standards align closely with international biodiversity goals, including the Convention on Biological Diversity (CBD) and the Sustainable Development Goals (SDGs). This alignment ensures that businesses can benchmark their contributions against global sustainability objectives, driving accountability and meaningful biodiversity action.

Taskforce on Nature-related Financial Disclosures (TNFD)

The Taskforce on Nature-related Financial Disclosures (TNFD) was established to guide businesses and financial institutions in understanding their interactions with nature. This initiative helps them assess the risks and dependencies associated with natural ecosystems, ensuring that nature-related challenges are incorporated into decision-making processes. Built on four foundational pillars—Governance, Strategy, Risk and Impact Management, and Metrics and Targets—the TNFD framework provides a structured approach to nature-related financial reporting. One of its standout methodologies is the LEAP Approach. This framework encourages organizations to Locate, Evaluate, Assess, and Prepare for nature-related risks, creating a comprehensive understanding of their ecological footprint. Recognizing that industries like agriculture, fisheries, forestry, and energy have significant connections to nature, TNFD tailors its recommendations to address the unique risks and opportunities these sectors face. By the end of 2024, the adoption of TNFD's guidelines had gained remarkable traction, with over 500 organizations embracing the framework—a significant 57% rise from earlier in the year. With its clear structure and growing global acceptance, TNFD is equipping organizations to align their operations with sustainability goals, ensuring that nature and business thrive together.

Sustainability Accounting Standards Board (SASB)

Industry-specific sustainability reporting is bolstered by standards that focus on material Environmental, Social, and Governance (ESG) issues with clear relevance to financial performance. These standards enable organizations to effectively identify and disclose sustainability risks and opportunities, ensuring informed decision-making and long-term accountability. A standout feature of these standards is the emphasis on providing clear, measurable metrics. This approach ensures businesses can address crucial topics such as biodiversity conservation, ecological impacts, resource management, and emissions in a transparent and actionable manner. By aligning financial reporting with sustainability goals, these standards help businesses showcase their commitment to responsible and ethical practices, driving both environmental and economic benefits.

United Nations Sustainable Development Goals (SDGs)

The Sustainable Development Goals (SDGs) provide a comprehensive blueprint for addressing global challenges, including biodiversity conservation and ecosystem restoration. These goals emphasize the interconnectedness of environmental health, societal well-being, and sustainable development. The goals that are directly contributing to Biodiversity Conservation are as follows,

- **SDG 2:** Zero Hunger Biodiversity underpins agriculture by supporting essential ecosystem services like pollination, soil fertility, and pest control. Diverse crop varieties ensure food security and enhance resilience against climate change.
- **SDG 3:** Good Health and Well-being Biodiversity is vital for health, providing medicinal plants, genetic resources for drug discovery, and clean environments that reduce the spread of diseases.
- **SDG 6: Clean Water and Sanitation** highlights the importance of protecting ecosystems such as wetlands, rivers, and forests, which play a critical role in water regulation. It also supports the restoration of freshwater ecosystems to improve biodiversity and ensure access to clean water.
- **SDG 7:** Affordable and Clean Energy Biodiversity supports renewable energy sources like biomass and hydropower by maintaining ecosystem health and balancing water cycles.
- **SDG 8:** Decent Work and Economic Growth Sectors such as tourism, agriculture, forestry, and fisheries depend heavily on biodiversity, creating millions of jobs worldwide.
- **SDG 11: Sustainable Cities and Communities** Urban biodiversity, including green spaces, parks, and urban forests, enhances liveability, reduces urban heat, and provides recreational opportunities.
- **SDG 12: Responsible Consumption and Production** advocates for sustainable resource use to minimize biodiversity loss. By addressing unsustainable agricultural practices, food waste, and supply chain impacts, it promotes harmony between production patterns and environmental conservation.
- **SDG 13: Climate Action** addresses the effects of climate change on ecosystems, underscoring adaptive strategies to safeguard biodiversity. Forests and wetlands are recognized as natural buffers that mitigate climate impacts and support species survival.

- **SDG 14: Life Below Water** focuses on the sustainable management of marine ecosystems and resources. It tackles issues such as marine pollution, overfishing, and habitat destruction while protecting species reliant on coral reefs, mangroves, and seagrasses.
- **SDG 15: Life on Land** directly targets biodiversity conservation, aiming to restore degraded ecosystems, halt deforestation, combat desertification, and prevent species extinction. Sustainable agricultural and forest management practices are integral to preserving terrestrial biodiversity.
- **SDG 17: Partnerships for the Goals** Achieving biodiversity conservation requires collaboration across nations, sectors, and communities, fostering partnerships that drive collective action.

3.2 Role of financial incentives, tax benefits, and subsidies in biodiversity action

New Financing Mechanisms and Green Finance: Financing mechanisms, such as green bonds, biodiversity credits, and impact investments, offer promising avenues for private sector contributions to biodiversity and climate goals. These instruments allow companies to access funding while supporting projects that deliver positive environmental outcomes, aligning business goals with sustainability priorities.

Green Bonds: Green bonds provide a low-cost financing option for companies aiming to invest in sustainability. India's green bond market, valued at over USD 20 billion as of 2024, has primarily funded renewable energy projects but is expanding to include biodiversity and ecosystem restoration. For example, HDFC Bank's green bond in 2021 financed renewable energy projects with biodiversity-positive outcomes, such as solar farms in degraded lands that facilitate ecosystem recovery (Climate Bonds Initiative, 2022).

Impact Investments: Impact investing, focusing on generating measurable social and environmental returns alongside financial ones, is growing in India. According to a 2022 report by the Indian Impact Investors Council (IIIC), impact investment assets in India surpassed USD 10 billion, with biodiversity-focused sectors such as sustainable agriculture and eco-tourism gaining traction. This growth indicates a strong demand for financial products that serve dual purposes of profitability and environmental conservation.

Carbon Credit Trading Scheme (CCTS): India's Carbon Credit Trading Scheme (CCTS) is a regulatory mechanism designed to promote carbon market development and support the country's climate goals under the Paris Agreement. Launched in 2022, the CCTS provides a framework for trading carbon credits that represent verified reductions in greenhouse gas emissions. By setting up a formal carbon trading platform, the CCTS enables industries to buy and sell carbon credits, incentivizing emission reductions and fostering investment in low-carbon technologies.

4. SECTOR-WISE ANALYSIS

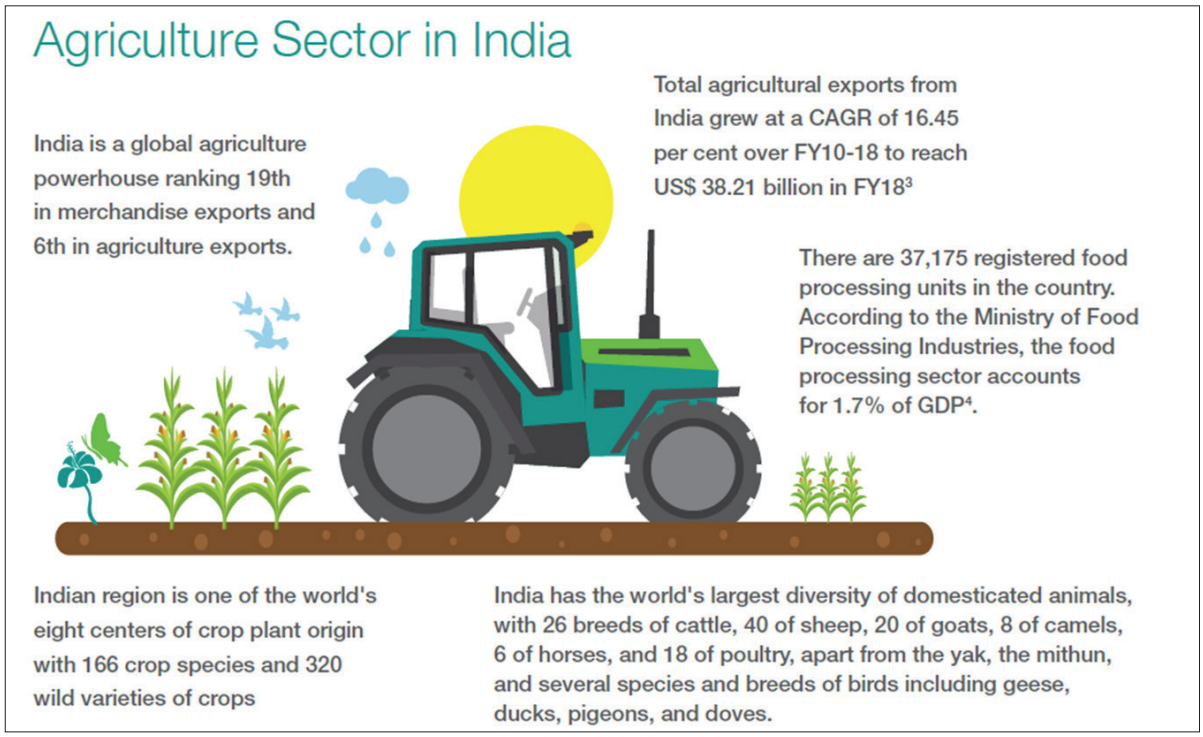
As the twin crises of climate change and biodiversity loss reshape global priorities, businesses across sectors are being called upon to recognize and respond to their deep interdependencies with nature. In India, where economic growth is inextricably linked to diverse ecosystems—from agricultural landscapes and river basins to forested and coastal zones—sector-specific pathways for biodiversity integration have become both a necessity and an opportunity. This chapter presents an in-depth analysis of eight critical sectors that exert significant influence

on, and are impacted by, biodiversity: Agriculture and Agri-business, Fisheries and Marine, Food and Beverages, Mining, Energy, Textiles, Automobiles, and Plastics and Packaging. It examines the biodiversity footprints, risk exposures, enabling policies, and emerging good practices within each sector. Through this analysis, the chapter aims to provide actionable insights that help businesses align with nature-positive goals, strengthen ESG performance, and contribute meaningfully to India's ecological and economic resilience. As the cornerstone of this report, this chapter moves beyond diagnosis to offer strategic direction, demonstrating that sectoral transformation is central to achieving a regenerative, inclusive, and sustainable future.

4.1 Agriculture and Agri-Business Sector

4.1.1 Sectoral Overview

India's agriculture sector plays a crucial role in the economy, contributing 16.8% to the GDP and employing 47% of the labour force. With 52% of the country's land classified as arable, the sector remains vital for rural livelihoods, supporting 58% of rural households. The Gross Value Added (GVA) from agriculture, including livestock, forestry, and fisheries, stood at 20.4% in 2016-17, growing at 3% in FY18. India is recognized as a global agricultural powerhouse, ranking 6th in agricultural exports and 19th in merchandise exports. The country is home to 166 crop species, 320 wild crop varieties, and the world's largest diversity of domesticated animals, including 26 breeds of cattle, 40 of sheep, 20 of goats, and 18 of poultry.[1]



(Deshmukh & Lingala Gowri, 2019)

[1] Deshmukh, P., & Lingala Gowri, S. (2019). Guidebook For Mainstreaming Biodiversity: Indian Agriculture Sector. www.cii.in

In India's agriculture sector, three key input industries—**seeds, fertilizers,** and **pesticides—** play pivotal roles in enhancing crop productivity and ensuring food security. These industries are integral to the agricultural value chain and have significant implications for agro-biodiversity and environmental health.

Seeds Industry: The seed industry in India is crucial for introducing high-yielding and resilient crop varieties. It encompasses the development and distribution of various seed types, including hybrid and genetically modified seeds, which are essential for improving crop yields and adapting to changing climatic conditions. India is currently the **fifth-largest seed market globally,** with a market size estimated at **₹31,706 crore** (USD 3.82 billion) in 2025. The market is **projected to grow to ₹41,583 crore** (USD 5.01 billion) **by 2030,** reflecting a Compound Annual Growth Rate (CAGR) of 5.56% over the forecast period (2025–2030).[2]

Fertilizers Industry: Fertilizers provide essential nutrients that enhance soil fertility and crop growth. The Indian fertilizer industry is one of the largest globally, supported by substantial government subsidies to ensure affordability for farmers. However, the overuse of chemical fertilizers has raised concerns about soil degradation and water pollution. India is the **second-largest consumer of fertilizers globally,** with the market size estimated at **₹1,236.7 lakh crore** (USD 14.9 billion) in 2024. The sector is expected to grow at a Compound Annual Growth Rate **(CAGR) of 4.3% over the next decade** (2024–2034),

[2] Mordor Intelligence. (2025b). India Seed Market Size & Share Analysis - Industry Research Report - Growth Trends. https://www.mordorintelligence.com/industry-reports/indian-seed-sector-analysis

indicating steady expansion driven by increasing agricultural demand and the need for enhanced crop productivity.[3]

Pesticides Industry: Pesticides are vital for protecting crops from pests and diseases, thereby reducing yield losses. India's pesticide industry is significant, with a strong presence in both domestic and international markets. Nonetheless, the excessive and unregulated use of pesticides poses risks to human health and the environment. India is the **fourth-largest producer of agrochemicals globally,** with the market size valued at **₹26,000 crore** (approximately USD 3.1 billion) in 2024. The industry is **projected to grow to ₹44,000 crore** (around USD 5.3 billion) by 2033, reflecting a Compound Annual Growth Rate **(CAGR) of 5.72% over the forecast period (2024–2033).[4]**

Agricultural biodiversity is deeply linked with India's food security, with 384 crops cultivated, including over 50,000 rice varieties and 1,000 mango varieties. (Deshmukh & Lingala Gowri, 2019). However, the sector faces critical challenges such as land fragmentation, with 85% of landholdings being small and marginal (<2 hectares each), soil degradation affecting 120.4 million hectares, excessive use of agrochemicals, and climate change vulnerabilities. Rainfed agriculture covers 54% of the net sown area and contributes 40% of total food production, emphasizing the need for sustainable management. Biodiversity in agriculture is essential for pollination, nutrient cycling, pest control, and climate resilience, highlighting the importance of integrating biodiversity conservation into agricultural policies and practices.[5]

4.1.2 Agriculture and its implications for biodiversity in India

Agriculture, the backbone of India's economy and rural livelihoods, also stands as one of the foremost contributors to biodiversity loss. As the sector strives to ensure food security for a growing population, agricultural expansion and intensification have led to significant disruptions across ecosystems. These transformations—ranging from land conversion and genetic erosion to water pollution and pollinator decline—pose long-term risks to ecological resilience and agricultural sustainability. Addressing these biodiversity challenges is crucial for ensuring the future viability of the sector.

1. **Loss of Agrobiodiversity and Genetic Erosion:** India is home to rich genetic resources, with over 166 cultivated crop species and 320 wild crop relatives. However, market-driven monocultures and the replacement of traditional landraces with hybrid, high-yielding varieties have narrowed genetic diversity. This genetic erosion compromises resilience, making crops more vulnerable to pests, diseases, and climate variability. For example, 384 commonly cultivated crops, including staples like rice and mango, are losing their indigenous landraces.

[3] Mordor Intelligence. (2025a). India Fertilizers Market Size & Share Analysis - Industry Research Report - Growth Trends. https://www.mordorintelligence.com/industry-reports/india-fertilizers-market

[4] imarc. (2024). Indian Pesticides Market Size, Industry Growth, Forecast | 2033. https://www.imarcgroup.com/indian-pesticides-market

[5] Thomson Jacob, C., Parida, A., & Meenakumari, B. (2019). Mainstreaming Biodiversity into Agriculture Sector for Increasing India's Food, Nutritional and Livelihood Security.

2. **Habitat Loss, Land Use Change, and Fragmentation:** The expansion of agricultural frontiers often involves deforestation, grassland conversion, and wetland alteration—leading to the destruction of wildlife corridors and natural habitats. Such changes have fragmented ecosystems, reduced biodiversity, and displaced many species. Large-scale irrigation and infrastructure projects alter hydrological regimes, threatening aquatic and riparian habitats. Fragmented agricultural plots in India also constrain landscape-level biodiversity management efforts.
3. **Pollinator Decline and Crop Yield Impacts:** Pollinators such as bees, butterflies, and birds are crucial to over 75% of global food crops. Yet, pesticide overuse and habitat degradation have led to dramatic declines in their populations. This has already impacted yields of oilseeds and fruits, forcing some farmers to resort to manual or artificial pollination—raising costs and lowering productivity.
4. **Insects and Pest Control:** It is estimated that 10 to 25% of India's food crop is destroyed every year by rats, either in the fields or as stored grain. Insectivorous and predatory birds and reptiles such as snakes and lizards play an important role in controlling insect and rodent pests of crops.
5. **Soil Degradation, Pollution, and Loss of Microbial Life:** Excessive application of synthetic fertilizers and pesticides has severely affected soil health. Soil microbial diversity—critical for carbon sequestration, nutrient cycling, and organic pest control—is in decline. Practices like stubble burning contribute to both air pollution and the depletion of essential nutrients, while intensive tillage further disrupts soil biodiversity and weakens its structure and fertility.
6. **Water Resource Exploitation and Contamination:** Agriculture is the dominant user of freshwater in India, drawing heavily from groundwater aquifers. Inefficient irrigation and over-extraction have led to declining water tables. Additionally, runoff carrying pesticides and fertilizers pollutes rivers, wetlands, and groundwater—causing eutrophication, affecting aquatic species, and threatening both biodiversity and public health.
7. **Spread of Invasive Species and Ecosystem Disruption:** The encroachment of agriculture into natural areas has facilitated the spread of invasive alien species. These species outcompete native flora, reduce biodiversity, and alter ecological balances. Monoculture systems, in particular, have become breeding grounds for non-native pests and weeds, increasing dependency on agrochemicals while weakening ecosystem resilience.
8. **Climate Change Contributions and Vulnerabilities:** Agriculture contributes significantly to India's greenhouse gas emissions, particularly methane from livestock and rice paddies, and nitrous oxide from fertilizers. Land use change, deforestation, and intensive cultivation amplify emissions. Simultaneously, agriculture is vulnerable to climate extremes—such as droughts, floods, and heatwaves—which threaten crop yields and biodiversity. Shifts in rainfall and temperature also alter soil moisture regimes, posing additional risks to natural and agro-ecosystems.
9. **Fragmented Land Holdings and Limited Landscape Integration:** The predominance of small and fragmented landholdings in India restricts the adoption of integrated biodiversity management practices. Diversified cropping, agroforestry, or ecological corridors are often unfeasible at such scales, limiting ecosystem-based approaches to conservation.

10. **Institutional and Knowledge Gaps:** Many farmers lack awareness of biodiversity-friendly agricultural practices, and public extension systems often do not prioritize or effectively communicate them. Institutional support for biodiversity in agriculture—through training, incentives, or regulatory frameworks—remains insufficient, limiting the scale of conservation efforts across farming landscapes.
11. **Economic Pressures and Social Disparities:** Farmers frequently operate under economic duress, driven to maximize short-term productivity with intensive input use. Shifting to sustainable practices is often seen as costly and risky without guaranteed returns or financial support. Moreover, the increasing commercialization of agriculture has led to land concentration and the marginalization of smallholders, exacerbating social inequalities and eroding traditional ecological knowledge systems.

The agriculture value chain interacts closely with biodiversity and ecosystem services (B&ES) at different stages. Some activities heavily depend on healthy ecosystems (like farming), while others (like manufacturing fertilizers) can have significant impacts on biodiversity.

4.1.3 Regulatory and Policy Landscapes

It is important that the conservation and sustainable utilization of agriculturally important plants, animals and microbes need to be effectively integrated into the biodiversity strategies, plans and programmes of the Ministry of Agriculture and Farmers' Welfare (MoA&FW). Some of the issues that need immediate attention includes: (a) protection of land races/traditional crop varieties; (b) policy on conventional breeding and (c) conservation of wild relatives of crop plants, etc.

India's agricultural policies and regulatory frameworks focus on sustainable farming, biodiversity conservation, and ecological resilience. National and international agreements guide policy interventions, with a growing emphasis on ecological agriculture, genetic resource conservation, and sustainable land-use management.

National-level Policies facilitating integration of biodiversity into the agriculture sector:

1. **The Biological Diversity (BD) Act, 2002:** This Act governs the conservation of biodiversity, sustainable use of biological resources, and fair benefit-sharing. Corporates must seek approval from the National Biodiversity Authority before accessing or commercializing biological resources. It is especially relevant for businesses using indigenous species, GMOs, or traditional knowledge.
2. **Environment Protection Act, 1986:** As the umbrella law for environmental protection, this Act sets standards for pollution control, waste management, and ecological conservation. Agro-industries must ensure compliance in all operations, or risk penalties and reputational damage. It encourages eco-friendly technologies and sustainable production.

3. **National Biodiversity Action Plan (NBAP):** NBAP outlines India's strategy for biodiversity conservation and ecosystem restoration. Corporates in agriculture and agroforestry are encouraged to align with its goals by adopting agroecological practices and restoring degraded land. Alignment with NBAP enhances sustainability credentials and CSR visibility.
4. **National Agricultural Policy, 2000:** This policy promotes agricultural growth through sustainable practices and rural development. It urges corporates to invest in modern technologies, improve resource use efficiency, and expand into export markets while maintaining environmental safeguards.
5. **Protection of Plant Varieties and Farmers' Rights Act (PPV&FRA), 2001:** The Act provides intellectual property rights for plant breeders while safeguarding farmers' traditional knowledge. It supports innovation in plant breeding and enables Indian companies to access global seed markets under UPOV-aligned frameworks.
6. **National Seed Policy, 2002:** This policy ensures timely availability of quality seeds and encourages private investment in seed R&D. Corporates must follow quality standards and are incentivized to develop high-yielding and resilient seed varieties to support food security.
7. **National Mission for Sustainable Agriculture (NMSA):** NMSA promotes climate-resilient and resource-efficient farming. Corporates can benefit through financial assistance and business opportunities in soil health management, water conservation, and sustainable inputs.
8. **Paramparagat Krishi Vikas Yojana (PKVY):** This scheme promotes organic farming by supporting farmer transitions and certification. Corporates can partner with farmers to develop organic product lines and meet the growing demand for organic food.
9. **National Policy on Agroforestry, 2014:** The policy encourages integration of trees with agriculture to boost biodiversity and carbon sequestration. Corporates can invest in agroforestry to access carbon markets and improve landscape resilience and profitability.
10. **National Livestock Mission (NLM):** NLM aims to enhance livestock productivity and sustainability. It provides corporates with opportunities to invest in animal health, feed production, and dairy/meat processing, while reducing environmental impact.
11. **The Business Responsibility and Sustainability Reporting (BRSR)** framework, mandated by SEBI for the top 1,000 listed companies in India, requires disclosure of Environmental, Social, and Governance (ESG) performance. Replacing the earlier Business Responsibility Report, BRSR aligns with the National Guidelines on Responsible Business Conduct (NGRBC) and emphasizes biodiversity under Principle 6, especially for agriculture and agri-businesses. It mandates reporting on sustainable sourcing practices and the percentage of inputs sourced responsibly. Companies engaging in afforestation or regenerative practices can gain recognition under leadership indicators, enhancing their ESG credibility and unlocking access to green finance. BRSR also aligns with global standards like GRI and SASB, encouraging integration of biodiversity into corporate sustainability strategies.

International Agreements and Targets on Biodiversity Conservation Relevant to Agriculture and Agri-business

Agriculture and agri-business sectors are deeply intertwined with biodiversity — both benefiting from and impacting ecological systems. Over the years, various international agreements and global frameworks have emerged to guide sustainable agricultural practices and ensure the conservation and equitable use of genetic resources. These agreements encourage countries and corporates alike to align with principles of ecological balance, fair benefit-sharing, and long-term food security. The following are key international instruments that influence biodiversity-related action in the agriculture sector:

S. No.	Framework / Agreement	Corporate Implication	Example Sector
1	Nagoya Protocol (CBD)	Requires benefit-sharing and access permissions for genetic resources	Seed, biotech, pharma
2	Convention on Biological Diversity (CBD) – Kunming Montreal Global Biodiversity Framework	Emphasizes mainstreaming biodiversity into agriculture, influencing policy alignment and ESG strategies	Agriculture, agri-business
3	FAO's International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA)	Encourages conservation and sustainable use of crop genetic diversity; promotes multilateral benefit-sharing	Seed banks, agri R&D institutions
4	Sustainable Development Goals (SDGs)	Encourages sustainable agriculture and biodiversity-friendly practices in corporate operations	Agri-business, food systems, agro processing
5	WTO – TRIPS Agreement	Governs IPR over genetic materials and biodiversity-linked products	Biotech, seed firms
6	GRI Standards (304)	Requires biodiversity impact disclosure in sustainability reports	FMCG, agri-business
7	SASB Standards	Offers sector-specific ESG performance metrics	Agro-input industries
8	TNFD (Taskforce on Nature-related Financial Disclosures)	Supports nature risk disclosures; still in pilot phase	Banks, agri-investors, corporates in natural resource use

In addition to the above, the FAO Action Plan (2024–2027), aligned with the FAO Strategic Framework and the Kunming-Montreal Global Biodiversity Framework, aims to mainstream biodiversity in agrifood systems through targeted support, policy alignment, and strengthened

global coordination. It outlines actions across four strategic outcomes and seven core functions, including data, policy, partnerships, and advocacy. The Plan promotes inclusive, gender-responsive approaches and offers practical tools for corporates—such as norms for sustainable sourcing, data-driven risk management, and models for public-private collaboration. It also aligns with emerging global regulations like the EU Deforestation Regulation, the Global Biodiversity Framework, and TNFD, making it increasingly relevant for businesses navigating biodiversity and sustainability disclosures.[6]

4.1.4 Corporate initiatives in the agriculture sector related to biodiversity conservation

Corporates in the agriculture sector are engaged in biodiversity conservation mainly through ESG and CSR mechanisms. Some trends in the application of these mechanisms for biodiversity conservation are described in this section.

Environmental, Social, and Governance (ESG):

The agriculture and agri-business sector in India, a cornerstone of the country's economy and rural livelihoods, is undergoing a transformation through the integration of Environmental, Social, and Governance (ESG) principles. With a growing emphasis on sustainable agricultural practices, technological innovation, and environmentally responsible operations, corporates in the sector are aligning their strategies with global sustainability goals. This includes promoting ecological farming, biodiversity conservation, rural development, ethical governance, and sustainable supply chains - reinforcing their commitment to environmental impact reduction and social equity.

In order to assess ESG trends for this report, some of the major corporates that play a significant role across the agriculture and agri-business value chain in India were identified. The selected companies represented diverse segments such as agrochemicals, seeds, fertilizers, and food processing, and were chosen based on their market presence, historical contributions, and active involvement in ESG initiatives. These long-listed companies include Godrej Agrovet, Rallis India Limited, DuPont India, Nuziveedu Seeds Limited, Advanta Seeds, IFFCO (Indian Farmers Fertiliser Cooperative Limited), Rasi Seeds, Coromandel International Ltd., Bayer CropScience India Ltd., UPL Limited, Syngenta India Private Ltd., Dhanuka Agritech Limited, Bharat Rasayan Limited (BRL), Sharda Cropchem Limited, Poabs Organic Estates, National Agro Industries, PI Industries Ltd, Krishak Bharati Cooperative, Agrocorp International, and Parle Agro. From the broader list of leading companies, a subset was shortlisted for detailed ESG report analysis based on the availability and accessibility of their disclosure and other reports. These reports provided insights into the sustainability strategies and ESG-related practices adopted by individual firms. Reports of the following companies were studied to understand recent developments, innovations and trends with regard to addressal of biodiversity concerns by agriculture sector companies through the ESG mechanism.

[6] FAO. (2020). FAO Strategy on Mainstreaming Biodiversity across Agricultural Sectors. In FAO Strategy on Mainstreaming Biodiversity across Agricultural Sectors. FAO.

Rallis India Limited: A Tata enterprise offering crop protection, seeds, and agri-services. Strong focus on carbon reduction, renewable energy, water conservation, and circular economy initiatives.[7]

- **Godrej Agrovet Limited (GAVL):** A diversified agri-business committed to climate action through renewable energy, water positivity, and carbon neutrality. Focused on inclusive growth and community development.[8]
- **UPL Ltd:** A global leader in sustainable agriculture with initiatives focused on biodiversity conservation, waste and water management, and integrated bio-solutions for farmers.[9]
- **Bayer CropScience Ltd. (India):** Combines agriculture and pharmaceutical operations. Promotes climate-smart agriculture, biodiversity-friendly practices, digital farmer engagement, and zero waste to landfill.[10]
- **IFFCO (Indian Farmers Fertiliser Cooperative Limited):** World's largest fertiliser cooperative emphasizing innovation in eco-friendly fertilisers like Nano Urea and Nano DAP. Commits to energy efficiency, afforestation, organic farming, and cooperative-based governance.[11]

General Trends Observed in the ESG Reports

- **Climate Action and Emission Reduction:** While primarily aimed at mitigating climate change, efforts to reduce carbon emissions - such as adopting renewable energy, implementing energy-efficient operations, and setting science-based targets - also contribute indirectly to biodiversity by reducing environmental stressors and preserving climate-sensitive ecosystems. Godrej Agrovet and UPL have detailed carbon neutrality roadmaps, and Rallis aims for 100% renewable thermal energy by 2027, which supports long-term ecological stability.
- **Renewable Energy and Resource Efficiency:** Solar energy installations, water harvesting systems, and Zero Liquid Discharge (ZLD) facilities are widely adopted. These not only enhance resource efficiency but also support biodiversity conservation by reducing pollution and safeguarding freshwater ecosystems. GAVL and Rallis, for instance, have achieved significant water positivity - benefiting aquatic biodiversity by maintaining ecological water flows and improving groundwater recharge.
- **Biodiversity and Sustainable Agriculture:** Direct biodiversity-focused initiatives are evident in the promotion of organic farming, integrated pest management (IPM), low-residue agrochemical formulations, and pollinator conservation strategies. UPL and Bayer lead in this domain through habitat conservation, pollinator-safe product development, and

[7] Rallis India Limited. (2024). Basis of Reporting: Approach to the Adoption of Integrated Reporting. https://www.rallis.com/

[8] Godrej agrovet. (2024). GAVL-Annual-Report-FY-2023-24.

[9] UPL Ltd. (2024). CSR Annual Report Reimagining a Brighter Tomorrow Celebrating 50+ years of working with the farming community.

[10] Bayer In India. (2023). Bayer_in_India_Sustainability_Report_05th_Nov_India.

[11] IFFCO. (2024). Giving Wings To Thoughts And Turning Dreams Into Reality Giving Wings To Thoughts And Turning Dreams Into Reality Giving Wings To Thoughts And Turning Dreams Into Reality.

partnerships with biodiversity-focused organizations. These practices support soil health, native species, and agro-ecological resilience.

- **Product Stewardship and Innovation:** The development of eco-friendly agri-inputs - including bio-solutions, nano-fertilisers, and low-toxicity crop protection products - demonstrates a shift towards reducing environmental and biodiversity impact. R&D efforts are increasingly aligned with goals to minimize harm to non-target organisms and preserve soil and aquatic microfauna.
- **Inclusive Growth and Community Development:** Several ESG initiatives strengthen community involvement in biodiversity conservation, especially through farmer training on sustainable practices, agroforestry, and water conservation. CSR programs—such as those by Bayer and UPL—provide digital advisory tools that include pollinator-safe farming guidance and promote regenerative practices, enhancing landscape-level biodiversity.
- **Governance and Transparency:** ESG oversight at the board or senior leadership level increasingly includes biodiversity as a strategic focus. Companies such as Bayer integrate biodiversity indicators into their ESG performance metrics. IFFCO's adherence to cooperative principles also supports collective decision-making for sustainable natural resource management.

Corporate Social Responsibility (CSR)

CSR in India's agriculture and agri-business sector plays a pivotal role in addressing rural development, farmer welfare, and environmental sustainability. As agriculture remains the backbone of India's economy, companies in this space are increasingly investing in programs focused on improving farm productivity, promoting climate-resilient practices, enhancing water use efficiency, and empowering smallholder farmers. Many of these initiatives recognize and address biodiversity aspects related to agriculture and larger natural resource management. CSR reports of some of the major corporates (agriculture as well as non-agriculture sector) in India were reviewed to understand better the focus of similar corporates on biodiversity aspects through their agriculture-related initiatives.

Significant CSR Initiatives promoting biodiversity in India

- **UPL Ltd.:** UPL's biodiversity initiatives include Sarus Crane conservation, tree planting, mangrove restoration, and watershed development projects. The company's community-based approach ensures long-term ecological and social benefits, with significant contributions to local biodiversity.12
- **ITC Limited:** ITC's CSR activities focus on water stewardship, climate-smart agriculture, and social forestry. It works on improving water availability, supporting farmers with sustainable agricultural practices, and greening vast areas of land across India.[13]

[12] UPL Ltd. (2024). CSR Annual Report Reimagining a Brighter Tomorrow Celebrating 50+ years of working with the farming community.

[13] The CSR Journal. (2025, January 28). Top 100 Companies for CSR and Sustainability in 2024 - The CSR Journal.

- **Mahindra & Mahindra Limited:** Mahindra's programs like Mahindra Hariyali focus on tree planting, carbon sequestration, and community-led environmental sustainability. It supports sustainable agriculture, soil conservation, and climate-resilient farming practices.[14]
- **Coromandel International:** Coromandel's CSR initiatives, including extensive tree planting, green cover programs, and sustainable farming projects, such as the Miyawaki Plantation and Bird's Paradise, have enhanced local biodiversity and environmental health.[15]

Key Common Biodiversity Themes Across CSR Efforts

- **Tree Plantation & Habitat Restoration:** All companies emphasize the importance of tree plantation as a core activity for restoring degraded landscapes and enhancing biodiversity. Examples include UPL's social forestry efforts, ITC's tree plantation in private and community lands, Mahindra's "Mahindra Hariyali" initiative, and Coromandel's focus on green cover around factory premises and urban landscapes.
- **Community Engagement & Local Impact:** Each company stresses the involvement of local communities in biodiversity efforts. This is seen in UPL's Rural Sarus Protection Groups (RSPGs) for Sarus Crane conservation, ITC's integrated watershed development, and Mahindra's community-led greening and natural resource management projects.
- **Conservation of Specific Species:** Corporates are increasingly focused on protecting specific species or ecosystems, such as UPL's Sarus Crane conservation efforts and Coromandel's biodiversity sanctuary creation at Kakinada (Bird's Paradise).
- **Coastal and Water Resource Conservation:** Efforts related to coastal biodiversity and water resource management are prominent, particularly in UPL's mangrove plantation initiatives and ITC's watershed management across multiple river basins, focusing on water stewardship.
- **Sustainable Agriculture & Climate-Smart Practices:** Initiatives to promote sustainable agriculture, reduce the environmental impact of farming, and enhance soil health are common. ITC's Climate-Smart Agriculture, Mahindra's promotion of climate-resilient farming, and Coromandel's sustainable neem cultivation for biopesticides are examples of this trend.
- **Use of Native Plant Species & Ecosystem Services:** Many companies emphasize using native species to promote local biodiversity. UPL's choice of native plant species for its social forestry program and Mahindra's focus on agroforestry and native species plantations for enhancing local ecosystems are noteworthy.

[14] Mahindra-Sustainability-Report-2022-23. (n.d.).

[15] Integrated Report FY 2022-23. (n.d.).

Alignment of Corporate ESG and CSR Trends with National Sustainability Priorities in Agriculture

The analysis of ESG and CSR trends across various corporates indicates a growing alignment with India's national sustainability goals in the agricultural sector. Many corporate initiatives mirror key themes from government policies and frameworks, reflecting shared priorities in promoting ecological balance, resource conservation, and long-term agricultural resilience, all factors which also support biodiversity protection in India.

- **Ecological Agriculture and Organic Farming:** Corporate ESG and CSR disclosures increasingly reflect support for organic and ecological farming practices. Several companies are investing in organic product lines, training farmers in sustainable techniques, and promoting reduced dependency on chemical inputs. These efforts align with national programs such as the National Mission for Sustainable Agriculture (NMSA) and Paramparagat Krishi Vikas Yojana (PKVY), both of which aim to mainstream organic farming and natural resource-based agriculture. The use of integrated and ecological pest management methods observed in some corporate initiatives further reflects policy-driven efforts to reduce synthetic pesticide use and encourage biodiversity on farms.[16]
- **Agrobiodiversity Conservation and Native Crop Protection:** There is also visible corporate interest in promoting traditional crops, preserving indigenous seed varieties, and engaging with local farming communities for climate-resilient cultivation practices. These actions support national objectives of conserving genetic diversity through on-farm biodiversity, seed conservation, and the protection of native livestock breeds. By encouraging the cultivation and marketing of region-specific crops and landraces, corporates contribute to preserving India's rich agricultural heritage and strengthening food system resilience in the face of climate change.[17]
- **Sustainable Water and Soil Management:** Corporate interventions in water and soil conservation show strong thematic alignment with key government schemes like the Soil Health Card (SHC) program. Initiatives such as rainwater harvesting, soil quality assessments, composting, and precision irrigation are frequently highlighted in ESG and CSR reports. These approaches not only promote efficient use of natural resources but also help reduce environmental degradation linked to intensive farming. Efforts to reduce stubble burning through crop residue management and awareness campaigns also reflect a shared commitment to reducing soil nutrient loss and curbing air pollution.[18]
- **Pollinator Conservation and Habitat Restoration:** Although fewer in number, some corporate programs address the critical issue of pollinator protection and habitat restoration. These efforts focus on enhancing biodiversity within agricultural landscapes, protecting native pollinators such as bees and butterflies, and restoring degraded ecosystems. This approach aligns with national conservation goals that emphasize

[16] Thomson Jacob, C., Parida, A., & Meenakumari, B. (2019). Mainstreaming Biodiversity into Agriculture Sector for Increasing India's Food, Nutritional and Livelihood Security.

[17] Deshmukh, P., & Lingala Gowri, S. (2019). Guidebook For Mainstreaming Biodiversity: Indian Agriculture Sector. www.cii.in

[18] Thomson Jacob, C., Parida, A., & Meenakumari, B. (2019). Mainstreaming Biodiversity into Agriculture Sector for Increasing India's Food, Nutritional and Livelihood Security.

pollinator-friendly farming and the preservation of wild crop relatives. By supporting habitat restoration and native vegetation planting, corporates contribute to broader ecosystem stability and agricultural productivity.[19]

- **Broader Mitigation Strategies Reflected in Corporate Practices:** Several cross-cutting mitigation strategies emphasized at the national level are echoed in corporate ESG and CSR practices. These include the adoption of agroecological principles, crop diversification, organic input use, and climate-smart agricultural techniques aimed at improving resilience to extreme weather. (Thomson Jacob et al., 2019);

4.1.5 Case Studies and Best Practices

The integration of sustainability and biodiversity conservation in agriculture has led to various successful case studies and best practices. These initiatives focus on ecological agriculture, traditional seed conservation, sustainable water management, and biodiversity-friendly farming systems. There are several options for the agriculture sector to reduce its impacts and dependencies on biodiversity and ecosystem services in the value chain through mainstreaming biodiversity. Some of the easy to implement steps are reduction of food loss during transport and storage, increasing crop yield using native crop species, moving from monoculture to multiple crop cultivation coupled with horticulture or medicinal plant cultivation, reduction of chemical fertilizer, pesticides and insecticides, judicious use of water, use of crop residue as fodder or fuel.

Some of the impactful initiatives are highlighted below.

1. ITC's Deforestation-free Initiatives in Tobacco and Pulpwood Value Chains

As part of its commitment to "Zero Deforestation" across its tobacco and pulpwood value chains, ITC has rolled out a comprehensive initiative aimed at ensuring sustainable land use, biodiversity conservation, and energy-efficient practices across its sourcing operations. The program, which is ongoing with milestones reported up to 2024, seeks to address growing global demands for deforestation-free, biodiversity-safe agricultural supply chains.

At the heart of this initiative lies a robust system of FSC®-certified plantations. To date, ITC has certified 1.49 lakh acres under the Forest Stewardship Council® Forest Management (FSC®-FM) standard, engaging over 25,000 farmers in responsible plantation practices. This effort has led to the procurement of 485,000 tonnes of FSC®-certified wood, ensuring traceability and adherence to stringent biodiversity and sustainability benchmarks.

In parallel, ITC has made significant strides in improving energy efficiency in tobacco curing—an energy-intensive process—through the deployment of 41,251 smart curing barns across Andhra Pradesh and Karnataka. These barns, equipped with digital and sensor technologies, have contributed to a 40% reduction in energy demand, while also promoting

[19] Deshmukh, P., & Lingala Gowri, S. (2019). Guidebook For Mainstreaming Biodiversity: Indian Agriculture Sector. www.cii.in

cleaner, more efficient processes. Additionally, over 200 farmers have been supported with Venturi Furnaces, further enhancing fuel efficiency during curing.

To foster farmer self-sufficiency and reduce pressure on natural forests, ITC introduced the 'Grow Your Fuel' model, under which 2.29 lakh acres of energy plantations have been established on degraded lands and marginal farmlands. These plantations serve as renewable sources of fuelwood, reinforcing the sustainability of the value chain.

A strong emphasis has also been placed on technology-driven traceability. All farms and barns are geo-tagged, and third-party monitoring ensures 100% traceability and verification of fuelwood sourcing. The company is also promoting the use of alternate fuels, such as crop residues, to further reduce dependence on natural forests.

This holistic approach has not only helped safeguard endangered and rare species within plantation zones but also contributed to community-level climate resilience through diversified agroforestry practices. The integration of biodiversity criteria into certification, along with transparent sourcing and technological innovations, positions ITC as a leading example of how corporations can align business goals with environmental stewardship.[20]

2. UPL's Social Forestry Initiative: Community-Led Greening in Gujarat

Launched in 2016, UPL's Social Forestry Initiative represents a long-term commitment to ecological restoration and community-driven greening in Gujarat. Targeting degraded lands and government wastelands, the program is centred on enhancing on-farm biodiversity, restoring ecosystems, and fostering environmental stewardship among rural communities.

To date, the initiative has resulted in the plantation of 2,27,905 saplings, creating a green cover of approximately 562.83 acres across various intervention models. The effort has been carried out with a strong community focus, engaging Gram Panchayats, schools, the Gujarat Forest Department, and local volunteers, including UPL's own CSR teams.

The afforestation efforts are divided into three primary categories:

- **Social Forestry:** With 83,050 trees planted across 143.83 acres, this stream targets community commons and government lands.
- **School Plantations & Sapling Distribution:** Aimed at sensitizing younger generations, this model has covered 202 acres with 1,01,301 saplings.
- **Wadi Project:** Focused on agroforestry and likely benefiting tribal or smallholder farming communities, the project has added 43,554 plants over 217 acres.

Plantations are designed with an average density of 1 tree per 12 square meters, ensuring sufficient space for healthy growth. The use of native species is expected to lead to a gradual increase in local biodiversity, while the initiative's consistent community engagement has helped achieve a commendable survival rate of approximately 80% — a

20 ITC-Sustainability Report. (2024). Shaping the future Evolve Nurture Sustain.

strong indicator of long-term impact. Beyond ecological benefits, the program contributes to climate resilience and microclimate improvement, especially in arid and semi-arid areas of Gujarat. Through inclusive participation and long-term nurturing strategies, UPL's social forestry efforts stand out as a scalable model for community-based ecological restoration in India.[21]

3. Godrej Agrovet's Sustainable Palm Oil Initiative: Driving Traceable & Responsible Cultivation in India

Palm oil plantations have faced widespread criticism globally for their long-term negative impacts on biodiversity, particularly through large-scale deforestation, habitat fragmentation, and the decline of endangered species such as orangutans and tigers.[22] In response to these challenges, Godrej Agrovet is attempting to promote more sustainable palm oil cultivation practices across India.

Focusing on environmental conservation, social responsibility, and economic viability, the company's ongoing program seeks to foster traceability, minimize ecological impacts, and support farming communities. Godrej Agrovet currently engages with over 10,000 palm oil farmers across six oil mills in India, providing resources and training to encourage the adoption of sustainable agricultural practices.

To enhance transparency, the company has implemented geo-tagging across its supply chain, achieving over 95% accuracy in field-level mapping - a step toward improving traceability in sourcing. At the foundation of this initiative is a Sustainable Palm Oil Policy addressing environmental, social, and governance (ESG) parameters, which includes:

- Engaging smallholder farmers to adopt improved cultivation and harvesting practices
- Protecting High Conservation Value (HCV) areas to reduce deforestation and preserve biodiversity
- Conducting training and capacity-building programs to enhance farmer livelihoods and encourage climate-resilient practices
- Establishing monitoring and evaluation mechanisms to track sustainability performance.

Through responsible sourcing protocols and community participation, Godrej Agrovet is working to mitigate the traditional environmental impacts of palm oil cultivation and promote more sustainable supply chains in a high-impact sector.[23]

[21] UPL-Biodiversity. (2025). Biodiversity Conservation for a Sustainable Future | UPL.

[22] Meijaard, E., Garcia-Ulloa, Sheil, J., Carlson, S. A., Juffe-Bignoli, & Brooks. (n.d.). Oil palm and biodiversity A situation analysis by the IUCN Oil Palm Task Force International Union For Conservation Of Nature.

[23] Godrej Agrovet Ltd.-Annual Report. (2024). Godrej Agrovet Limited-At a Glance.

4. Bayer's Better Life Farming Initiative: Empowering Smallholders Through Agri-Entrepreneurship

Launched in 2018 and expanded in 2020, Bayer's Better Life Farming (BLF) initiative is a corporate-led, multi-stakeholder effort aimed at supporting rural farming ecosystems in India. The initiative focuses on providing integrated agricultural services to smallholder farmers to improve productivity, income, and resilience. At the centre of the program are Better Life Farming Centres (BLFCs), with over 1,100 centres established across the country. These centres are operated by local agri-entrepreneurs who provide access to farming inputs, agronomic guidance, and market linkages for smallholders. Bayer reports that more than 1,400 farmers in Madhya Pradesh have been trained under the initiative, with a focus on key crops such as pulses, cotton, and corn. During the COVID-19 pandemic, the program extended support to over 400,000 smallholder farmers across 17 states, supplying farming kits that included seeds, crop protection products, and personal protective equipment (PPE).

BLF operates through collaborations with partners such as the International Finance Corporation (IFC), Netafim, and local organizations. The program incorporates digital farm management tools, customized agronomic advice, and gender-inclusive approaches, including the promotion of women agri-entrepreneurs. The reported outcomes of the initiative indicate a positive and multifaceted impact on the agricultural ecosystem. Farmers have experienced improved access to agricultural inputs and technical knowledge, enabling them to adopt better cultivation practices. This has led to higher crop yields and increased incomes, contributing to enhanced livelihoods. Additionally, the initiative has facilitated stronger market linkages and better price realization, allowing farmers to capture greater value for their produce. Importantly, the support provided has also helped build greater resilience to climate risks and external shocks, including those posed by the COVID-19 pandemic, ensuring more stable and sustainable farming systems. Through its multi-stakeholder model, Better Life Farming represents an effort by Bayer and its partners to engage smallholder farmers in climate-smart and inclusive agricultural practices.[24]

5. Jain Irrigation's Land Restoration & Biodiversity Initiative: Greening the Barren, Empowering Communities

Since the early 1990s, Jain Irrigation Systems Ltd. (JISL) has undertaken one of India's early corporate-led efforts in land restoration and biodiversity conservation. What began as a project to rehabilitate degraded land in Maharashtra has evolved into a large-scale ecological regeneration program integrated with sustainable agriculture and community engagement. Central to the initiative is the development of Jain Hills, a 2,500-acre area now supporting a diverse ecosystem of native flora and fauna. This transformation was carried out through a combination of afforestation, habitat creation, and watershed development practices, aimed at converting previously barren land into fertile, biologically diverse terrain.

[24] Bayer India. (2020, November 2). Bayer expands Better Life Farming initiative in India | Bayer India.

The program focuses on aligning habitat restoration with agricultural development, utilizing scientific land-use planning and community-centred approaches.

Key interventions have included:

- Watershed development to enhance water retention, recharge groundwater, and reduce surface runoff
- Soil conservation measures to prevent erosion and improve soil fertility
- Introduction of micro-irrigation systems to optimize water usage and support agricultural productivity
- Farmer training initiatives promoting sustainable practices, agroecology, and biodiversity conservation

The initiative has yielded significant environmental and socio-economic benefits. One of the most notable outcomes has been the increase in local biodiversity, marked by the return of native bird and animal species to restored habitats. This ecological revival has been complemented by improvements in soil and water health, which are essential for sustaining long-term agricultural productivity and ecological balance. Additionally, the initiative has focused on capacity-building for thousands of farmers, equipping them with resource-efficient and climate-resilient agricultural techniques. These efforts have collectively contributed to the development of more sustainable and adaptive farming systems in the region. The Jain Hills project illustrates a corporate effort to combine ecological restoration with rural development and sustainable land management practices.[25]

6. Syngenta India's Biodiversity & Regenerative Agriculture Drive: Scaling Sustainability Across Landscapes

Since 2014, Syngenta India has been working to incorporate biodiversity and regenerative agriculture into large-scale farming systems. The initiative is designed to address environmental challenges, farmer livelihood concerns, and climate vulnerabilities, and has reached 38.7 million hectares of farmland globally through its soil and biodiversity programs.

As part of Syngenta's global Good Growth Plan, the company has trained over 74 million farmers, with 95% based in the Asia Pacific region and China, on the safe and sustainable use of agricultural products. The initiative aims to position farmers as key participants in driving change. By 2030, Syngenta plans to expand the adoption of regenerative agriculture practices to 50 million hectares, with a focus on soil health, pollinator management, and ecological stability.

A significant element of this initiative is the Operation Pollinator program, which works to establish and maintain pollinator habitats on farmland, aiming to restore insect populations that support crop productivity. In addition, Syngenta has developed a solar-

[25] Jain, B. (n.d.). Jain Hills & Valley. www.jains.com

powered, low-cost Biodiversity Sensor, in collaboration with IIT Ropar, that can monitor and identify insect species continuously. This tool facilitates real-time biodiversity tracking and more informed agronomic decision-making. Syngenta collaborates with environmental organizations such as The Nature Conservancy to support practices such as habitat protection, soil health regeneration, efficient resource use.

Key achievements of the initiative include:

- A 27% increase in biodiversity across 5 million hectares of farmland, based on field assessments.
- The creation of the LIVINGRO™ platform, which measures biodiversity indicators and evaluates the ecological impacts of different agronomic practices.
- The ongoing implementation of regenerative agriculture projects that aim to enhance biodiversity and improve long-term soil health, contributing to farming systems that are more resilient and adaptable to climate change.

4.1.6 Challenges and Gaps for corporate attention to biodiversity conservation

While the biodiversity challenges in agriculture - such as genetic erosion, soil degradation, and habitat loss - underscore the urgency of adopting more sustainable practices, addressing these issues requires collective and coordinated action. In recent years, many agri-businesses and corporates have begun to integrate biodiversity considerations into their Environmental, Social, and Governance (ESG) and Corporate Social Responsibility (CSR) frameworks. However, translating these commitments into meaningful, on-ground impact presents its own set of challenges. From the short-term nature of many CSR projects to difficulties in measuring biodiversity outcomes, corporates often face structural, technical, and policy-related barriers that hinder the full-scale implementation of biodiversity-friendly initiatives. Understanding and addressing these gaps is crucial for aligning private sector efforts with broader conservation and sustainability goals in agriculture.

Key gaps include:

1. **Short-Term Nature of CSR Projects:** Many CSR initiatives in the agri-business sector operate within short funding cycles or annual project frameworks. This temporal limitation significantly hampers the ability to pursue biodiversity conservation, which inherently requires long-term commitment. Initiatives aimed at restoring ecosystems, reviving native species, or regenerating degraded lands often take years to yield measurable results. However, many current CSR models tend to prioritize quick wins and visible outcomes within limited timeframes, leading to fragmented or incomplete efforts when it comes to addressing deep-rooted ecological issues.
2. **Challenges in Measuring and Monitoring Biodiversity Impacts:** Evaluating the impact of corporate biodiversity initiatives remains a major challenge due to the complexity of ecosystems and the lack of accessible monitoring tools. Quantifying ecological outcomes - such as changes in species richness, soil microbial health, or pollinator diversity - is

not only resource-intensive but also highly technical. Many existing frameworks do not include standardized biodiversity metrics, which makes it difficult for companies to assess progress, demonstrate impact, or report in line with ESG standards. This lack of clarity creates hesitancy in fully investing in biodiversity-oriented interventions.

3. **Limited Technical Capacity and Knowledge:** A significant barrier for agri-businesses is the limited in-house expertise in biodiversity conservation and ecosystem management. Many companies lack access to ecological specialists or meaningful partnerships with biodiversity-focused organizations. Furthermore, biodiversity often remains an underdeveloped pillar within corporate ESG strategies, leading to a lack of clear guidance or tools for implementation. This knowledge gap results in piecemeal or compliance-oriented efforts, rather than strategic and impactful biodiversity actions.
4. **Fragmented Policy and Regulatory Ecosystem:** The existing policy and regulatory landscape around biodiversity and agriculture is often fragmented and lacks clear direction for private sector engagement. Businesses frequently face overlapping or ambiguous mandates from various government agencies, which reduces their confidence to invest in long-term biodiversity-related initiatives. Additionally, the absence of targeted incentives or mandatory disclosures for biodiversity conservation discourages deeper corporate participation, especially when weighed against more quantifiable ESG areas like carbon emissions or water use.
5. **Low Stakeholder Awareness and Engagement:** Engaging local stakeholders, particularly farmers and rural communities, poses a critical challenge for corporates attempting to implement biodiversity-friendly practices. Limited awareness, mistrust, and insufficient understanding of biodiversity's long-term benefits often create resistance to change. Moreover, there is frequently a disconnect between corporate biodiversity objectives and the on-ground priorities or traditional knowledge systems of local populations. This misalignment makes it difficult to build trust and foster collaborative models essential for the success of biodiversity initiatives.
6. **Complexity in Scaling Biodiversity Initiatives:** Unlike more standardized interventions such as renewable energy or waste management, biodiversity projects are inherently context specific. Soil types, climate conditions, native species, and cultural practices vary widely across regions, making it difficult for companies to scale a successful biodiversity model from one geography to another. This limits the ability of corporates to replicate pilot programs or extend biodiversity strategies across their full value chains, thereby confining impact to small, isolated pockets.
7. **Conflict Between Productivity and Conservation Goals:** Agri-businesses often operate under pressure to maintain high levels of productivity, supply chain efficiency, and profitability - priorities that can conflict with the slower, more nuanced goals of biodiversity conservation. The perceived trade-off between short-term output and long-term ecological health discourages investment in biodiversity-friendly practices. In many cases, business models have yet to evolve to fully integrate the value of ecosystem services, making biodiversity an ancillary concern rather than a core operational priority.
8. **Lack of Market Incentives for Biodiversity-Conserving Products:** Despite growing global attention on sustainable agriculture, consumer demand for biodiversity-friendly

products remains relatively low, particularly in price-sensitive markets. There is limited willingness to pay a premium for goods produced through biodiversity-conscious farming methods, and certification schemes that can build trust or communicate ecological value are still in nascent stages. Without strong market-based incentives or differentiated branding opportunities, companies find it difficult to justify the additional investment required for biodiversity-aligned sourcing and production practices.[26][27][28]

4.1.7 Opportunities for further action

Opportunities for Further Action by Corporates to Address Biodiversity in Agriculture

The agriculture and agri-business sectors could consider a range of opportunities to enhance their contribution to biodiversity conservation. These actions may span across strategy, sourcing, processing, and consumer engagement, and can support both sustainability goals and long-term business resilience. The following areas suggest potential pathways for deeper corporate engagement:

1. **Strategic Integration and Biodiversity Risk Assessment**

   Corporates may find value in embedding biodiversity considerations into broader business strategies and operational planning. This might include mapping ecological dependencies and impacts across the supply chain, conducting site-level ecosystem assessments, and exploring risks and opportunities related to biodiversity. Developing biodiversity-related action plans, engaging with stakeholders, or supporting the formulation of sectoral biodiversity standards could be beneficial steps.

2. **Sustainable Sourcing and On-Farm Conservation**

   There may be opportunities to support biodiversity-friendly sourcing practices by promoting agroecological approaches such as crop diversification, organic farming, and the use of native seed varieties. Companies might explore partnerships with farmers to conserve traditional knowledge and genetic diversity—through community seed banks or sustainable input systems—which could enhance supply chain resilience and align with national biodiversity and climate goals.

3. **Sustainable Manufacturing, Circular Practices, and Ecosystem Stewardship**

   In the production phase, adopting circular economy principles—such as recycling agricultural residues, composting, or reducing effluents—could help reduce ecological impacts. Supporting initiatives to maintain soil health, reduce water pollution, or restore degraded habitats might contribute to improved environmental performance. Additionally, engaging with local communities and integrating traditional ecological knowledge could further reinforce ecosystem stewardship.

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[26] Nelson, V., & Morton, J. (2020). CGIAR Research Program 2020 Reviews: Climate Change, Agriculture and Food Security (CCAFS).

[27] TNFD. (2022). The TNFD Nature-Related Risk and Opportunity Management and Disclosure Framework Beta v0.2

[28] MoEFCC & UNDP. (2022). India, Naturally! India's Living Biodiversity-A People's Resource Fourth Edition.

4. **Consumer Engagement, Product Innovation, and Policy Support**

   Engaging consumers through awareness campaigns, sustainability labelling, or biodiversity-friendly branding may help influence more responsible consumption patterns. Corporates might also consider supporting biodiversity-focused research, contributing to policy dialogue, or collaborating on the implementation of national and global biodiversity strategies. Such efforts could enhance ESG performance and help position companies as leaders in sustainable agriculture.

4.2 Fisheries and Marine Sector

4.2.1 Sectoral Overview

India's coastal and marine (C&M) ecosystems, comprising estuaries, mudflats, backwaters, lagoons, mangroves, coral reefs, and seagrass beds, are among the most biologically and economically productive ecosystems. These ecosystems play a crucial role in sustaining livelihoods, enhancing food security, and providing essential ecological services, thereby

contributing significantly to poverty reduction and human well-being.(Jacob et al., 2018) Fisheries and aquaculture are integral to India's economy, serving as a primary source of food production, nutritional security, employment, and income. The sector provides direct livelihoods to over 20 million fishers and fish farmers while contributing approximately INR 1.75 lakh crore annually to the country's gross value added (GVA). Additionally, fisheries serve as a major export sector, with fish being one of the most important agricultural commodities traded internationally.[29]

The demand for fish as a source of protein has seen a significant rise globally, accounting for 17% of the world's animal protein intake and 6.7% of total protein consumption.[30] Rich in high-quality protein, amino acids, vitamins, and minerals, fish is an essential component of human nutrition and health. In India, marine fisheries play a crucial role in food security and economic growth, with total marine fish landings estimated at 3.83 million tonnes in 2017, valued at ₹78,408 crores at the retail level. Since 1950, marine fish production has witnessed a sixfold increase, growing from 5.8 lakh tonnes to 3.59 million tonnes in 2014. The fisheries sector also makes a vital contribution to the national economy, accounting for approximately 1% of India's GDP.[31] Despite its significant economic and ecological importance, the sector faces multiple sustainability challenges. Overexploitation of fisheries resources, habitat destruction, and biodiversity loss due to unsustainable fishing practices continue to threaten marine ecosystems.[32] Additionally, anthropogenic activities, pollution, dredging, and reclamation of natural habitats have further exacerbated ecosystem degradation. If not addressed, these challenges could severely impact marine biodiversity and the long-term sustainability of fisheries.

However, India's fisheries and marine biodiversity sectors are undergoing a critical transformation, with growing recognition of the need to integrate conservation into business strategies. Despite the existence of regulatory frameworks, environmental guidelines, and sustainability programs, many corporates operating in this space face substantial challenges in adopting biodiversity-positive practices. For businesses, especially those involved in seafood processing, aquaculture, logistics, and export, translating biodiversity commitments into action is constrained by overlapping governance structures, high compliance costs, and a lack of clarity on sustainable operating standards. Corporates often struggle to navigate fragmented marine regulations, coordinate with multiple agencies, and adopt traceability protocols due to weak institutional alignment. Moreover, the absence of strong market incentives, consumer demand for certified sustainable seafood, and access to biodiversity-friendly technologies hampers the mainstreaming of eco-conscious business models. Infrastructure gaps such as inadequate cold storage and waste management systems further compound biodiversity loss and discourage private sector investment in sustainable sourcing.

29 Jaini, M. (2020, July 2). India's fisheries: Past, present, and future | India Development Review.

30 CMFRI. (2025). Central Marine Fisheries Research Institute | Home.

31 Joshi, K. K., & S, V. M. (n.d.). International Workshop-cum-Training Programme on "Fisheries and Aquaculture" Status of marine biodiversity in India.

32 Jacob, T., Singh Yadava, Y., Rabikumar, & Meenakumari. (2018). Centre for Biodiversity Policy and Law Naonal Biodiversity Authority Taramani, Chennai-600 113 Tamil Nadu, India Mainstreaming Biodiversity into Coastal and Marine Fisheries Sector.

The challenges also extend to the availability of skilled labour and real-time ecological data, which are essential for integrating ecosystem considerations into business risk assessments, environmental impact reporting, and supply chain transparency. In sum, the corporate sector faces a convergence of policy, market, financial, and institutional barriers that hinder the implementation of biodiversity-aligned operations. Addressing these gaps is essential not only for marine ecosystem conservation but also for ensuring the long-term viability and global competitiveness of India's blue economy.[33]

4.2.2 Impacts of the Fisheries and Marine Sector on Biodiversity in India

India's fisheries and marine sector plays a crucial role in food security, livelihoods, and economic growth. However, its operations have significant implications for marine and coastal biodiversity. The following key thematic areas reflect the intertwined sectoral pressures and biodiversity impacts:

1. **Overexploitation of Marine Resources and Species Depletion:** India's marine fisheries largely function under an open-access regime, with limited regulatory oversight on fishing effort and weak enforcement of the Marine Fishing Regulation Act (MFRA). Mechanized trawling, responsible for over 55% of marine production, along with unsustainable gear like ring seines and purse seines, has led to high rates of overfishing. By-catch levels range between 25–54%, resulting in the incidental capture of juveniles, non-target, and endangered species. This has triggered a shift towards smaller open seas fish, a phenomenon known as "fishing down the food chain"—ultimately altering ecosystem structures and food webs.
2. **Habitat Loss and Ecosystem Degradation:** Coastal infrastructure development, such as ports and tourism facilities, has led to habitat fragmentation, coastal erosion, sedimentation, and destruction of critical ecosystems including coral reefs, mangroves, estuaries, and seagrass beds. Destructive fishing techniques like bottom trawling further damage benthic habitats essential for spawning and feeding. Reduced freshwater inflows due to upstream diversions exacerbate salinity changes, lowering water quality and threatening the health of brackish and coastal ecosystems.
3. **Pollution from Land-Based and Marine Sources:** Approximately 80% of marine pollution in India originates from land-based sources such as untreated sewage, industrial effluents, agricultural runoff, and plastic waste. Marine litter, especially microplastics and oil spills, causes physiological harm and mortality in fish, seabirds, and marine mammals. Notable oil spills such as the 2010 Mumbai and 2017 Chennai incidents, have led to the death of hundreds of marine animals and significant habitat damage. The bioaccumulation of toxins and plastics in marine species further disrupts ecological integrity and poses risks to human consumers.
4. **Climate Change and Oceanographic Shifts:** Marine ecosystems are highly vulnerable to climate-induced stressors including rising sea surface temperatures, ocean acidification, sea-level rise, and extreme weather events. These impacts are altering fish migratory

33 Jacob, T. (n.d.). ECO SI UN Ocean Decade 2021.

routes, spawning seasons, and geographical distributions—as observed in Indian oil sardine and mackerel stocks. Coral bleaching, loss of nursery grounds, and disruption of marine food chains are key consequences of these changes, severely affecting species resilience and community livelihoods.

5. **Invasive Alien Species and Ecosystem Imbalance:** Ballast water discharge from cargo ships introduces invasive alien species (IAS) that outcompete native flora and fauna, alter trophic relationships, and degrade habitats. Invasive species such as Caulerpa, Cladophora, and Carijoa riisei have been reported in multiple Indian marine zones, including the Andaman & Nicobar Islands, Gulf of Mannar, and west coast. The presence of 18 documented IAS has severely affected indigenous biodiversity and ecosystem stability.
6. **Governance, Traceability, and Regulatory Gaps:** India's fisheries governance is marked by fragmented jurisdiction between Central and State governments, resulting in policy incoherence and weak enforcement. Coastal waters up to 12 nautical miles and deeper Exclusive Economic Zones (EEZ) are increasingly exploited, with minimal oversight on total allowable catch, spatial closures, or catch documentation. This undermines traceability systems and restricts India's ability to meet international standards for sustainable fisheries, impacting export competitiveness and marine conservation outcomes.
7. **Underwater Noise Pollution and Marine Fauna Stress:** Industrial activities such as shipping and offshore exploration contribute significantly to underwater noise pollution, which affects the communication, navigation, and mating behaviors of marine fauna—especially cetaceans, teleost fishes, turtles, and invertebrates. The Convention on Biological Diversity (CBD) and its Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) have highlighted underwater noise as a major emerging threat to marine biodiversity.
8. **Illegal Trade and Exploitation of Protected Species:** High global demand for marine products has led to illegal, unreported, and unregulated (IUU) fishing and unsustainable extraction of threatened marine species, such as seahorses, sea cucumbers, corals, and mollusks. Despite legal protections under the Wildlife (Protection) Act, 1972, and regulations under CITES and India's Foreign Trade Act, enforcement remains weak. This unchecked exploitation continues to drive biodiversity loss and undermines marine ecosystem services.[34]

4.2.3 Regulatory and Policy Landscapes

India's marine and fisheries sector operates under a robust regulatory ecosystem informed by international agreements and emerging global standards. These frameworks not only promote sustainable resource use but also guide biodiversity conservation efforts and shape corporate environmental responsibility.

[34] Jacob, T., Singh Yadava, Y., Rabikumar, & Meenakumari. (2018). Centre for Biodiversity Policy and Law Naonal Biodiversity Authority Taramani, Chennai-600 113 Tamil Nadu, India Mainstreaming Biodiversity into Coastal and Marine Fisheries Sector

1. International Agreements

India is a signatory to several international conventions and protocols that promote marine biodiversity conservation:

- **United Nations Convention on the Law of the Sea (UNCLOS), 1982:** UNCLOS defines national rights and responsibilities over marine resources, including conservation within Exclusive Economic Zones (EEZs). It establishes legal tools for managing overfishing, protecting ecosystems, and regulating marine pollution.[35]
- **Ramsar Convention on Wetlands, 1971:** This convention emphasizes the wise use and protection of wetlands, many of which are crucial coastal habitats. For India, it helps conserve mangroves, estuaries, and lagoons that support diverse marine species and act as fish nurseries.[36]
- **Convention on International Trade of Endangered Species of Wild Fauna and Flora (CITES), 1973:** CITES regulates global trade in endangered marine species such as corals, sea turtles, and certain fish. It helps prevent biodiversity loss by ensuring trade does not threaten species' survival.[37]
- **Bonn Convention on the Conservation of Migratory Species of Wild Animals (CMS), 1979:** CMS facilitates coordinated conservation efforts for migratory marine species like whales, dolphins, and seabirds. It supports habitat protection across national boundaries, ensuring species survival throughout their migratory routes.[38]
- **Convention on Biological Diversity (CBD), 1992:** CBD forms the foundation of India's biodiversity policies. It encourages ecosystem conservation, sustainable use of marine resources, and equitable benefit-sharing from genetic resources like marine biota.[39]
- **United Nations Framework Convention on Climate Change (UNFCCC), 1992:** While climate-focused, UNFCCC indirectly supports marine biodiversity by addressing issues like ocean warming, acidification, and extreme weather events that threaten marine ecosystems and fisheries.
- **FAO Code of Conduct for Responsible Fisheries (CCRF), 1995:** CCRF provides voluntary guidelines for sustainable fisheries management. It promotes ecosystem-based approaches, habitat protection, and responsible aquaculture - key to preserving fishery-related biodiversity.
- **Nagoya Protocol, 2010:** This protocol strengthens CBD implementation by ensuring fair access and benefit-sharing of marine genetic resources. It supports conservation efforts by providing legal clarity around bioprospecting in marine environments.[40]

[35] Oceans and Law of the Sea-United Nations. (2024). Oceans and Law of the Sea.

[36] Ramsar. (2024). Home page | The Convention on Wetlands

[37] CITES. (2024). Front | CITES. https://cites.org/eng

[38] CMS. (2025). CMS | Convention on the Conservation of Migratory Species of Wild Animals.

[39] CBD. (2024). Home | Convention on Biological Diversity. https://www.cbd.int/

[40] The Nagoya Protocol. (2024). The Nagoya Protocol on Access and Benefit-sharing. https://www.cbd.int/abs

- **Voluntary Guidelines on Tenure of Land, Fisheries & Forests (2012):** These guidelines advocate secure tenure rights for small-scale fishers, enabling them to manage resources sustainably. They empower local communities as biodiversity stewards through equitable and participatory governance.
- **Voluntary Guidelines for Securing Sustainable Small-scale Fisheries (2014):** These guidelines promote socially and environmentally sustainable fisheries. They prioritize the well-being of small-scale fishers while safeguarding coastal and marine biodiversity through inclusive policies.

2. Regional and Global Business Frameworks

- **Indian Ocean Tuna Commission (IOTC) and Bay of Bengal Programmes:** These regional bodies foster collaborative management of shared marine resources. They enhance fishery sustainability and biodiversity protection across international waters through science-based regulations and ecosystem monitoring.[41]
- **Global Reporting Initiative (GRI):** GRI helps companies report environmental impacts, including on biodiversity, using standardized metrics. It encourages greater transparency on marine ecosystem impacts and drives business accountability.[42]
- **Taskforce on Nature-related Financial Disclosures (TNFD):** TNFD guides businesses in identifying, assessing, and disclosing nature-related risks and opportunities. For marine sectors, this means recognizing dependencies on ocean health and integrating biodiversity into strategic decision-making.43
- **Science Based Targets for Nature (SBTN):** SBTN supports companies in setting measurable goals to halt and reverse nature loss. It enables marine-sector businesses to align operations with biodiversity thresholds and contribute to global restoration efforts.[44]
- **Natural Capital Protocol:** This framework assists businesses in valuing their dependencies and impacts on ecosystems. In the marine context, it fosters better decisions around resource use, pollution control, and ecosystem preservation.45

3. National Policies and Legislative Framework

India's legislative landscape for marine and fisheries biodiversity conservation is shaped by a range of sectoral and environmental laws. These policies collectively ensure the sustainable use of marine resources while protecting critical ecosystems and empowering coastal communities.

- **The Wildlife (Protection) Act, 1972 (WLPA, 1972)** provides legal protection to marine species like sea turtles, dugongs, and certain fish, helping to preserve marine biodiversity through species-level conservation.

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[41] IOTC-FAO. (2024). IOTC | Indian Ocean Tuna Commission / Commission des Thons de l'Océan Indien. https://iotc.org/

[42] GRI. (2025). GRI - Standards. https://www.globalreporting.org/standards/

[43] TNFD. (2024). The Taskforce on Nature-related Financial Disclosures. https://tnfd.global/

[44] SBTN. (2025). Science Based Targets Network. https://sciencebasedtargetsnetwork.org/

[45] Capitals Coalition. (2025). Natural Capital Protocol – Capitals Coalition.

- **Marine Products Export Development Authority Act, 1972** promotes sustainable seafood exports and aligns aquaculture practices with international biodiversity and safety standards.
- **Marine Fishing Regulation Act (MFRA) promulgated by each coastal State/UT based on a model bill circulated by the Union Ministry of Agriculture in 1978** enacted by coastal States/UTs regulate fishing zones, gear types, and seasonal bans to prevent overfishing and allow for resource regeneration.
- **Maritime Zones of India (MZI) Act, 1981** defines India's maritime jurisdiction, empowering the country to manage resources in the Exclusive Economic Zone (EEZ), including marine biodiversity and fisheries.
- **Environment (Protection) Act, 1986** serves as an umbrella legislation to enforce environmental standards in marine pollution control, effluent discharge, and aquaculture operations.
- **Coastal Regulation Zone Notification, 1991 and 2011** restrict industrial, aquaculture, and infrastructure development along ecologically sensitive coastal stretches, safeguarding critical habitats like mangroves and estuaries.
- **Coastal Aquaculture Authority Act, 2005** regulates the setup and operation of coastal aquaculture farms, ensuring minimal ecological impact through licensing and monitoring systems.
- **Biological Diversity Act, 2002 (BD Act, 2002)** ensures the conservation of biological resources and regulates access to marine genetic material, promoting fair and equitable benefit-sharing with local communities.
- **National Environmental Policy, 2006** advocates for ecosystem-based management of marine and coastal resources, promoting biodiversity conservation, sustainable livelihoods, and pollution control in fragile coastal zones.
- **National Policy on Marine Fisheries (NPMF), 2017** provides an overarching goal towards ensuring the health and ecological integrity of the marine living resources in the Indian EEZ through sustainable harvest for the benefit of the present and future generations. It is based on seven pillars that guide the actions of various stakeholders in meeting the vision and mission set for the marine fisheries sector of the country, namely sustainable development, socio-economic upliftment of fishers, principle of subsidiarity, principle of partnership, principle of inter-generational equity, principle of gender justice, precautionary approach.
- **The National Mission on Blue Revolution** integrates ecological sustainability with economic development, aiming to modernize the sector while aligning with SDGs and India's Blue Economy vision.

4. State Level Regulations and Implementation

- Marine Fishing Regulation Acts (MFRA) in Coastal States/UTs-
  - ♦ Each coastal State/UT has its own MFRA, aligned with the Union Ministry of Agriculture's model bill (1978).
  - ♦ Regulates vessel registration, gear restrictions, and seasonal bans

- Implementation of Biodiversity Action Plans at State Level-
  - ♦ State Biodiversity Boards (SBBs) oversee the implementation of BD Act, 2002
  - ♦ Preparation of People's Biodiversity Registers (PBRs) for marine bioresources

4.2.4 Current Sustainability and Conservation Initiatives in the Sector in India

Some of the key initiatives aimed at integrating biodiversity conservation and sustainable fisheries management in India's coastal and marine sector focus on habitat protection, responsible fishing, pollution control, species conservation, and governance reforms, are as below:

1. Marine Protected Areas (MPAs) and Biodiversity Conservation

India currently has 130 Marine Protected Areas (MPAs), with 24 located in mainland India and 106 in island territories. These MPAs cover 8,214 km , representing 5% of India's Protected Area network, though they account for less than 0.3% of the total land area. The Convention on Biological Diversity (CBD) mandates the identification of Ecologically or Biologically Significant Marine Areas (EBSAs) based on criteria such as uniqueness, importance for life-cycle stages, habitat vulnerability, biodiversity, and productivity. The aim is to promote sustainable fisheries and ensure the protection of at least 10% of the world's coastal and marine areas. In line with this, KMGBF targets, and SDG-14 emphasize the conservation of at least 10% of coastal and marine areas of particular importance for biodiversity and ecosystem services. This conservation should be achieved through effective and equitable measures, including connected systems of protected areas and other area-based conservation initiatives.

The Wildlife Institute of India (WII) has identified Important Coastal & Marine Biodiversity Areas (ICMBAs), focusing on ecosystem resilience, biodiversity uniqueness, ecological functions, cultural significance, socio-economic potential, and land tenure. Out of 350 surveyed sites, 106 have been prioritized to strengthen India's MPA network, with these sites playing crucial roles as breeding and nursing grounds for finfish and shellfish species, thereby enhancing fisheries resources. Additionally, the National Centre for Sustainable Coastal Management (NCSCM) has mapped Ecologically Sensitive Areas (ESAs) under the CRZ Notification, 2011 and developed a framework for assessing the ecological sensitivity of mangroves, coral reefs, seagrasses, and salt marshes. Using EBSA criteria, NCSCM has identified highly sensitive areas and created a framework to recognize Critically Vulnerable Coastal Areas (CVCAs). The International Union for Conservation of Nature (IUCN) and the CBD also focus on identifying Important Marine Mammal Areas (IMMA) to ensure sustainable fisheries and protect marine mammals.

2. Seasonal Fishing Bans – 60-day annual ban to replenish fish stocks.

India has implemented a 60-day annual fishing ban to help replenish fish stocks and maintain ecological balance. Initially, the ban was enforced for 45 days during the monsoon season, but it was later extended to 60 days. This ban is uniformly enforced across all

coastal States and Union Territories (UTs) to reduce fishing pressure on marine ecosystems. The coastal States and UTs enforce the ban in territorial waters under the Marine Fisheries Regulation Act (MFRA), while the Union Government enforces it in extra-territorial waters (Exclusive Economic Zone or EEZ) through an executive order. The Central Marine Fisheries Research Institute (CMFRI) conducted a study under the GIZ/MoEF&CC's TEEB Project, examining the economic impact of the seasonal fishing ban. The study found that the ban led to improved ecosystem services, including increased fish catches, higher fisher incomes, and enhanced biodiversity. The economic valuation for states such as Gujarat, Karnataka, Kerala, Tamil Nadu, and Andhra Pradesh revealed an incremental fish growth value of ₹107 billion (US$ 0.76 million) and a net social benefit of ₹1.09 million (US$ 18,167).

3. By-Catch Reduction Measures – Gear modifications, legal size restrictions, TEDs.

By-Catch is the incidental capture of non-target species during fishing. The global annual by-catch discards are estimated by the FAO at 7.3 million tonnes, highlighting the scale of the issue. Indian fisheries, operating in a multi-species, multi-gear system, face significant challenges with by-catch, which is a complex problem due to the variety of fishing methods used. In India, mechanized fishing vessels capture between 25–54% of by-catch, including juvenile fish, non-edible biota, and marine mammals, much of which is used in fishmeal production. According to the Central Marine Fisheries Research Institute (CMFRI), over 250 fish species are caught as by-catch in Indian waters. To address this, the CMFRI has taken several measures, including defining Minimum Legal Size (MLS) for 58 fish species, advising on gear modifications to reduce the capture of juvenile fish, and introducing selective fishing techniques such as square mesh cod ends and Turtle Excluder Devices (TEDs) to minimize the impact on non-target species.

4. Co-Management Initiatives – Community-based conservation efforts.

Co-management in fisheries is globally recognized as a successful approach to local-level fisheries management, involving all stakeholders in decision-making through a participatory process. This system brings together local fishing communities, scientists, and policymakers to collaboratively manage and conserve marine resources.

In India, several co-management practices have been adopted, such as the alternate-day fishing regulation and self-regulation by women seaweed collectors in the Gulf of Mannar and Palk Bay areas of Tamil Nadu. In Maharashtra, fishing communities have initiated efforts to conserve coastal and marine resources. Similarly, community-based fisheries management is being practiced in Nagapattinam District, Tamil Nadu, and community conservation efforts are underway in Orissa. Under the GEF-UNDP Project on 'Mainstreaming biodiversity conservation in production sectors,' some key co-management initiatives have been carried out, notably in Sindhudurg (Maharashtra) and East Godavari (Andhra Pradesh). These initiatives highlight the importance of local communities in achieving sustainable fisheries and conservation outcomes.

5. Invasive Species Management – Ballast water regulations, risk assessments

The spread of marine invasive alien species poses a significant threat to coastal and marine biodiversity, primarily due to ballast water discharge from global shipping. This practice

transfers living organisms across oceans, creating ecological, economic, and public health risks. To address this issue, India introduced regulations on September 8, 2017, requiring ships above 400 gross tonnages to comply with ballast water management protocols. These regulations include the implementation of a management plan, maintaining a record book, using a treatment system, and obtaining certification. The CSIR-National Institute of Oceanography (NIO) is assisting the Ministry of Shipping in tackling ballast water challenges. India has signed the Ballast Water Management Convention (2004), but has yet to ratify it, leaving some regulatory gaps in fully addressing the issue of invasive species spread via ballast water.

6. **Plastic & Marine Debris Reduction – Integration with Swachh Bharat Abhiyan**

   India is integrating marine debris mitigation into the Swachh Bharat Abhiyan, with a strong focus on reducing single-use plastics and cleaning coastal habitats. As part of this initiative, regulations have been introduced to control ship waste disposal and prevent ocean pollution. These efforts aim to address the growing issue of marine debris and promote cleaner, healthier coastal environments.

7. **Eco-Certification and Traceability in Fisheries Trade**

   Certification, eco-labelling, and traceability in the fisheries sector are becoming increasingly important, especially in relation to international fish trade. Eco-labelling offers several benefits, such as helping consumers make informed choices about the sources of their seafood and creating market incentives for ecologically sustainable fishing practices.

   Traceability has become a key requirement, with the EU markets mandating traceability for all seafood imports since January 2010, ensuring transparency and accountability in seafood sourcing. India achieved a significant milestone with its first Marine Stewardship Council (MSC) certification for the short-neck clam fishery in Ashtamudi Lake, Kerala. This certification not only promotes sustainable fisheries but also contributes to ecosystem protection. It marks India's first MSC certification and the third such certification in Asia.

8. **Capacity Building – Training for sustainable fisheries management**

   The Wildlife Institute of India (WII) has developed customized courses for both the forest and fisheries sectors, focusing on sustainable Marine Protected Area (MPA) and fisheries management. These courses are based on a detailed need and gap analysis to address the specific challenges in these sectors. Additionally, community-based programs are being promoted to encourage sustainable fisheries management and raise awareness about biodiversity conservation.

4.2.5 ESG and CSR Trends in the Fisheries and Marine Sector

This section highlights some of the good practices and trends related to ESG and CSR in the commercial fisheries and marine sector in India.

Environmental, Social and Governance (ESG):

India's fisheries and marine sector plays a pivotal role in the nation's food security, employment generation, and export earnings. The sector has witnessed considerable growth with shrimp aquaculture leading the charge, supported by an integrated supply chain involving hatcheries, feed mills, farms, and processing units. The demand for traceable, sustainable, and high-quality seafood, particularly shrimp, has driven Indian companies to align with international standards and ESG (Environmental, Social, and Governance) principles to meet global market expectations.

Identifying Key Corporates in the Sector

To evaluate ESG trends in the fisheries and marine sector, this study focussed on 15 major corporates that significantly influence various segments of this sector, including fisheries, seafood processing, aquaculture, and marine conservation. The selected companies represent diverse value chains and were chosen based on their market influence, track record, and adoption of ESG activities. These 15 corporates include Silver Sea Food, Abad Fisheries Private Limited, Seasaga Group, Geo Seafood, Apex Frozen Foods Ltd, Munnujii Foods International Pvt. Ltd, Oceans Secret, Green Incredible Foods Pvt Ltd (Green Chick Chop), Golden Prize India

Avanti Feeds (Aquaculture), Kings Infra (Aquaculture), Coastal Corporation Limited (Aquaculture), Sharat Industries (Aquaculture), Zeal Aqua Ltd. (Aquaculture), and Waterbase Ltd. Out of the 15 corporates selected, a further specific group was shortlisted for an in-depth review of their ESG reports, based on the availability of their detailed disclosures. These reports serve as a primary source for understanding how these companies are incorporating sustainability practices, addressing environmental impacts, and ensuring ethical governance in their operations. The corporates in this sector whose reports in the public domain were studied closely are as follows:

- **Apex Frozen Foods Ltd:** The business focus is on vertically integrated shrimp farming and export. Efforts to strengthen sustainability includes streamlining business practices to achieve environmental certifications, supporting livelihood generation and women's employment. CSR initiatives focus on sanitation and water
- **Avanti Feeds Limited:** The business focus is on shrimp feed production and vertically integrated aquaculture. Significant efforts have been made in aspects related to renewable energy, water recirculation, traceability, farmer support, sustainable feed, and community development.
- **The Waterbase Limited:** The corporate mainly focuses on feed production and shrimp processing. Research-backed ESG alignment, ethical aquaculture, inclusive governance, and responsible business values are some of the focus areas of the corporate.
- **Coastal Corporation Limited:** The business focus is on shrimp export with global market presence. Efforts to strengthen sustainability include renewable energy, sustainable sourcing, transparency, ethical governance, and research & development for product quality.

General Trends Observed in the ESG Reports

- **Commitment to Sustainable Aquaculture Practices**

  All four companies have integrated sustainable aquaculture methods into their core operations, demonstrating a shared commitment to reducing environmental impacts and conserving biodiversity. Specific trends include:

  - **Responsible Feed and Broodstock Management:** Ensuring that shrimp or fish feed is sourced sustainably and that breeding practices reduce environmental stress on wild populations (e.g., Apex Frozen Foods and Avanti Feeds).
  - **Certification to Global Standards:** Each company is certified by organizations like BAP (Best Aquaculture Practices), which include biodiversity protection standards such as no encroachment on wetlands and mangroves.

- **Coastal and Marine Habitat Protection**

  Several CSR efforts have focused on preserving coastal ecosystems through both direct actions and policy adherence. This includes:

  - **Mangrove and Wetland Preservation:**

    Apex Frozen Foods follows guidelines that protect mangrove habitats, and Kings Infra emphasizes coastal zone management. These companies also avoid harmful practices like shrimp farming near critical marine habitats, promoting buffer zones and habitat restoration (as seen in Waterbase Ltd and Zeal Aqua Ltd.).

  - **Pollution Control and Effluent Management:**

    All four corporates implement eco-friendly practices like closed-loop water systems, water treatment plants, and zero discharge operations to prevent water contamination and the degradation of aquatic habitats. This not only protects biodiversity but also improves overall sustainability in marine environments.

- **Climate Resilience and Eco-Conscious Farming**

  The rising concerns about climate change have driven these companies to adopt climate-smart aquaculture practices, mainly through the following strategies.

  - **Adaptation to Climate Change:** Companies like Kings Infra and Apex Frozen Foods focus on resilient farming practices, especially as coastal areas are increasingly affected by extreme weather events (e.g., cyclones and floods). They use research-based models to create climate-resilient farming systems.
  - **Minimizing Greenhouse Gas Emissions:** Initiatives related to reducing carbon footprints are common, ensuring that operations are environmentally responsible and have minimal impacts on the surrounding ecosystems.

- **Environmental Stewardship**

  - Environmental certifications such as BAP, ASC, HACCP, and ISO 14001 are commonly pursued, underscoring alignment with global standards for aquaculture sustainability.
  - A clear effort is being made toward renewable energy adoption, with solar energy used for captive consumption in companies like Avanti and Coastal.

- Water conservation is prioritized, especially by Avanti through water recirculation systems to reduce dependency on freshwater resources.
- Waste segregation and eco-friendly disposal practices are gaining traction, demonstrating a shift toward responsible environmental management.
- Companies are increasingly focusing on sustainable fishing methods to meet global trade and eco-certification standards.
- By-catch reduction strategies such as the use of fish excluder devices (TEDs) and square mesh cod ends are gaining prominence.
- Seasonal fishing bans are supported by corporations to help replenish fish stocks.
- Eco-labelling of seafood products is being encouraged to reduce plastic packaging and promote sustainable seafood supply chains.
- Private sector collaborations with government and NGOs to support MPAs and Ecologically Sensitive Areas (ESAs)
- Corporate-backed research projects focus on coral reef restoration, mangrove reforestation, and seagrass bed conservation
- The fisheries sector is investing in low-emission fishing technologies, including energy-efficient boats and alternative fuel sources.
- Companies involved in blue carbon initiatives support the protection of mangroves and seagrass beds, which act as major carbon sinks.

- **Social Responsibility**
  - All companies place strong emphasis on livelihood generation, especially through employment of rural youth and women (notably by Apex), and support for shrimp farmers.
  - Farmer training and capacity building are consistently implemented across companies, especially Avanti and Waterbase, who conduct workshops and distribute technical resources.

- **Governance**
  - Companies are adopting the Business Responsibility and Sustainability Reporting (BRSR), as seen in Apex Frozen Foods Ltd and Avanti Feeds Limited, in line with SEBI requirements.
  - Ethical conduct and corporate governance frameworks are emphasized across the board, with principles like fairness, accountability, and stakeholder inclusiveness being central to organizational values.
  - There is a growing trend toward digital traceability and transparent supply chains, particularly highlighted by Avanti's investment in traceability systems.
  - Alignment with global biodiversity commitments such as the CBD, Aichi KMGBF Targets, and SDG-14 (Life Below Water).

- **Corporate Social Responsibility (CSR)**

  CSR in India's fisheries and marine sector is gaining momentum as companies recognize the critical role of coastal and marine ecosystems in sustaining livelihoods, food security, and biodiversity. With a focus on inclusive growth and environmental stewardship, CSR initiatives in this sector often support the welfare of fisherfolk, promote sustainable fishing practices, and invest in marine conservation. Key trends include skill development for coastal communities, adoption of eco-friendly technologies, waste and plastic reduction in marine environments, and the creation of alternative livelihoods, aligning corporate responsibility with the resilience and socio-economic advancement of coastal populations.

CSR Reports of Corporates in the Sector

- **Avanti Feeds Ltd**

  Avanti's CSR initiatives focus on aquaculture skill development, environmental restoration, and sustainable feed innovation. Key initiatives include the AU-Avanti Skill Development Centre, urban forestry, effluent management, and pioneering plant-based feed alternatives. Its collaborations with global organizations reflect a strong commitment to responsible aquaculture.[46];

- **Kings Infra Ventures Ltd**

  Kings Infra emphasizes eco-friendly aquaculture through technologies like RAS and bio floc under its SISTA360 protocol. Its Community Development Centre for Learning Livelihood and Research (CDC-LLR) centre promotes education, research, and responsible farming, empowering communities through sustainable livelihood initiatives.[47]

- **The Waterbase Ltd**

- Waterbase invests in eco-friendly aquafeeds and promotes sustainable aquaculture through Good Aquaculture Practices (GAP). Its CSR spending targets ecological balance and environmental sustainability, supported by R&D-driven product innovation.[48]

- **Apex Frozen Foods Ltd**

  Apex's sustainability practices, though embedded more in operations than direct CSR, support biodiversity through BAP-certified farming, responsible sourcing, and eco-friendly farm management. The company's traceable, ethical supply chain contributes indirectly to marine habitat protection.[49]

[46] Avanti Feeds-Sustainability. (2025). Sustainability - Avanti Feeds.

[47] Kings Infra. (2025). Kings Infra Ventures Limited. https://www.kingsinfra.com/

[48] The Waterbase Limited-Annual Report. (2023).

[49] Vasiliy Budarin. (2023). Sub: Submission of Notice of 11 th Annual General Meeting & Annual Report for FY 2022-23 Ref: Regulation 30 and Regulation 34 of the SEBI (Listing Obligations and Disclosure Requirements). https://apexfrozenfoods.in/

Some common CSR initiatives of sectoral corporates supporting biodiversity themes

- **Stakeholder and Community Engagement in Biodiversity**

  A key trend across all four companies is engaging local communities in biodiversity conservation efforts. These include:

  - **Farmer Education:** Avanti Feeds and Waterbase Ltd conduct training and awareness campaigns on sustainable aquaculture practices for local farmers, empowering them to integrate biodiversity conservation into their farming techniques.
  - **Coastal Community Support:** Through their CSR programs, companies like Waterbase Ltd and Kings Infra support the livelihood of local communities by introducing alternative, sustainable livelihoods (e.g., eco-tourism, mangrove restoration) alongside aquaculture.

- **Long-Term Sustainability Goals**

  All four corporates are setting goals that aim to build a long-term, sustainable impact on biodiversity conservation. This includes partnerships with NGOs and Government Bodies for large-scale habitat restoration projects (e.g., mangrove replanting programs).

4.2.6 Case Studies of Best Practices related to ESG and CSR in the Sector

There are several successful case studies where sustainable fisheries management, biodiversity conservation, and community participation have led to positive outcomes. These case studies showcase innovative strategies, policy implementations, and co-management efforts that integrate environmental, social, and economic sustainability.

1. **DSM Engineering: Tackling Ghost Nets for Marine Conservation**

   DSM Engineering's ghost net recovery initiative is a global program focused on addressing marine plastic pollution, particularly from abandoned fishing gear (ghost nets). With an estimated 8 million metric tons of plastic entering oceans each year—approximately 10% of which is attributed to ghost nets—the initiative aims to support marine biodiversity conservation while promoting circular economy practices. Working in collaboration with divers, fishers, and coastal communities, DSM collects discarded nets and repurposes them into high-performance polyamide (nylon) materials used in a range of industrial and consumer products, including surfboards and sports equipment. The initiative integrates marine conservation efforts with sustainable material innovation.

   Key Practices & Results

   - **Pollution Mitigation through Recycling:** Collects ghost nets from oceans with help from local divers and fishing communities. Repurposes them into durable nylon materials for eco-friendly products.

- **Product Innovation & Circular Economy:** Collaborated with Starboard, a global water sports brand. Surfboards and accessories made with recycled fishing net-based components. End products are also recyclable—ensuring a closed-loop system.
- **Community Engagement & Awareness:** Partners with local fishers, diving networks, and NGOs. Promotes awareness around sustainable fishing practices and plastic waste management.

2. Tata Power's Mahseer Conservation Initiative: A Legacy of Freshwater Biodiversity Stewardship

Launched in 1970, Tata Power's Mahseer Conservation Initiative is one of India's longest-standing corporate-led biodiversity programs, embedded within the company's broader environmental sustainability approach. The initiative was created in response to concerns from local communities near Tata Power's Walwan Dam in Maharashtra, where the Deccan Mahseer fish, once abundant, was in decline. Recognizing the environmental impact of hydropower infrastructure, Tata Power collaborated with the Maharashtra Fisheries Department to conserve and reintroduce the species through habitat-based interventions.

Key Features and Impacts

- **Conservation Efforts:** Over 8.1 million fry and fingerlings have been raised, with more than 300,000 of these reintroduced into the wild. As a result of these efforts, the species has been reclassified from Endangered to Least Concern on the IUCN Red List, marking a significant conservation achievement.
- **Integration with Operations:** The initiative is integrated into Tata Power's hydropower operations, reflecting a model where ecological responsibility is considered a core part of energy production.
- **Ecosystem Support:** In addition to fish repopulation, the initiative promotes afforestation, water quality improvement, and riparian ecosystem restoration, contributing to the overall resilience of freshwater ecosystems.
- **Community Engagement:** Over 325 fisheries scientists have been trained, and the active involvement of local communities remains central to the initiative's success, underscoring the program's social dimension.

3. Mithapur Coral Reef Recovery Project: Reviving Marine Ecosystems through Science and Stewardship

Launched in 2008, the Mithapur Coral Reef Recovery Project is an ESG initiative led by Tata Chemicals Limited (TCL), in collaboration with the Wildlife Trust of India (WTI) and the Gujarat Forest Department. Located off the coast of Mithapur, Gujarat — the site of TCL's marine chemical operations — the project focuses on restoring degraded coral reefs, enhancing marine biodiversity, and supporting local livelihoods. It combines scientific techniques with community participation to address ecological impacts associated with industrial activities in a coastal environment.

Key Features and Impacts

- **Reef Restoration and Techniques:** Approximately 3,149.6 square meters of coral reef area have been restored through methods such as coral translocation from Lakshadweep, artificial reef installation, and the application of Biorock technology, which promotes calcium carbonate deposition to aid coral growth.
- **Marine Biodiversity Trends:** Fish diversity in the project area has increased from 55 to 64 species, with the reappearance of species such as seahorses and Starry Pufferfish.
- **Community Involvement and Livelihoods:** The initiative involves coastal fishing communities in reef management efforts and promotes sustainable fishing practices. Reported fishing catch efficiency has risen from 0.6 kg/hr to over 3 kg/hr.
- **Monitoring and Collaboration:** Ongoing ecological monitoring and partnerships with various stakeholders contribute to data-based conservation activities and marine habitat management.

4. HCL – Restoring the Health of Marine and Coastal Ecosystems

As part of its CSR program Harit, HCL has undertaken activities aimed at restoring marine and coastal ecosystems across several Indian states. Initiated in 2021, the project focuses on ecological restoration, coastal afforestation, and community-based conservation efforts. While not directly linked to HCL's operational activities, the initiative forms part of the company's broader approach to environmental stewardship and sustainability under its CSR commitments.

Key Features and Impacts

- **Habitat Restoration and Afforestation:** Restoration of approximately 232.9 acres of degraded coastal land through the planting of more than 250,000 native saplings and over 270,000 mangroves, supporting shoreline stabilization and contributing to climate resilience efforts.
- **Ghost Net Removal and Marine Clean-Up:** Removal of more than 57,000 kilograms of ghost nets from coastal waters in Tamil Nadu, aimed at improving marine biodiversity and reducing threats to marine species.
- **Climate Impact:** The project is expected to contribute to the annual sequestration of around 1,350 metric tons of CO_2 , aligning with broader climate adaptation and carbon reduction goals.
- **Community Engagement:** Local communities in Ramanathapuram and Thoothukudi have been engaged and trained in areas such as sustainable fishing, biodiversity conservation, and alternative livelihood practices to support eco-restoration activities.

5. Infosys Foundation & WWF-India: Conserving Olive Ridley Turtles

In 2015, the Infosys Foundation collaborated with WWF-India to initiate a conservation program focused on Olive Ridley Turtles along Odisha's coastline. As part of its CSR activities related to environmental sustainability and biodiversity conservation, the

Foundation supports the protection of nesting sites and efforts to improve hatchling survival rates. The initiative responds to risks faced by sea turtle populations, including predation, human activities, and coastal development.

Key Features and Impacts

- **Nesting Site Protection:** Interventions include installation of barriers to minimize predation and disturbances from human and animal activity at mass nesting beaches. Further, hatcheries have been established to provide controlled environments for egg incubation, aiming to enhance hatching success rates.
- **Community Engagement and Monitoring:** Involvement of local residents through compensation for monitoring nesting activities, patrolling beaches, and conducting awareness programs, promoting community-based conservation efforts.
- **Species-Specific Conservation:** The program focuses on Olive Ridley Turtles, a species listed under Schedule I of the Wildlife Protection Act and classified as Vulnerable by IUCN, with activities directed toward reducing threats and supporting conservation infrastructure for the species' survival.

6. Tata Chemicals – Save the Whale Shark Project

Launched in 2004, Tata Chemicals, in collaboration with the Wildlife Trust of India and the Gujarat Forest Department, initiated the Save the Whale Shark Project to support the conservation of the endangered whale shark species along Gujarat's Saurashtra coast. The project is part of Tata Chemicals' CSR efforts focused on community development and biodiversity conservation, aiming to encourage a transition among fishing communities from hunting practices to conservation through awareness, incentives, and cultural engagement.

Key Features and Impacts

- **Community Awareness and Cultural Integration:** Street plays, workshops, and local outreach sensitized coastal communities about the ecological importance of whale sharks. Also involved spiritual leaders to culturally associate the whale shark with sacred symbols fostered a protective sentiment among fishermen.
- **Rescue and Release Protocols:** Fishermen who accidentally catch whale sharks receive compensation for net damage, promoting safe release. Standardized rescue procedures have facilitated the release of over 850 whale sharks, with no poaching incidents reported since the project's inception.
- **Scientific Research & Monitoring:** Continuous research on whale shark biology and migration patterns informs conservation strategies and contributes to the broader scientific understanding of the species.

7. HPCL & Coastal Impact: Artificial Reef Project in Goa

In 2023, Hindustan Petroleum Corporation Limited (HPCL), in collaboration with Coastal Impact, a marine conservation organization, initiated the Artificial Reef Project near Grande Island, Goa. Implemented under HPCL's CSR program, the project aims to enhance marine biodiversity through the deployment of artificial reef structures and coral transplantation.

Although HPCL operates primarily in the infrastructure and energy sectors, this initiative is not directly linked to its core business activities and focuses on community engagement and ecological restoration.

Key Features and Impacts

- **Artificial Reef Deployment:** 50 Artificial Structures installed across four reef sites around Grande Island to support coral colonization and marine habitat regeneration.
- **Coral Transplantation and Growth:** Transplantation of over 500 coral fragments, with a recorded survival rate of 60.41% and an average size increase of 522% over an 18-month monitoring period.
- **Community Awareness and Engagement:** Organization of awareness campaigns and educational activities aimed at engaging local communities and promoting marine conservation practices.
- **Research and Monitoring:** Ongoing ecological monitoring and documentation to refine reef-building strategies and measure ecosystem recovery.

8. Nokia India & WWF-India: River Watch Project

Launched in 2009, the River Watch Project focuses on monitoring and conserving aquatic biodiversity within the Satluj–Beas–Ravi river systems and the Harike Wetland in Punjab. Led through a partnership between Nokia India CSR, WWF-India, and the Punjab Forest & Wildlife Department, the initiative was developed in response to environmental pressures such as pollution, habitat loss, and increasing anthropogenic impacts.

Key Practices & Outcomes

- **Biomonitoring & Species Assessment:** Recorded 9 mammal species, 200 avian species, 7 turtle species, and 26 fish species in the Harike Wetland.
- **Pollution Mitigation & Sustainability:** Promoted biofertilizers as alternatives to chemical inputs to combat habitat degradation.
- **Community Awareness:** Capacity-building and environmental education for local stakeholders.

9. Godrej & Boyce: Soonabai Pirojsha Godrej Marine Ecology Centre

Established in 1985 by Godrej & Boyce at Pirojshanagar near Mumbai's Thane Creek, the Soonabai Pirojsha Godrej Marine Ecology Centre focuses on the conservation and restoration of approximately 750 hectares of mangrove ecosystems. Located adjacent to the company's industrial township, the Centre represents an approach to integrating ecological stewardship with industrial development. Over the years, it has contributed to documenting and monitoring a diverse range of marine and terrestrial species, including 20 fish species, 15 crab species, 7 prawn species, several mollusc species, 206 bird species, 33 reptile species, 30 spider species, 12 mammal species, and 82 butterfly species.

Key Practices & Results

- **Research & Monitoring:** Ongoing ecological research and biodiversity assessments focused on urban mangrove ecosystems and adjacent habitats.
- **Mangrove Restoration:** Implementation of restoration initiatives aimed at enhancing habitat resilience, supporting coastal protection, and contributing to carbon sequestration and climate adaptation efforts.
- **Education & Community Awareness:** Development and delivery of environmental education and outreach programs targeting schools, local communities, and stakeholders to build awareness of the role of urban mangroves in sustainability.
- **Partnerships & Collaboration:** Engagement with NGOs, academic institutions, and sustainability organizations. Participated in the founding of the India Mangroves Coalition, in collaboration with CII and WWF.

4.2.7 Challenges and Gaps in Corporate Action for Biodiversity in the Fisheries and Marine Sectors

Despite conservation efforts and legislation changes, fisheries, aquaculture, seafood processing, and other marine-related sectors confront significant challenges when it comes to integrating biodiversity-friendly techniques into their operations. The key constraints include:

- **Regulatory Ambiguity and Compliance Complexity**

  Unclear Guidelines and Overlapping Jurisdictions: Multiple authorities oversee biodiversity-related regulations (e.g., MoEFCC, NFDB, FSSAI), causing confusion and inefficiencies. The lack of a unified framework on Access and Benefit Sharing (ABS) and eco-certification often deters corporate engagement.

- **Financial Constraints and Limited Incentives**

  High costs associated with the adoption of eco-friendly gear, traceability systems, and certification (e.g., MSC, organic aquaculture) act as barriers—especially for MSMEs. The current fiscal ecosystem lacks structured financial incentives such as subsidies or soft loans to support biodiversity-centric investments in the marine sector.

- **Technological Gaps and Innovation Deficits**

  Access to sustainable fishing technologies, by-catch reduction devices, and low-impact aquaculture systems is limited among Indian companies, particularly in coastal and artisanal economies. R&D in biodiversity-positive marine technologies remains underfunded and fragmented, and private sector participation in innovation remains low.

- **Data Deficiency and Monitoring Challenges**

  Most corporates lack access to reliable marine biodiversity datasets, impeding impact assessments and biodiversity risk management. Tracking ecosystem impacts of fishing, pollution, and aquaculture is limited by the absence of standardized corporate monitoring frameworks.

- **Market Pressures and Low Consumer Awareness**

  The demand for low-cost seafood products discourages companies from making sustainability investments that increase costs. Weak consumer awareness around marine biodiversity and product eco-labels reduces the market incentive for sustainable seafood.

- **Capacity Gaps and Lack of Technical Expertise**

  There is a dearth of technical experts in the private sector to implement biodiversity action plans, especially in SMEs. Few industry-specific programs exist to train corporate staff on marine conservation, sustainable harvesting techniques, and ESG compliance.

4.2.8 Pathways to Corporate Leadership on Biodiversity in the Fisheries and Marine Sectors in India

India's marine ecosystems are biologically rich and economically vital, supporting over 4 million livelihoods and contributing significantly to national food security and blue economy growth. Yet, increasing pressures from overfishing, pollution, habitat degradation, and climate change pose serious risks to the long-term sustainability of these ecosystems. While the government and communities remain central to conservation efforts, businesses have a unique opportunity to drive transformative change through targeted investments, innovative solutions, and inclusive business models. The following thematic areas highlight how corporates can play a leadership role in conserving coastal and marine biodiversity while strengthening their ESG performance, supply chain resilience, and market positioning.

1. **Sustainable Fisheries and Resource Stewardship**

   Businesses can strengthen social equity and sustainability in the fisheries sector by sourcing seafood from traditional and small-scale fishers operating in territorial waters, thereby supporting exclusive access regimes. They can also contribute to co-management systems by collaborating with State Governments and Biodiversity Management Committees to promote fisher-led governance. Furthermore, corporates can use the seasonal fishing ban period as an opportunity to invest in training programs on sustainable fishing practices, hygiene standards, by-catch reduction techniques, and value addition, enhancing fishers' skills and incomes. These efforts contribute to long-term resource security, ensure traceable and ethically sourced products, and build brand loyalty and credibility among coastal communities.

2. **Innovation and Technology for Marine Monitoring**

   Corporates can lead in adopting advanced technologies by investing in digital traceability systems such as blockchain and QR coding to improve product provenance and regulatory compliance. Co-developing responsible fishing gear such as Turtle Excluder Devices, square mesh nets, or biodegradable alternatives, and deploying AI and IoT tools for real-time monitoring can help detect illegal fishing and reduce environmental impact. Additionally, supporting the development and implementation of marine spatial planning tools allows for more efficient and conflict-free use of marine zones. These innovations help reduce

regulatory risks, open access to certified eco-labelled markets, and position businesses as early movers in the emerging ocean-tech space.

3. Biodiversity Conservation and Habitat Restoration

Businesses can contribute directly to biodiversity protection by co-financing the management of Biodiversity Heritage Sites, especially those critical for fish breeding, turtle nesting, and coral reef conservation. Investments in the restoration of mangroves, coral reefs, and seagrass meadows support nature-based solutions that offer both biodiversity and climate co-benefits, including blue carbon sequestration. Corporates can also sponsor programs for species recovery, assist in the identification and conservation of vulnerable marine species within India's Exclusive Economic Zone (EEZ), and support data collection efforts related to Normally Traded Commodities. These actions support biodiversity offset goals, enhance ESG reporting, and strengthen coastal resilience and disaster risk mitigation.

4. Climate Resilience and Infrastructure Investments

By partnering with insurers and public agencies, corporates can help design and implement risk insurance products tailored to the needs of fishing communities, protecting livelihoods against climate-induced shocks. Businesses can also co-invest in resilient infrastructure, such as eco-compliant landing sites, cold chains, and green harbour facilities. Moreover, climate-smart aquaculture systems—including integrated multi-trophic aquaculture (IMTA), offshore cage farming, and seaweed cultivation—offer sustainable food production options suited to warming ocean conditions. These initiatives contribute to recognized climate adaptation measures, de-risk corporate operations in vulnerable coastal zones, and enable diversification into future-ready food systems.

5. Marine Pollution Reduction and Circular Economy

Businesses can actively participate in marine conservation by sponsoring fisher-led cleanup initiatives aligned with national cleanliness missions such as Swachh Bharat, thereby directly reducing marine debris. Investing in biodegradable packaging and sustainable fishing gear offers an avenue to reduce plastic pollution associated with seafood, fast-moving consumer goods, and e-commerce supply chains. Additionally, corporates involved in shipping or logistics can collaborate on innovative ballast water treatment technologies to prevent the spread of invasive species. These actions deliver strong CSR visibility, drive product innovation in sustainable design, and lower regulatory exposure in pollution-prone regions.

6. Trade, Certification, and Market Linkages

Corporates can elevate their market credentials by adopting internationally recognized certification schemes such as the Marine Stewardship Council (MSC) and Fair Trade, thereby improving access to global sustainable seafood markets. Strengthening traceability and labelling systems helps enhance consumer trust and brand value. Collaborations with export promotion boards such as the Marine Products Export Development Authority (MPEDA) can support training on hygiene, traceability, and value chain upgrades, benefiting both fishers and downstream processors. These efforts enable access to premium markets,

improve supply chain governance, and offer reputational benefits linked to sustainable sourcing.

7. **Policy Alignment and Multi-Stakeholder Collaboration**

   By participating in policy dialogues and consultations with institutions such as the National Biodiversity Authority (NBA), State Biodiversity Boards (SBBs), and the Ministry of Environment, Forest and Climate Change (MoEFCC), corporates can help shape pragmatic and science-based regulatory frameworks. Ensuring that marine bioprospecting or bioresource utilization aligns with licensing and compliance requirements under the Biological Diversity Act ensures legal certainty and ethical use. Additionally, aligning business strategies with India's National Biodiversity Action Plan and Sustainable Development Goal 14 (Life Below Water) strengthens legitimacy and provides long-term strategic foresight in navigating evolving policy landscapes.

8. **Community Awareness and Ecosystem Education**

   Corporates can play a catalytic role in building socio-ecological resilience by funding coastal eco-clubs and youth awareness programs under initiatives like the National Green Corps (NGC) or state-led campaigns. Support to training institutions for developing curricula on sustainable fisheries, marine hygiene, traceability, and entrepreneurship fosters a knowledgeable coastal workforce. Participating in the development of coastal and marine People's Biodiversity Registers (PBRs) further anchors companies within local governance systems. These initiatives foster strong local partnerships, enhance community stewardship, and reinforce a company's identity as a responsible and trusted stakeholder.

4.2.9 Conclusion: Turning Stewardship into Strategy

Marine biodiversity conservation is no longer just a policy or NGO domain. It is a strategic imperative for future-ready corporates, especially those directly engaged in fisheries and other aspects of the marine sector, offering clear advantages in risk mitigation, compliance, supply security, and brand equity. By integrating biodiversity into operations, corporates can unlock value while safeguarding India's marine heritage.

4.3 Food and Beverages Sector

4.3.1 Sectoral Overview

The Indian food and beverage (F&B) industry is a significant contributor to the nation's economy, accounting for approximately 3% of India's GDP. As the second-largest food producer globally, India leads in the production of milk, pulses, and spices. The sector is projected to grow at a compound annual growth rate (CAGR) of 8.7% from 2024 to 2030. In the fiscal year 2023-2024, the industry was valued at ₹5,69,487 crore and is projected to reach ₹7,76,511 crore in 2025, reflecting a robust growth trajectory.[50] Despite this potential, the food processing industry currently contributes less than 10% to the total food output, indicating substantial room for growth and investment. The government's National Food Processing Policy (NFPP) aims to increase the level of food processing to 20% by 2025, thereby enhancing value addition and creating employment opportunities. Additionally, various export promotion schemes, such as the Merchandise Exports from India Scheme (MEIS) and Agricultural and Processed Food Products Export Development Authority (APEDA) schemes, provide incentives and promotional support to F&B exporters.

India's diverse agro-climatic zones support the cultivation of a wide variety of crops and spices, allowing to produce high-quality ingredients such as basmati rice, cardamom, turmeric, and mangoes. This diversity, coupled with relatively lower production costs compared to many developed countries, enhances India's competitive advantage in food

[50] UJA Market Report. (n.d.). Food and Beverage Industry in India. Retrieved March 19, 2025, from https://uja.in/blog/market-reports/food-and-beverage-industry-in-india/

processing and manufacturing. However, the F&B sector faces challenges, including inadequate infrastructure, supply chain inefficiencies, and the need for technological innovation.[51] Addressing these issues is crucial for sustaining growth and improving global competitiveness.[52] Furthermore, as the industry expands, adopting environmentally sustainable practices becomes imperative to mitigate impacts such as greenhouse gas emissions and water consumption. Globally, food production accounts for over a quarter (26%) of greenhouse gas emissions and utilizes half of the world's habitable land. Agriculture consumes 70% of global freshwater withdrawals and contributes significantly to ocean and freshwater eutrophication.

Biodiversity plays a vital role in shaping the business landscape, providing essential ecosystem services such as pollination, soil fertility, water purification, and climate regulation that benefit agriculture and related sectors. Companies must assess and manage their impacts on biodiversity to ensure the sustainable use of natural resources across their value chains. By conserving and restoring biodiversity, they contribute to building climate resilience within their supply chains and reduce vulnerability to climate-related disruptions.[53]

In summary, the Indian F&B industry holds significant growth potential, driven by robust demand, supportive policies, and inherent competitive advantages. Strategic investments and sustainable practices, including support to and incorporation of biodiversity conservation measures, will be key to unlocking this potential and ensuring long-term success.[54]

4.3.2 Impacts of the Food and Beverage Sector on Biodiversity in India

The Food and Beverage (F&B) sector is a cornerstone of India's economy, contributing approximately 3% to the national GDP and employing over 7 million people across the value chain. While it plays a critical role in driving economic growth, employment, and food security, the sector also exerts significant pressure on India's biodiversity and ecological systems. Its impacts are far-reaching, spanning land use change, pollution, climate change, and resource overextraction, making it one of the most biodiversity-impacting industries globally.

1. Land Use Change and Habitat Loss

The expansion of agricultural land to meet the sector's raw material needs such as sugarcane, rice, wheat, soy, and palm oil, has led to extensive deforestation and habitat fragmentation. This is particularly concerning in biodiversity-rich areas like the Western Ghats, Eastern Himalayas, and central India, where forests are being converted into monoculture farms. These practices reduce native species habitats, disrupt wildlife corridors, and erode ecosystem services such as pollination and carbon sequestration. The

[51] Sahu Yogita. (2024, October). India Food and Beverage Industry Growth, Future Analysis 2028. Ken Research.

[52] Grant Thorton. (n.d.). Indian Food & Beverage Sector: The new wave.

[53] IBEF. (n.d.). An Overview of the Indian Food Processing Sector. IBEF. Retrieved March 19, 2025, from https://www.ibef.org/blogs/an-overview-of-the-indian-food-processing-sector

[54] Grant Thornton. (n.d.). Indian Food & Beverage Sector: The new wave.

intensification of monocropping systems further accelerates biodiversity loss by displacing traditional polyculture practices that supported a diversity of flora and fauna.

2. Water Overuse and Aquatic Biodiversity Stress

India's F&B sector is a major consumer of freshwater, with agriculture accounting for nearly 90% of national water use. Irrigation-intensive crops such as sugarcane and paddy have led to widespread groundwater depletion, drying up wetlands and altering the flow regimes of rivers and lakes. These changes severely impact aquatic ecosystems, threatening the survival of fish, amphibians, and aquatic plants. In addition, runoff from agricultural fields containing fertilizers, pesticides, and livestock waste contaminates water bodies, leading to eutrophication, oxygen depletion, and mass die-offs of aquatic organisms.

3. Soil Degradation and Below-Ground Biodiversity Loss

The heavy reliance on synthetic fertilizers and pesticides in intensive farming systems has resulted in the degradation of soil health and a significant decline in microbial biodiversity. Soil organisms such as bacteria, fungi, and earthworms play a crucial role in maintaining soil fertility, nutrient cycling, and pest control. Their depletion weakens the resilience of agricultural systems, increases dependence on external inputs, and diminishes the natural regenerative capacity of soils, posing long-term risks to food production and ecological sustainability.

4. Climate Change Contributions

The F&B sector is a significant source of greenhouse gas emissions, especially methane from livestock farming and carbon emissions from fossil fuel-based food processing and transportation. These emissions contribute to climate change, which further compounds biodiversity loss through rising temperatures, erratic rainfall, and increased frequency of extreme weather events. Climate-induced changes can alter species distribution, disrupt breeding cycles, and increase the vulnerability of already threatened ecosystems.

5. Industrial Processing, Plastic Pollution, and Packaging Waste

India's growing packaged food industry has led to an exponential rise in plastic packaging, much of which is single-use and poorly managed. A considerable amount of this waste enters terrestrial and marine ecosystems, where it poses fatal risks to wildlife through ingestion or entanglement. Species such as sea turtles, seabirds, and fish are particularly affected. Additionally, food processing units are energy-intensive and contribute to environmental pollution, amplifying pressures on biodiversity both directly and indirectly.

6. Supply Chain Complexity and Transparency Gaps

The F&B sector's complex and often opaque supply chains hinder accountability and traceability, particularly in sourcing raw materials from ecologically sensitive regions. Unsustainable sourcing can perpetuate deforestation, overfishing, and the exploitation of biodiversity hotspots, while lack of data and transparency impedes biodiversity-positive decision-making.

7. **Livestock Farming and GHG Emissions**

   Livestock production is another critical area of biodiversity impact. It drives land conversion for pasture and feed crops, contributes to deforestation, and is a major emitter of methane—a potent greenhouse gas. Livestock also compete with wildlife for resources and contribute to overgrazing, which leads to further land degradation and biodiversity decline.

8. **Socioeconomic Drivers and Consumer Behaviour**

   Market demand for inexpensive, uniform food products incentivizes large-scale, input-intensive farming and industrial processing that prioritize efficiency over ecological sustainability. Economic pressures often discourage biodiversity-friendly practices, especially among smallholders who lack access to incentives or premium markets. At the same time, growing consumer demand for processed and convenience foods drives unsustainable production and packaging practices.

4.3.3 Regulatory and Policy Landscape

The Food and Beverage (F&B) sector in India operates within a comprehensive regulatory framework that not only ensures food safety and promotes industry growth but also addresses biodiversity conservation and environmental sustainability. Regulations within this sector are increasingly focusing on food safety, sustainability, and minimizing the environmental footprint of food production, packaging, and waste management. Compliance with these regulations is critical for businesses aiming to operate sustainably and contribute positively to biodiversity conservation.[55]

- **The Draft National Food Processing Policy (2019)** aligns with broader environmental goals, encouraging investments in food processing to enhance food security and reduce wastage. Additionally, this policy emphasizes sustainable practices in food production, packaging, and waste management, all of which play a significant role in mitigating biodiversity loss by reducing the environmental footprint of the F&B industry.
- **Food Safety and Standards Regulations:** The Food Safety and Standards Authority of India (FSSAI) is the key regulatory body for food safety and hygiene, ensuring the safety and quality of food products. Under the Food Safety and Standards Act, 2006, businesses must follow mandatory guidelines like Good Manufacturing Practices (GMP), Hazard Analysis and Critical Control Points (HACCP), and Food Safety Management Systems (FSMS) to ensure safe food production. By emphasizing sustainable production and packaging, the policy can reduce environmental impacts such as habitat destruction and pollution that contribute to biodiversity loss. FSSAI's stringent packaging and labelling regulations further promote sustainability by encouraging the use of eco-friendly materials and reducing food waste.
- **Foreign Investment and Trade Policies:** The Indian government has opened the food processing industry to 100% Foreign Direct Investment (FDI) under the automatic route, encouraging foreign investments in manufacturing and retail. The development of Mega Food Parks and the reduction of customs duties on food processing equipment are aimed

55 IFBSSI. (2023a). Indian Food & Beverage Sectorial System of Innovation. www.unido.org

at modernizing the sector. These policies not only boost food exports but also promote the adoption of sustainable technologies by attracting foreign players with environmentally conscious practices.

- **Taxation and Compliance Policies India's Goods and Services Tax (GST)** system has streamlined the taxation of essential and processed foods, encouraging affordable access to basic food items. For sustainable operations, the government has reduced excise duties on energy-efficient refrigeration units and introduced service tax exemptions for sustainable food processing activities. The tax reforms aim to reduce costs for businesses implementing energy-efficient and sustainable practices, thereby incentivizing companies to adopt biodiversity-friendly practices, such as sustainable sourcing and eco-friendly packaging.
- **Sustainability and Environmental Regulations:** Sustainability is becoming a core focus in India's F&B regulatory landscape. The SAMPADA Scheme offers subsidies to food processing industries for adopting energy-efficient technologies and carbon reduction strategies. To address plastic pollution, FSSAI mandates the use of biodegradable and recyclable packaging materials for processed foods. Several companies are participating in waste reduction programs, such as the Indian Food Sharing Alliance (IFSA), which facilitates the donation of surplus food to reduce waste. These sustainability initiatives aim to mitigate environmental degradation, reduce waste and emissions, and promote eco-friendly packaging, all of which help conserve biodiversity by reducing pollution and habitat destruction.
- **Key Challenges in Regulatory Compliance:** Despite the robust regulatory measures, challenges persist in ensuring widespread adherence to biodiversity conservation and sustainability goals.
    - High compliance costs make it difficult for small food businesses to implement biodiversity-friendly practices.
    - Inconsistent enforcement of FSSAI guidelines across states results in varying standards for food safety and sustainability practices.
    - Inefficient supply chain management leads to food wastage, contributing to environmental degradation and biodiversity loss.

  Addressing these challenges is essential to improving regulatory compliance and enhancing the effectiveness of policies that protect biodiversity. Supporting small and medium enterprises (SMEs) in adopting sustainable practices is critical to achieving broader biodiversity conservation goals across the sector.

4.3.4 ESG and CSR trends in the Food and Beverages Sector in India

Environmental, Social, Governance (ESG)

The Indian Food & Beverages (F&B) sector is one of the largest in the country, encompassing diverse industries ranging from processed foods and beverages to agriculture-linked

businesses. With rapid urbanization, rising incomes, and increasing health awareness, this sector is witnessing growing consumer demand for sustainability in food sourcing, packaging, and production. As the sector is deeply interwoven with agriculture, natural resources, and energy systems, ESG (Environmental, Social, and Governance) performance plays a vital role in shaping its future sustainability.

To gain meaningful insights into ESG practices in the F&B sector, the study identified 20 leading corporates that influence the industry's value chain, including food manufacturing, beverages, dairy, and packaged goods. The selected companies were chosen for their strong market presence, legacy, and demonstrated commitment to ESG activities. Selected corporates included Nestle India Ltd., Hindustan Unilever Ltd (HUL), Tata Consumer Products Ltd., Britannia Industries Ltd., ITC Ltd., Varun Beverages Ltd., Dabur India Ltd., Jubilant FoodWorks Ltd., Godrej Consumer Products Ltd., Amul, PepsiCo, Coca-Cola, Parle, Cadbury India (Mondelez India Foods Private Limited), MTR, Haldiram's, Balaji Wafers, Patanjali Foods, Gits Food, and Bambino.

From this broader list, a focused group was shortlisted based on the accessibility and comprehensiveness of their ESG-related disclosures. These reports offered valuable perspectives into the strategies adopted by these firms to drive sustainability and responsible business conduct.

- **ITC Limited:** Comprehensive coverage on biodiversity, water stewardship, regenerative agriculture, plastic neutrality, and TNFD-aligned reporting.
- **Tata Group Entities - Tata Consumer Products Limited (TCPL):** Strong ESG governance structure, responsible sourcing, biodiversity efforts, and circular packaging.
- **Hindustan Unilever Limited (HUL):** Focused on decarbonization, circular packaging, water conservation through Hindustan Unilever Foundation, and sustainable sourcing.
- **Nestlé India:** Emphasis on regenerative agriculture, deforestation-free sourcing, and biodiversity regeneration through global initiatives.
- **Jubilant FoodWorks Ltd:** Emphasis on energy efficiency, water conservation, sustainable packaging, responsible sourcing, and reduction of food and plastic waste through structured ESG initiatives.

ESG Trends and Good Practices in the Indian Food and Beverage Sector

The Food and Beverage (F&B) sector in India is increasingly integrating environmental, social, and governance (ESG) principles into business operations, with growing recognition of the linkages between ecological sustainability, supply chain resilience, and long-term value creation. A review of recent ESG disclosures and sustainability reports from leading Indian and multinational F&B companies reveals several converging trends and commendable practices in biodiversity conservation, climate action, community engagement, and corporate governance.

1. **Environmental Stewardship and Nature-Positive Action**
   - **Biodiversity and Nature-Based Solutions (NbS):**

     All reviewed companies demonstrate strong commitments to biodiversity conservation through nature-based solutions across their supply chains and operations. Practices include large-scale habitat restoration, ecological agriculture, and protection of endangered species. Examples include ITC's development of biodiversity plots to promote native flora and fauna, Tata Coffee's hornbill habitat restoration efforts, and Nestlé's landscape-level reforestation initiatives.
   - **Water Stewardship:**

     Water resource management is a cornerstone of environmental strategies. Companies are undertaking decentralized watershed development, rainwater harvesting, and community-based conservation. HUL's Hindustan Unilever Foundation has enabled the creation of 3.2 trillion litres of cumulative water potential. Similarly, Tata Chemicals and ITC have scaled watershed initiatives across their areas of influence, contributing to the resilience of freshwater ecosystems and agrarian communities.
   - **Climate Action and Decarbonization:**

     Climate change mitigation is a key focus, with companies setting time-bound, science-based targets to reduce emissions and enhance energy efficiency. Tata Chemicals has commissioned a carbon capture plant, and HUL reports a 98% reduction in CO_2 emissions per tonne of production since 2008. These efforts are aligned with India's low-carbon development goals and contribute indirectly to biodiversity protection by reducing climate-induced ecological stress.
   - **Circular Economy and Packaging Sustainability:**

     Plastic neutrality, circular packaging, and improved end-of-life product responsibility are being actively pursued. Companies like HUL, TCPL, and Nestlé are advancing Extended Producer Responsibility (EPR) compliance, sustainable packaging design, and local sourcing of packaging materials. Jubilant FoodWorks is improving packaging efficiency across its Quick Service Restaurant formats to reduce plastic waste - an important step in mitigating plastic-related biodiversity risks, particularly in aquatic ecosystems.

2. **Social Responsibility and Community-Based Approaches**
   - **Sustainable Agriculture and Farmer Engagement:**

     There is widespread investment in regenerative agriculture and sustainable sourcing practices, with emphasis on certification schemes such as Rainforest Alliance and Fairtrade. For instance, ITC's climate-smart village model and Nestlé's income accelerator program for cocoa farmers demonstrate long-term support for biodiversity-friendly agricultural transitions. These programs enhance soil health, promote agrobiodiversity, and reduce dependency on chemical inputs.
   - **Community-Centric Implementation:**

     Several ESG initiatives adopt decentralized, community-led approaches to conservation, resource management, and livelihood improvement. HUL's Project

Shakti and ITC's Social Investments Programme engage rural women and farmers in participatory planning, fostering both social and ecological outcomes. Community involvement has proven critical for ensuring stewardship of local ecosystems and scaling nature-positive actions.

3. **Governance, Disclosure, and Global Alignment**
    - **ESG Governance and Standards Integration:**

      Companies are increasingly aligning with globally recognized frameworks, such as the Taskforce on Nature-related Financial Disclosures (TNFD), Science-Based Targets Network (SBTN), SEBI's Business Responsibility and Sustainability Reporting (BRSR), and the Natural Capital Protocol. This alignment supports greater transparency, improved risk management, and standardized reporting on biodiversity and other ESG dimensions.
    - **Data-Driven, Science-Based Commitments:**

      Quantified, time-bound targets for carbon, water, waste, and biodiversity indicators are now standard in ESG disclosures. These targets help institutionalize accountability and provide measurable pathways for companies to demonstrate environmental leadership.
    - **Participation in National and International ESG Platforms:**

      Many corporates are proactive participants in global and national coalitions, sustainability forums, and multi-stakeholder partnerships. These platforms offer knowledge-sharing, collective action opportunities, and harmonization with emerging global frameworks.

This review of ESG reports from leading Indian and multinational corporations in the F&B sector reveals a sector-wide transition toward more responsible, inclusive, and ecologically aligned business models. Although individual companies tailor their strategies to their unique contexts, there is clear convergence on the importance of biodiversity, climate action, water stewardship, community engagement, and structured governance

Building on these ESG-driven shifts, many of these corporations also channel significant efforts into CSR initiatives that further embed sustainability, inclusivity, and biodiversity resilience into local communities.

Corporate Social Responsibility (CSR)

Corporate Social Responsibility (CSR) in India's Food & Beverage (F&B) sector has evolved from philanthropic giving to strategic, impact-driven programs aligned with community development and environmental stewardship. Given the sector's deep links to rural livelihoods, agriculture, and health, CSR initiatives are increasingly focused on empowering farming communities, enhancing nutrition, promoting education, and restoring ecosystems. With the mandatory CSR spending requirement under the Companies Act, 2013, F&B companies are integrating social value into core operations, often co-creating solutions with NGOs, local governments, and grassroots organizations to drive inclusive and sustainable development.

Selection of Corporates for CSR Report Review

- **Tata Consumer Products Limited (TCPL)**

  Tata Consumer Products focuses on healthcare, sanitation, education, rural development, women empowerment, and environmental sustainability. In FY 2023-24, it spent ₹20.12 crores benefiting over 1.39 million people. Key initiatives include rainforest restoration and elephant corridor management for biodiversity conservation.

- **Hindustan Unilever Limited (HUL)**

  HUL's flagship Project Prabhat has impacted 10 million lives with a focus on improving livelihoods, health, and water conservation. In FY 2023-24, it spent ₹234 crore, including over ₹30 crore for developmental projects in aspirational districts. It supports water management and waste initiatives while promoting renewable energy.

- **Nestlé India**

  Nestlé's initiatives emphasize nutrition awareness, water conservation, sanitation, and rural development. In FY 2023-24, it allocated ₹68.5 crore to programs like Project Vriddhi, which focuses on sustainable agricultural practices, and the Biodigester Project, which converts cattle manure to biogas.

- **Dabur India's**

  Dabur's initiatives promote biodiversity through programs like Project Herbal Kingdom, involving over 10,000 farmers. Its ecological regeneration efforts include planting medicinal herbs and supporting sustainable agricultural practices.

Corporate Social Responsibility and Community-Led Biodiversity Action in India's Food and Beverage Sector

India's Food and Beverage (F&B) sector is increasingly embracing biodiversity conservation, sustainability, and climate resilience as integral components of their Corporate Social Responsibility (CSR) and Environmental, Social, and Governance (ESG) strategies. As biodiversity becomes more embedded in corporate value chains, companies are aligning their social investments with ecological stewardship, community empowerment, and nature-based solutions.

1. Community-Centric Approaches to Conservation

A defining feature of biodiversity-related CSR initiatives in the F&B sector is the emphasis on collaboration with local communities. From managing elephant corridors (e.g., Tata Consumer Products' efforts in wildlife-human conflict zones) to scaling regenerative agriculture with smallholders (e.g., Nestlé's Project Vriddhi), companies are investing in participatory models that enhance both ecological and social outcomes. Community-led conservation initiatives empower local populations with traditional ecological knowledge and foster ownership of natural resource management, enhancing the long-term sustainability of interventions.

2. Sustainable Agriculture and Land Use Transformation

A key area of focus is the promotion of regenerative and biodiversity-friendly agriculture. Companies like Nestlé, Dabur, and ITC are investing in practices such as crop

diversification, reduced tillage, agroforestry, and organic inputs to improve soil health, restore ecological functions, and support pollinators. Initiatives such as Dabur's Herbal Kingdom focus on the conservation of medicinal plants, promoting biodiversity-rich farming systems. The integration of agroforestry - growing trees alongside crops, is expanding due to policy support under India's National Agroforestry Policy (NAP) and corporate partnerships. These systems not only provide multiple livelihood benefits but also serve as biodiversity corridors by restoring degraded lands, supporting pollinators, and enhancing climate resilience.

3. Water Stewardship and Aquatic Ecosystem Protection

Water conservation is another central pillar of corporate CSR. Companies are implementing watershed development, rainwater harvesting, and efficient irrigation systems across operations and sourcing regions. HUL's water conservation initiatives and Nestlé's Project Vriddhi exemplify efforts that not only ensure water security but also protect aquatic ecosystems and biodiversity dependent on freshwater systems. Community-based fisheries management is also emerging as a biodiversity-positive approach, with localized strategies being developed to prevent overfishing, rehabilitate coastal ecosystems, and ensure the sustainability of marine resources.

4. Pollinator Protection and Low-Chemical Farming

Responding to growing concern over pollinator decline, corporates and community groups are encouraging bee-friendly practices such as minimizing pesticide use, preserving natural habitats, and increasing flowering plant diversity. These actions help sustain biodiversity while enhancing agricultural productivity through natural pollination services, creating a win-win scenario for farmers and ecosystems.

5. Waste Management and Circular Economy Innovations

F&B companies are advancing circular economy solutions, particularly in solid waste and plastic packaging management. CSR efforts such as HUL's Project Prabhat and Nestlé's Hilldaari are promoting waste collection, source segregation, and recycling, thereby reducing pollution loads in terrestrial and aquatic ecosystems. These actions are essential for protecting biodiversity from plastic ingestion, entanglement, and habitat degradation.

6. Climate Mitigation and Carbon Reduction Goals

Carbon footprint reduction is a cross-cutting theme, with many companies setting science-based decarbonization targets and transitioning toward renewable energy. HUL and Tata Consumer Products, among others, are leading efforts to achieve carbon neutrality, which also has indirect benefits for biodiversity by mitigating climate-related stressors on ecosystems.

7. Institutional Partnerships and National Collaboration

India's F&B sector is actively participating in collaborative initiatives such as the Indian Food Sharing Alliance (IFSA), which works to reduce food waste by connecting surplus food providers with recipients, thereby minimizing resource-intensive food loss. These

partnerships are supported by government entities like FSSAI and complement broader sustainability goals.

Across the board, CSR efforts in India's F&B sector reveal a strong alignment with biodiversity conservation priorities, driven by both business imperatives and ethical commitments. These initiatives demonstrate how corporates can serve as powerful allies in ecological restoration, sustainable agriculture, and climate resilience, especially when grounded in community partnership and science-based planning. As these practices scale, they hold the potential to transform India's food systems into models of sustainability and biodiversity stewardship.

4.3.5 Case Studies of Best Practices

1. **Nestlé**

- **Nestlé: Regenerative Agriculture for Sustainable Growth**
  Nestlé's Regenerative Agriculture Program, introduced as part of its Creating Shared Value Report (2020-2021), addresses environmental challenges such as soil degradation and water scarcity. The initiative aims to regenerate 1 million hectares of farmland by 2025, focusing on key areas such as soil health, water retention, and carbon sequestration. By adopting practices like crop rotation, agroforestry, and minimal tillage, Nestlé works with farmers, particularly in India, to reduce dependency on chemical fertilizers, improve biodiversity, and capture carbon in the soil.

  In addition to environmental gains, the program has contributed to rural communities by promoting livelihoods and empowering local populations. The initiative has also influenced agricultural policies, reflecting Nestlé's ongoing engagement in efforts toward sustainable farming and climate resilience.

- **Nestlé: Towards a Deforestation-Free Supply Chain**
  In 2022, Nestlé worked towards eliminating deforestation in its supply chains with the goal of sourcing key commodities like palm oil, meat, soy, and cocoa without contributing to forest loss. According to the company's Deforestation-Free Supply Chain Initiative Report, 99.1% of its primary supply chains had achieved deforestation-free status by the end of the year. This was achieved through satellite monitoring, aerial and ground verification, and supplier risk assessments, with over 97% of suppliers meeting the deforestation-free criteria. Nestlé's traceability systems have mapped 55% of its commodities to low-risk origins, with the company targeting 100% deforestation-free cocoa and coffee by 2025. The initiative reflects an approach to supply chain sustainability that combines environmental compliance, transparency, and stakeholder accountability.

2. **Unilever: A Decade of the Sustainable Living Plan**

   With the launch of the Unilever Sustainable Living Plan (2010–2020), the company aimed to reduce its environmental impact while improving social equity. By 2020, over 60% of its agricultural raw materials were sourced sustainably, and CO_2 emissions from

manufacturing were reduced by 52% per ton of production compared to 2008 levels. Key initiatives included Unilever's work in regenerative agriculture, waste reduction, and water and wetland conservation. Programs such as Knorr's Landmark Farms promoted agroforestry, crop diversification, and pollinator-friendly farming. The company also focused on packaging innovation, aiming for 100% recyclability by 2025, and addressing microplastic pollution.

In addition to its environmental goals, Unilever worked to improve livelihoods and promote equity across its value chain, integrating environmental, social, and governance (ESG) considerations into its global business strategy.

3. PepsiCo: Leading India's Water Stewardship and Climate Action

Water scarcity is a significant environmental challenge in India, and PepsiCo has integrated this issue into its sustainability strategy. Since 2012, the company has replenished over 10 billion litres of water in India through various watershed and irrigation programs. According to its 2023 Global Water Stewardship Report, PepsiCo has improved water-use efficiency by 27% per litre of beverage product over the past decade. As part of its PepsiCo Positive (pep+) framework, the company has implemented regenerative agriculture practices across 1.8 million acres, aimed at enhancing soil biodiversity. PepsiCo has also reduced Scope 1 and 2 GHG emissions by 13% year-on-year. Additionally, the company has introduced precision irrigation and circular packaging strategies to further align with its environmental goals. Through a combination of technology, partnerships with farmers, and local water stewardship efforts, PepsiCo aims to reduce its environmental impact while fostering community resilience and long-term agricultural sustainability.

4. Apeejay Tea: Biodiversity Conservation in Assam's Tea Estates

Apeejay Tea, operating in Assam's tea-growing regions, has implemented initiatives to integrate biodiversity conservation with agricultural productivity. In collaboration with WWF-India, the company has transformed its estates into wildlife-friendly areas, aiming to reduce human-elephant conflict and protect important wildlife corridors. Through practices such as agroforestry and pollinator-friendly farming, Apeejay's initiatives support the ecological integrity of the region, which is known for its biodiversity. The estates now host a variety of wildlife, including elephants, leopards, and various bird species. Additionally, improvements in soil health and water retention have contributed to enhanced tea yields.

5. Tata Coffee: Rainforest Conservation in the Anamalai Hills

Tata Coffee's plantations in the ecologically sensitive Western Ghats, located in the Annamalai Hills, incorporate agroforestry practices aimed at conservation. Approximately 30% of the estate area is designated for conservation, providing habitat for over 200 bird species, including the endangered Great Indian Hornbill. The company has worked on reforesting degraded lands and has reduced pesticide usage by 40%, leading to improvements in soil health, pollinator diversity, and water retention. It has also reduced soil erosion by 35%, which supports long-term ecosystem stability. Through shade-grown coffee cultivation and certifications from the Rainforest Alliance, Tata Coffee integrates sustainability into its operations, aligning coffee production with conservation efforts.

6. **McCain India: Championing Soil Biodiversity through Sustainable Potato Farming**

   In the potato-growing regions of Gujarat and Punjab, McCain India has implemented regenerative agriculture practices in collaboration with over 1,000 farmers across 10,000 acres. The initiative promotes crop rotation, reduced pesticide use, and organic soil enrichment. Through the adoption of precision irrigation techniques, farmers have reduced water usage by 30%. Additionally, biodiversity-focused practices such as companion planting and integrated pest management have led to a 20% reduction in chemical use. Soil fertility has improved by 10–15%, which has contributed to healthier crops and increased farmer incomes. By integrating environmental management with agronomic practices, McCain India is working toward a model that emphasizes soil health, farmer education, and ecological balance in the processed food sector.

4.3.6 Challenges and Gaps

1. **Supply Chain Inefficiencies and Food Wastage**

   India's F&B sector faces critical supply chain inefficiencies, leading to an estimated 40% loss in agricultural produce annually due to inadequate cold storage, transportation, and processing facilities. This not only undermines food security but also exacerbates biodiversity loss. Wastage increases the demand for continuous agricultural production, which often involves clearing natural ecosystems, leading to habitat destruction and reduced species richness. The fragmented supply chain, marked by multiple intermediaries, results in delays and price fluctuations. Additionally, small-scale farmers often lack access to direct markets, which contributes to post-harvest losses and discourages the cultivation of diverse, indigenous crops that are more resilient to climate variability but less profitable in conventional markets. Minimizing food wastage can reduce the pressure to convert forests or wetlands into farmland. Expanding cold chain infrastructure, promoting digital traceability, and supporting initiatives like Krishi UDAAN 2.0 can optimize the movement of perishable goods and lower environmental strain. Encouraging the cultivation and marketing of underutilized, native crops also enhances agro biodiversity.

2. **Regulatory Gaps and High Compliance Costs**

   Inconsistent food safety regulations across Indian states result in high compliance burdens for food businesses, particularly SMEs. The lack of a unified framework leads to inefficiencies and limits innovation in eco-conscious food practices. Complicated regulatory environments may discourage businesses from adopting sustainable sourcing or organic farming, which are crucial for maintaining soil health and pollinator populations. A streamlined, biodiversity-aware regulatory framework can support safer and more sustainable food systems.

3. **Infrastructure Deficiencies and Lack of Investments**

   Only about 10% of India's agricultural produce is processed, in contrast to over 50% in developed economies. This gap results in high food spoilage, particularly due to insufficient

cold storage and costly logistics. Spoilage increases demand for higher yields, which often promotes monoculture farming and chemical-intensive agriculture - both harmful to biodiversity. Investment in food processing infrastructure can help reduce this pressure by extending shelf life and enabling better value extraction from diverse crop varieties. Encouraging public-private partnerships (PPPs) and incentivizing green infrastructure projects can further integrate biodiversity protection into industry expansion.

4. **Shortage of Skilled Workforce**

   A lack of skilled labour in food processing, safety, and sustainability practices hampers the industry's growth. Most vocational programs are not aligned with evolving industry needs, especially around ecologically responsible production. Without trained professionals in sustainable sourcing, organic certification, and low-impact processing, businesses may unintentionally harm ecosystems. Targeted skill development - through Skill India and food-specific training programs - should include biodiversity-conscious curriculum to promote environmentally sustainable practices.

5. **Changing Consumer Preferences and Innovation Gaps**

   As consumers demand organic, plant-based, and sustainable foods, many Indian businesses are slow to adapt due to high R&D costs and limited venture capital. Innovation in eco-friendly packaging, plant-based alternatives, and the commercialization of neglected crops could reduce pressure on conventional agriculture and promote biodiversity. Supporting food tech incubators and biodiversity-focused R&D can help bridge the innovation gap while aligning with environmental goals.

4.3.7 Opportunities for further action

The Food and Beverage (F&B) sector in India has significant growth potential driven by technological advancements, policy reforms, sustainability initiatives, and investment opportunities. Capitalizing on these areas can improve food security, economic growth, and global competitiveness. Integrating biodiversity into its development strategies can ensure long-term food security, environmental sustainability, and alignment with global goals such as the Kunming-Montreal Global Biodiversity Framework and UN SDGs.[56]

1. **Expanding Food Processing and Value Addition**

   With only 10% of India's agricultural produce currently being processed, there exists a significant opportunity to invest in food processing and value addition. Not only can this reduce post-harvest losses and improve farmer incomes, but when aligned with biodiversity objectives, it can also support the conservation of local, underutilized crop varieties and traditional food systems. Promoting eco-sensitive food clusters, such as biodiversity-conscious Mega Food Parks that use low-impact technologies and prioritize biodiversity-rich zones, can yield environmental and economic dividends. Strengthening value chains for indigenous foods and climate-resilient crops, which typically require fewer chemical inputs, can help preserve agrobiodiversity. To ensure long-term ecological integrity, biodiversity

56 Grant Thorton. (n.d.). Indian Food & Beverage Sector: The new wave.

impact assessments should be integrated into the planning and development of food processing zones.

2. Strengthening Sustainability and ESG Integration

Sustainability efforts in packaging, waste management, and energy efficiency are increasingly being adopted by the food industry, but there is a need to explicitly integrate biodiversity and ecosystem health into these ESG frameworks. Businesses can adopt biodiversity-sensitive ESG standards that include targets for sustainable sourcing, pollinator protection, and land-use neutrality. Reducing environmental leakage through plastic-free packaging solutions is another key priority, helping to prevent harm to terrestrial and marine ecosystems. Furthermore, the promotion of closed-loop food systems and regenerative agriculture models can restore degraded soils and enhance natural habitats, offering co-benefits for food security and biodiversity.

3. Boosting Innovation and Technological Advancements

Emerging technologies offer immense potential to improve agricultural productivity while maintaining ecological balance, provided they are designed with biodiversity considerations in mind. There is a growing need to support research and development in nature-positive agri-tech, including bio-inputs, seed banks for native crop varieties, and AI tools that guide habitat-friendly farming practices. The deployment of IoT-enabled biodiversity monitoring systems within supply chains can provide valuable insights into habitat integrity and land-use dynamics. At the same time, innovations in low-impact food processing technologies can reduce energy, water, and land usage, contributing to a more sustainable production footprint.

4. Expanding Global Trade and Export Potential

India's food export potential is considerable and aligning it with biodiversity goals can create a competitive edge in international markets increasingly focused on sustainability. Promoting Geographical Indication (GI)-tagged and biodiversity-rich products, such as millets, wild honey, and tribal forest produce, can strengthen India's position in green trade. Aligning export standards with global frameworks like the Global Biodiversity Framework (GBF) and the EU Green Deal will become crucial, particularly for organic and climate-smart products. Building robust traceability systems will further ensure that biodiversity-positive sourcing is certified and recognized globally.

5. Improving Workforce Development and Skill Training

A biodiversity-aligned food system requires a workforce equipped with the right knowledge and skills. Expanding Skill India programs to include training on circular economy principles, agroecology, and ecosystem services can help fill this gap. Encouraging industry-academia partnerships can embed biodiversity awareness in food and beverage training curricula, building capacity across the value chain. Moreover, businesses should be incentivized to hire and train professionals in areas such as eco-certification, biodiversity auditing, and sustainable sourcing, thereby fostering an ecosystem of skilled green professionals.

4.4 Mining Sector in India

4.4.1 Introduction

The mining sector plays a pivotal role in India's economic development, serving as a cornerstone for industrial growth and infrastructure development. According to recent data, the sector contributes approximately 0.9% to India's GDP directly, though its indirect impact on the economy is substantially larger[57]. For every 1% incremental growth in the mining and quarrying sector, India experiences approximately 1.3% incremental growth in industrial production and 0.3% incremental growth in overall GDP[58]. This multiplier effect underscores the sector's strategic importance to India's economic ambitions.

The sector's contribution to Indian Gross Value Added (GVA) has shown robust growth with a CAGR of 9% over the last 5 years, maintaining a steady 2% contribution to the overall Indian GVA[59]. Recent economic data shows that GDP from Mining in India increased to 826.04 INR Billion in the fourth quarter of 2024 from 650.12 INR Billion in the third quarter of 2024, demonstrating the sector's continued growth trajectory[60].

The mining industry in India encompasses 1,206 working mines and generates employment for approximately 1.25 crore people, highlighting its significant role in job creation[61]. The total value of mineral production stands at Rs 1.40 lakh crore, making it a substantial contributor to the

[57] Government of India: Ministry of Mines: National Mining Ministers' Conference 2025

[58] The Industry – IME 2025 – International Mining, Equipment & Minerals Exhibition

[59] The Industry – IME 2025 – International Mining, Equipment & Minerals Exhibition

[60] India GDP From Mining

[61] Government of India: Ministry of Mines: National Mining Ministers' Conference 2025

national economy[62]. The industry comprises mostly small-scaled operations, with the private sector playing a dominant role, contributing 60% of the industry's overall revenue[63].

India holds a significant position in the global mining landscape, ranking among the top producers of several key minerals. The country is the third-largest energy consumer globally, following China and the United States, which drives consistent increases in demand for power and electricity, consequently boosting coal consumption[64]. India ranks among the top ten global producers of bauxite, iron ore, manganese ore, aluminium, and zinc[65]. Additionally, the country is making strides in mining critical and strategic minerals like lithium, cobalt, and rare earth elements, which are essential for global energy transitions[66].

The mining sector in India is poised for significant growth and transformation. The demand for steel in FY25 is projected to rise by approximately 10% due to the government's intensified focus on infrastructure development[67]. Similarly, zinc demand in India is anticipated to double over the next five to ten years, fuelled by significant investments in the infrastructure sector[68].

The government has implemented various initiatives to boost the sector, including the Coal Block Allocation Policy and the Make in India campaign, aimed at increasing domestic production[69]. Recent regulatory reforms, technological advancements, ESG integration, and the commencement of offshore mining are transforming the industry[70]. The Union Budget 2025-26 has announced significant reforms in the mining sector, particularly for critical minerals, along with the introduction of a State Mining Index[71].

4.4.2 Biodiversity impacts of the Sector

India's mining sector has significant impacts on biodiversity, largely due to the geographical overlap between mineral-rich areas and biodiverse regions. The sector affects biodiversity through direct habitat destruction, fragmentation, pollution, and indirect impacts that extend beyond mining sites.

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62 Government of India: Ministry of Mines: National Mining Ministers' Conference 2025

63 Mining 2025 – Trends & Developments (India)

64 India Metals & Mining Industry Report 2025: Coal, Steel and Zinc Demand Surge as India's Mining Industry Expands Through 2030 - ResearchAndMarkets.com

65 Mining 2025 – Trends & Developments (India)

66 Mining 2025 – Trends & Developments (India)

67 India Metals & Mining Industry Report 2025: Coal, Steel and Zinc Demand Surge as India's Mining Industry Expands Through 2030 - ResearchAndMarkets.com

68 India Metals & Mining Industry Report 2025: Coal, Steel and Zinc Demand Surge as India's Mining Industry Expands Through 2030 - ResearchAndMarkets.com

69 India Metals & Mining Industry Report 2025: Coal, Steel and Zinc Demand Surge as India's Mining Industry Expands Through 2030 - ResearchAndMarkets.com

70 Mining 2025 – Trends & Developments (India)

71 Union Budget 2025-26: Mining and metals sector Highlights | EY - India

Mineral reserves in India are predominantly located in states with substantial forest cover, including Madhya Pradesh, Chhattisgarh, Jharkhand, Odisha, Maharashtra, and Andhra Pradesh. These states have forest cover ranging from 16% to 80% of their geographical area, supporting rich floral and faunal diversity[72]. This overlap creates an inherent conflict between resource extraction and biodiversity conservation.

A recent study revealed that between 1994 and 2022, mining activities reduced forest cover by 7.32-17.61%, shrunk water bodies by 5-10%, and led to the loss of agricultural land by 3-5%. Even in Bishrampur, presented by the government as "a benchmark for sustainable mining and responsible land reclamation," forest cover decreased by 38% during this period[73].

At least ninety wildlife sanctuaries and national parks across India are threatened by mining activities. In Goa, mining for manganese and iron ore threatens multiple protected areas, including Bhagwan Mahavir Wildlife Sanctuary and Mollem National Park. Similarly, stone mining near Sariska Tiger Reserve, diamond mining near Panna National Park, and limestone mining in Jamva Ramgarh Sanctuary illustrate the widespread threats to protected areas[74].

The case of elephants in Odisha is particularly concerning. This population, constituting 74% of eastern India's elephants, faces serious conservation challenges due to habitat destruction from mining expansion, transportation infrastructure, and increased human pressure. Similarly, in Karnataka, Sandur had a sizable population of sloth bears that are no longer found in the area due to habitat displacement[75]. The Western Ghats, overall, suffers from significant ecological impacts including soil erosion, deforestation, and damage to aquatic habitats from mining operations[76].

Mining affects both terrestrial and aquatic ecosystems. Due to increased sedimentation and turbidity caused by mining, the survival of aquatic animals has been documented to be at great risk. Studies have unequivocally stated that iron-ore mining and associated activities in the Kudremukh region have induced habitat fragmentation and loss in species diversity and distribution, especially amphibians. Fish, in particular, are "subject to morphological damage by the iron present in the water," which not only causes diseases but may also "cross the species barrier when these fish are eaten by other animals"[77].

Mining affects biodiversity at multiple spatial scales—site, landscape, regional, and global—through both direct and indirect processes. At the site level, habitat destruction is immediate and severe. At landscape and regional levels, chemical and physical waste

[72] IBBI Publication Mining Sector

[73] Coal mining has led to 35% loss of native land cover in India's central coal belt | News | Eco-Business | Asia Pacific

[74] Mining industry: Implications for wildlife conservation | Wildlife Institute of India, an Autonomous Institute of MoEF, Govt. of India

[75] Chandran, Pooja (2020) Mining in the Western Ghats – implications and demand for sustainable management. HPNLU Journal of Environment and Disaster Management. Vol 1. pp 15-27.

[76] What is the impact of mining on the Western Ghats?

[77] Chandran, Pooja (2020) Mining in the Western Ghats – implications and demand for sustainable management. HPNLU Journal of Environment and Disaster Management. Vol 1. pp 15-27.

discharge (including mercury, cyanide, and acid drainage) can degrade ecosystems over great distances[78].

Indirect impacts occur when mining facilitates additional biodiversity loss through infrastructure development that attracts human populations or exacerbates existing threats such as hunting and invasive species. Cumulative impacts, where multiple mines cause greater biodiversity loss than the sum of individual operations, remain significantly understudied[79].

4.4.3 Rehabilitation Challenges

The ecological restoration of mined areas remains inconsistent across companies and regions in India[80]. Studies show that compensatory afforestation efforts often fall short – plantations make up only a small proportion of what has been lost due to mining and much less than what is supposed to have been created under compensatory afforestation programs. Native plants removed during mining operations are frequently replaced by grasses and invasive alien species, which offer less protection against erosion[81].

- **Biophysical Challenges:** Rehabilitating biodiversity in mining-affected areas presents significant ecological challenges. Most mine rehabilitation efforts struggle to restore the complex ecological communities that existed pre-mining. A key issue is the loss of original soil structure and microbial communities that are fundamental to ecosystem functioning[82]. Research shows that resulting post-mining sand tailings often lack requisite soil properties to support vegetation regrowth[83]. The replacement of native vegetation with fast-growing exotic species further complicates ecological restoration. Studies in mining regions reveal that rehabilitated areas often fail to support the complex food webs and ecological interactions of natural forests. Additionally, challenges in selecting fast-growing species adapted to the particular environmental constraints of mine land hamper effective rehabilitation efforts[84].
- **Policy and Legal Challenges:** Biodiversity rehabilitation faces significant regulatory hurdles. India's mine closure guidelines often lack specific, measurable biodiversity targets, focusing instead on general revegetation without addressing ecosystem functionality or species composition. The monitoring mechanisms primarily track vegetation cover rather thanbiodiversity recovery, creating a significant gap in evaluating rehabilitation success[85].

[78] Mining and biodiversity: key issues and research needs in conservation science | Proceedings of the Royal Society B: Biological Sciences

[79] Mining and biodiversity: key issues and research needs in conservation science | Proceedings of the Royal Society B: Biological Sciences

[80] IBBI Publication Mining Sector

[81] Coal mining has led to 35% loss of native land cover in India's central coal belt | News | Eco-Business | Asia Pacific

[82] Otesile, AA and Bakarr, I (2018) Assessing effects of mining and post-mining land rehabilitation on biodiversity and habitats in Southern Sierra Leone. Proceedings of 6th NSCB Biodiversity Conference, Uniuyo (171-179 pp).

[83] Ahirwal, J., & Maiti, S. K. (2021). Restoring coal mine degraded lands in India for achieving the UN_2 sustainable development goals. Restoration Ecology, 30(5). https://doi.org/10.1111/rec.13606

[84] Gastauer M, Souza Filho PWM, Ramos SJ, Caldeira CF, Silva JR, Siqueira JO, Furtini Neto AE. (2019) Mine land rehabilitation in Brazil: Goals and techniques in the context of legal requirements. Ambio. 2019 Jan; 48(1): 74-88. doi: 10.1007/s13280-018-1053-8.

[85] Integrating Mining and Biodiversity Conservation: case studies from around the world | IUCN, ICMM

To address these challenges, initiatives like the five-year project on eco-rehabilitation of mining-degraded sites across India by the Indian Council of Forestry Research and Education (ICFRE) aim to standardize practices for eco-rehabilitation of degraded coal mines across different agro-climatic zones[86].

- **Financial Challenges:** Biodiversity rehabilitation suffers from chronic underfunding. Restoration of complex ecosystems requires long-term financial commitment beyond the typical monitoring period mandated by regulations. The true cost of comprehensive biodiversity rehabilitation—including soil restoration, native species reintroduction, and ecosystem monitoring—is often significantly higher than current industry allocations.
- **Human Resource Challenges:** There is a critical shortage of ecological expertise within mining companies and regulatory bodies. Most rehabilitation work is contracted to third parties with limited ecological knowledge of local ecosystems. Additionally, traditional ecological knowledge from local communities is rarely incorporated into restoration planning.

4.4.4 Biodiversity rehabilitation action: some cases

In FY 2023-24, the coal sector brought 2,734 hectares of land under green cover, and planted 5.1 million saplings, enhancing biodiversity and creating green community spaces. Additionally, 372 hectares were covered by grass, stabilizing soil, improving moisture retention, and preventing erosion in reclaimed land[87].

Eco-parks and mine tourism sites in coalfields offer recreation and economic benefits while promoting sustainability. Reclaimed lands are also being converted into renewable energy hubs, agricultural zones, and water reservoirs, supporting long-term ecological goals. Water management efforts supplied 4,892 lakh kilolitres of treated mine water for domestic, irrigation, and industrial use. Additionally, overburden material is being used to produce construction sand, aiding infrastructure development, reducing environmental strain, enhancing river ecosystems, improving water flow, and boosting groundwater recharge[88]. The sector is increasingly focusing on reducing greenhouse gas emissions, adopting renewable energy, and integrating circular economy principles into operations[89].

Tata Steel's Noamundi Iron Mine

Tata Steel's Noamundi Iron Mine in Jharkhand exemplifies a holistic approach to ecological restoration and biodiversity conservation in post-mining landscapes. The company has reclaimed 126 hectares of mined-out areas on Hills 1 and 2 through afforestation with native species, creating dense biomass that now supports diverse flora and fauna. These efforts have provided food security for local wildlife and employment opportunities for nearby communities

[86] Inception Workshop to Start 5-yr Project on Eco-rehabilitation of Mining-degraded Sites Held In Doon | Dehradun News - The Times of India

[87] Press Release: Press Information Bureau

[88] Advancing Sustainable Mining in India Towards Eco-Friendly Practices - Elets eGov

[89] Advancing India's Mining Sector: Strategies for Sustainable Growth and Competitiveness

engaged in horticulture and plantation activities. The reclaimed areas also serve as sources for traditional medicinal plants, reducing pressure on natural forests[90]. In recognition of these initiatives, the mine received the 'Most Innovative Environmental Project Award' in the biodiversity category at the 6th GreenCO Summit organized by the Confederation of Indian Industries in 2017[91].

Complementing these restoration efforts, Tata Steel implemented the Bird Niche Nesting Project, installing over 130 artificial nests to support 18 species of hole-nesting birds identified through biodiversity assessments. This initiative, guided by the International Union for Conservation of Nature (IUCN), has enhanced avian biodiversity in the area[92]. Additionally, the company established a 3 MW solar power plant atop Hill 1, offsetting approximately 20% of the mine's electrical energy requirements and reducing CO_2 emissions by 4,400 tonnes annually[93].

Tata Steel has also developed thematic parks, including the Sir Dorabji Tata Botanical Park and Nakshatra Park, which house diverse plant species and serve as educational and recreational spaces for the community. These integrated efforts demonstrate Tata Steel's commitment to sustainable mining practices and biodiversity conservation. It received a 5-Star rating from the Indian Bureau of Mines for sustainable practices for 2021-22, including a comprehensive Biodiversity Management Plan developed with the International Union for Conservation of Nature (IUCN)[94].

SAIL's Biodiversity Conservation Initiatives in Saranda

The Steel Authority of India Limited (SAIL) has adopted a comprehensive approach to biodiversity conservation, extending its efforts beyond mining sites to encompass surrounding ecosystems. In the ecologically rich Saranda Reserve Forest of Jharkhand, SAIL developed an Integrated Wildlife Management Plan for Singhbhum (East) and a Catchment Area Treatment (CAT) Plan in collaboration with IIT Kharagpur. The primary objective is to restore the biodiversity of the Saranda Forest ecosystem. To accomplish this, a three-tier plantation model was adopted, involving the strategic planting of 2,664 trees and 3,136 herbs/shrubs in 1.5 hector degraded backfilled area. This initiative aims to rehabilitate the degraded land that has been adversely affected by mining activities[95]. The initiatives included the complete digitalization of the Saranda region, resulting in a comprehensive database to guide conservation strategies. A recent biodiversity assessment in the Saranda Forest Division, conducted jointly with the Wildlife Institute of India, identified key conservation

[90] Emphasis on Biodiversity

[91] Noamundi: Tata Steel's Noamundi iron mine bags 'Most Innovative Environmental Project Award' in Biodivesity category - The Economic Times

[92] IBBI Publication Mining Sector

[93] Mining 2025 – Trends & Developments (India)

[94] Review and assessment of the potential restoration of ecosystem services through the implementation of the biodiversity management plans for SDG-15 localization - PMC

[95] Murmu, M., & Behera, S. (2024). Strategies for Sustainable Mine Reclamation: Case Study of the Meghahatuburu Iron Ore Mine. Journal of Geological Society of India, 100(9), 1320–1330. https://doi.org/10.17491/jgsi/2024/173985.

priorities, including the protection of elephant corridors and endangered species, as well as the implementation of long-term monitoring protocols[96].

Aditya Birla Group's Integrated Biodiversity Approach[97]

Hindalco (part of Aditya Birla Group) used the Integrated Biodiversity Assessment Tool (IBAT) to identify high-priority sites that could benefit from detailed Biodiversity Management Plans, developing four such plans for five facilities. The company developed a 2,000 sq. meter butterfly conservation area and planted native trees, herbs, and shrubs to attract butterflies and pollinator insects. At Vilayat (Gujarat), **Grasim Industries** is developing a Miyawaki forest with over 68,000 trees already planted and aims to reach 100,000 trees. This technique improves biodiversity, sequesters carbon, increases green cover, reduces air pollution, and preserves the water table. The Miyawaki technique applied at **Aditya Aluminium's** CHP area achieved a remarkable 99.5% plant survival rate. The afforestation program at Utkal Alumina added 20% new species, while over 10,000 saplings planted near coal mines in Gare Palma increased green cover by 5.7%. **UltraTech Cement** (another Aditya Birla Group company) has 13 mines awarded a 5-star rating by the Ministry of Mines for 2021-22, recognizing its sustainable and responsible mining practices.

4.4.5 Outlook for Biodiversity Conservation Investments in India's Mining Sector

India's mining sector is increasingly prioritizing biodiversity conservation, driven by regulatory mandates, ESG compliance, and corporate responsibility. The sector is witnessing significant transformation in its approach to environmental stewardship, with several key developments shaping this evolution:

Regulatory Push

The National Mineral Policy (2019)[98] mandates avoiding "inviolate areas" and emphasizes sustainable practices, creating a foundational framework for biodiversity protection in mining operations. The policy specifically recognizes that mining operations should not be conducted in ecologically fragile and biologically rich areas, providing clear guidance for site selection and operational planning.

The revised Mining Plan Guidelines 2024[99] by the Ministry of Coal emphasize sustainable coal mining practices with a strong focus on environmental management. The guidelines mandate restoration, remediation, and regeneration measures within mining plans to ensure responsible natural resource management. Key improvements include continuous monitoring of water quality, integration of fly ash filling protocols, and strict safety audits to minimize

[96] Assessment and monitoring of biodiversity value in Saranda Forest division

[97] Championing biodiversity by shifting the needle - Stories - Aditya Birla Group

[98] National Mineral Policy (2019)

[99] Press Release: Press Information Bureau

environmental impact. Additionally, mandatory drone surveys, preference for blast-free mining methods, and mechanized coal loading aim to enhance efficiency while reducing ecological disruption. These reforms reflect India's commitment to ethical coal mining, balancing industrial growth with environmental conservation.

The Union Budget 2025-26 has identified mining as one of the six sectors for transformative reforms to boost India's global competitiveness[100]. The government plans to encourage mining reforms in States, introduce a State Mining Index, and promote critical mineral recovery from tailings. Improved tailings management will enhance domestic mineral availability while supporting local processing industries. Additionally, the elimination of customs duties on scrap materials, including critical minerals and lithium-ion battery waste, aims to strengthen India's recycling sector, reduce costs for domestic producers, and attract investment in newer capacities.

The Pradhan Mantri Khanij Kshetra Kalyan Yojana (PMKKKY) prioritizes environmental preservation and pollution control in mining-affected areas. The revised PMKKKY guidelines (2024) mandate that at least 70% of District Mineral Foundation (DMF) funds be allocated to high-priority sectors, including environmental management[101]. These funds support initiatives such as drinking water projects, pollution control measures, and ecological restoration. Additionally, the guidelines emphasize local governance involvement, ensuring that Gram Sabhas and local bodies contribute to sustainable planning. The framework also aligns with constitutional provisions for Scheduled Areas and Tribal Areas, reinforcing environmental safeguards.

Standards and Disclosure Frameworks

Over the past decade, the mining sector in India has seen a significant evolution in standards and disclosure frameworks related to environmental management, with a growing emphasis on biodiversity. This shift is driven by both global imperatives-such as the Sustainable Development Goals (SDGs) and the Convention on Biological Diversity (CBD)-and national priorities, including India's National Biodiversity Targets and the addendum to the National Biodiversity Action Plan (NBAP). The sector's impacts on biodiversity are profound, as mineral-rich regions often overlap with high-biodiversity forest areas, necessitating robust frameworks to manage and disclose environmental risks and actions.

The International Council on Mining and Metals (ICMM) plays a pivotal role in setting global best practices for biodiversity management in the mining sector. ICMM's "Mining with Principles" framework and its 2025 Good Practice Guide for Achieving No Net Loss or Net Gain of Biodiversity lay out a comprehensive, science-based approach for member companies and the wider industry[102]. The guide emphasizes a structured process that begins with establishing a robust biodiversity baseline and area of analysis, followed by the

[100] Press Release: Press Information Bureau

[101] Press Release:Press Information Bureau

[102] International Council on Mining and Metals (ICMM). (2025). Achieving No Net Loss or Net Gain of Biodiversity: Good Practice Guide. ICMM.

selection of site-level biodiversity indicators and metrics tailored to local ecological contexts.

The guidance stresses the importance of progressive rehabilitation, adaptive management, and transparent disclosure of methodologies and site-level outcomes. ICMM's Nature Position Statement, aligned with the Kunming-Montreal Global Biodiversity Framework, commits members to measurable nature-positive outcomes, including the use of credible metrics, stakeholder engagement, and the integration of Indigenous and local knowledge. Importantly, ICMM's approach is designed to be compatible with international standards such as IFC Performance Standard 6 and supports alignment with emerging disclosure frameworks like TNFD.

At the national level, foundational documents like the IBBI Guidebook for Mainstreaming Biodiversity in the Indian Mining Sector provide practical guidance for integrating biodiversity into every phase of mining, from exploration to closure[103]. This guidebook recognizes the sector's major drivers of biodiversity loss-land use change, habitat destruction, water and soil pollution, and impacts on indigenous communities-and links mining activities to India's national biodiversity targets. It emphasizes the need for companies to assess dependencies and impacts on ecosystem services, and to adopt best practices in rehabilitation, waste management, and stakeholder engagement.

Recent years have seen the emergence of sophisticated disclosure frameworks, most notably the Taskforce on Nature-related Financial Disclosures (TNFD)[104]. The TNFD recommendations, launched in 2023, provide a globally endorsed structure for companies to identify, assess, manage, and disclose nature-related dependencies, impacts, risks, and opportunities (DIRO), with a strong focus on biodiversity. The TNFD's LEAP approach (Locate, Evaluate, Assess, Prepare) is being piloted by leading Indian mining companies such as Hindustan Zinc Limited, which now integrates site-level biodiversity risk assessments, science-based targets, and comprehensive biodiversity management plans into its operations. The TNFD framework aligns with international best practices and is designed to be compatible with other reporting standards such as the Task Force on Climate-related Financial Disclosures (TCFD) and Global Reporting Initiative (GRI).

Technology & Innovation

Technological innovation and digital transformation are also reshaping environmental management in Indian mining. Reports by EY and the Federation of Indian Mining Industries highlight the adoption of IoT, AI, and real-time monitoring to improve efficiency, reduce environmental footprints, and enable data-driven decision-making[105]. These advances support

[103] Deshmukh, P., & Lingala, S. G. (2019). Guidebook for Mainstreaming Biodiversity: Indian Mining Sector. Confederation of Indian Industry (CII).

[104] Taskforce on Nature-related Financial Disclosures (TNFD). (2023). Draft Sector Guidance – Metals and Mining. TNFD.

[105] Confederation of Indian Industry (CII) & EY India. (2023). Utkrisht Bharat in Mining – Technological Interventions to Transform the Growth of Indian Mining Sector. Confederation of Indian Industry.

more transparent, timely, and actionable disclosure of environmental and biodiversity performance.

- In addition, technology and innovation can also aid in biodiversity positive actions, such as through
- Advanced monitoring technologies including AI, automation, and IoT systems are being deployed for efficient resource use and pollution control. For example, mining companies are using Geo-Textile mats for soil stabilization, significantly improving the success rate of revegetation efforts on degraded lands.
- Biodiversity assessment tools like the Integrated Biodiversity Assessment Tool (IBAT) are helping companies identify high-priority sites that require detailed Biodiversity Management Plans, enabling more targeted and effective conservation efforts.
- Specialized restoration techniques such as the Miyawaki method of afforestation are being implemented at reclaimed mining sites, achieving plant survival rates of over 99% and accelerating ecosystem recovery compared to conventional approaches.

4.4.6 Implementation Constraints

Despite increasing awareness of biodiversity's importance in the post-mining landscape, implementation of conservation and restoration efforts faces persistent and multifaceted challenges. One of the foremost constraints is the critical shortage of ecological expertise. Globally, only around 12% of mining companies employ dedicated biodiversity specialists, a gap that significantly undermines the design, execution, and monitoring of effective conservation strategies[106]. Regulatory agencies often face similar shortfalls, resulting in under-resourced oversight and limited technical capacity to enforce biodiversity safeguards.

Restoration efforts are also hampered by fundamental scientific and logistical issues. Monitoring biodiversity outcomes remains a complex task. Current frameworks often rely on surface-level metrics, such as vegetation cover, which fail to capture ecosystem functionality or changes in species composition. Without robust indicators and long-term monitoring systems, it becomes difficult to assess the ecological integrity of rehabilitated sites or to make evidence-based course corrections. Further complicating this is the widespread lack of baseline data. In many mining regions, pre-mining biodiversity inventories are either missing or incomplete, making it nearly impossible to define restoration targets or evaluate progress against ecological benchmarks.

Material constraints compound these problems. Successful ecosystem rehabilitation requires site-specific native species, especially those adapted to degraded or nutrient-poor soils. However, commercial nurseries rarely stock such specialized plants at the scale required, pushing companies toward fast-growing exotic species that offer short-term aesthetic appeal but little ecological value. This undermines the goal of recreating self-sustaining native ecosystems. Even large-scale initiatives like the Indian Council of Forestry Research and

[106] Sonter, L. J., Ali, S. H., & Watson, J. E. M. (2018). Mining and biodiversity: key issues and research needs in conservation science. Proceedings of the Royal Society B: Biological Sciences, 285(1892).

Education (ICFRE)'s Eco-Rehabilitation Project have highlighted the recurring difficulty in sourcing appropriate native saplings.

Financial and social barriers further limit the effectiveness and scalability of restoration programs. The cost of ecological rehabilitation in India is typically estimated between ₹6–9 lakh per hectare—substantially lower than international norms of ₹25–30 lakh per hectare required for full ecosystem recovery[107]. This funding shortfall often results in superficial or incomplete interventions that fail to deliver long-term biodiversity benefits.

Community engagement poses additional implementation hurdles. In tribal and forest-dependent regions, the displacement of local populations and erosion of traditional ecological knowledge can weaken the foundation for successful restoration. Projects frequently neglect to involve local communities in the planning and monitoring phases, despite evidence—such as from the ERM Group[108]—that participatory approaches significantly improve ecological and social outcomes.

4.4.7 Future Trends

The future of biodiversity management in India's mining sector is poised for a transformation driven by policy evolution, financial incentives, and collaborative innovation. One of the most notable trends is the growing influence of Environmental, Social, and Governance (ESG) frameworks on investment decisions. Global investors are increasingly directing capital toward mining companies that can demonstrate measurable, positive impacts on biodiversity through transparent metrics and conservation programs. This shift is incentivizing firms to adopt nature-positive business models, integrate circular economy principles, and disclose their environmental performance in line with emerging global standards such as the Taskforce on Nature-related Financial Disclosures (TNFD) and guidance from the International Council on Mining and Metals (ICMM).

At the domestic level, regulatory frameworks are becoming more competitive and performance oriented. The upcoming State Mining Index (2025) is set to introduce sustainability as a key criterion for ranking state-level mining governance. This index is expected to foster healthy inter-state competition, encouraging innovations in policy, stricter enforcement of biodiversity safeguards, and better integration of ecological considerations in mining approvals and monitoring systems. As Indian protocols mature and align with global benchmarks, they will provide a more coherent structure for balancing economic and ecological priorities.

Collaborative approaches are also gaining traction, particularly through public-private partnerships (PPPs) that unite government bodies, mining companies, conservation NGOs, and local communities. These partnerships are enabling more landscape-scale, science-informed interventions such as the creation of Miyawaki forests, butterfly conservation zones, and

107 Coal mining has led to 35% loss of native land cover in India's central coal belt | News | Eco-Business | Asia Pacific

108 Mining and Social Responsibility: Nurturing Communities through Proactive Initiatives | ERM Group

community-led habitat restoration. These initiatives not only restore ecological function but also build local stewardship and resilience.

A further development is the growing adoption of biodiversity offsetting mechanisms. These are being used by companies to achieve no net loss—or even a net gain—of biodiversity by investing in conservation efforts beyond their immediate areas of impact. Properly governed, such mechanisms could create significant new funding streams for protected areas and critical habitats, addressing historical funding gaps in biodiversity conservation.

Taken together, these trends signal the emergence of a dynamic and multi-layered framework for environmental governance in India's mining sector. It blends national initiatives such as the India Business & Biodiversity Initiative (IBBI) and the National Biodiversity Action Plan (NBAP) with international guidance and cutting-edge technologies for real-time ecological monitoring and performance evaluation. Industry leaders are not just complying with these frameworks but are also piloting next-generation approaches like science-based targets for nature and comprehensive site-level biodiversity management plans. If these innovations are scaled and aligned with inclusive, well-funded, and ecologically grounded strategies, the sector could evolve into a global exemplar of how to reconcile resource extraction with ecological stewardship.

4.5 Energy Sector in India

4.5.1 Introduction

India's energy sector plays a critical role in its economic development, underpinning industrial growth, infrastructure expansion, and national prosperity. As the world's third-largest energy consumer (after China and the United States), India's energy demand is growing at over 5% annually and is projected to more than double by 2040. This positions the country as one of the most dynamic energy markets globally.

At the centre of the global energy transition, India is integrating rapid economic expansion with ambitious decarbonization goals. It targets 50% of its power generation capacity from non-fossil fuel sources by 2030 and net-zero emissions by 2070[109]. With a GDP growth rate of 7.8%, India was the world's fastest-growing major economy in 2023 and is on track to become the third-largest economy by 2030. This economic trajectory has driven a sharp increase in clean energy investments over the past three years, reflecting a strong commitment to meeting energy transition targets.

India's power sector ranks sixth globally in both energy production and installed capacity. As of January 2025, the total installed capacity stood at 466.26 GW, 47.3% of which is coal-based and 45.9% is renewables (Table 1).

Table 1: Power Generation Mix (January 2025)

Source	Capacity (GW)	Percentage (%)
Coal	220.49	47.29
Solar energy	100.33	21.52
Wind	48.37	10.37
Hydro power	46.97	10.07
Oil and Gas	25.41	5.45
Bio power	11.41	2.45
Nuclear	8.18	1.75
Small hydro	5.1	1.09
Total	466.26	100

Source: India Energy, NITI Aayog

By January 2025, non-fossil fuel capacity reached 217.62 GW. The year 2024 marked record additions of 24.5 GW in solar and 3.4 GW in wind capacity, representing a more than twofold increase in solar installations and a 21% rise in wind capacity over 2023.[110] Over the past decade, solar capacity alone has grown 32 times, positioning India as the third-largest solar power producer globally. The Union Budget 2025–26 introduced several strategic initiatives to accelerate the energy transition. A Nuclear Energy Mission aims to establish 100 GW of nuclear power capacity by 2047. In support of innovation, a dedicated research and development programme for Small Modular Reactors (SMRs) has been launched with an outlay of ₹20,000 crore, with at least five indigenously developed SMRs expected to be operational by 2033. To facilitate greater private sector participation, amendments to the Atomic Energy Act and the Civil Liability for Nuclear Damage Act have been proposed.

Additional budget measures include increased allocation to the PM Surya Ghar Muft Bijli Yojana to expand household access to solar energy and the launch of a national manufacturing

[109] Company's Role in Energy Sector and the Impact on Indian Economy

[110] Press Release: Press Information Bureau

mission to boost domestic production of solar PV cells, wind turbines, grid-scale batteries, and electrolysers, promoting self-reliance in the clean energy value chain. The National Electricity Plan (NEP) outlines India's power sector expansion through 2031-32. It projects a peak demand of 277.2 GW by 2026-27 and 366.4 GW by 2031-32, targeting an installed capacity of 609 GW and 500 GW of non-fossil fuel capacity by 2030. Implementing the plan will require an estimated investment of ₹33.6 trillion (US$384.5 billion) over the next decade.

Energy access and affordability remain critical challenges. Despite progress through initiatives like SAUBHAGYA, aimed at achieving 100% household electrification, energy poverty continues in several regions. The UJALA scheme for LED bulb distribution has saved households approximately ₹17,000 crore (nearly $2.5 billion) annually. India imports nearly 90% of its crude oil and 50% of its natural gas, costing ₹15-18 lakh crore annually (FY24). Reducing import dependency is a strategic priority. The National Green Hydrogen Mission, with an allocation of ₹19,744 crore, aims to produce 5 MMT of green hydrogen annually by 2030, potentially reducing fossil fuel imports by ₹1 lakh crore per year.

The energy sector contributes approximately 6-7% to India's GDP and directly supports nearly 4 million jobs. The renewable energy sector currently employs around 1 million people and could create an additional 3 million jobs by 2030 through solar, wind, and green hydrogen projects. However, with fossil fuel sectors (coal, oil, gas) employing about 1.2 million people, a just transition strategy is needed to ensure economic security for affected workers. India's climate commitments include achieving 500 GW of non-fossil capacity by 2030 and net-zero emissions by 2070. In 2024 alone, renewable energy development avoided 40.2 million tonnes of CO2 emissions, according to the Council on Energy, Environment and Water (CEEW).

4.5.2 Biodiversity Impacts

India's energy sector, encompassing both fossil fuels and renewables, exerts profound and multifaceted impacts on biodiversity at both national and local scales.

4.5.2.1 Fossil Fuel Sector

India's fossil fuel sector (coal, oil, gas) significantly impacts biodiversity through habitat loss, pollution, and other disruption.

a) Habitat Loss and Fragmentation

At the national level, coal mining and related fossil fuel activities are a primary driver of forest loss and landscape fragmentation in India. According to a World Resources Institute (WRI) analysis, mining drove the loss of nearly 1.4 million hectares of tree cover in India between 2001 and 2020, with much of this loss concentrated in central India's coal belt[111]. This region, which includes states like Jharkhand, Chhattisgarh, and Odisha, is not only rich in coal but also forms the largest contiguous tiger landscape in

[111] Mining Is Increasingly Pushing into Critical Rainforests and Protected Areas | World Resources Institute

the country[112]. The expansion of coal mining in these areas has resulted in the destruction of dense forests – over 739,000 hectares with canopy density above 40% - and has fragmented critical wildlife corridors that connect protected areas and tiger reserves.

In Jharkhand, unregulated coal mining has severely impacted elephant corridors. Mining operations have created gaps in forest areas, forcing elephants to move into human settlements or risk injury in mining pits. This has led to increased human-elephant conflict and threatens the long-term viability of elephant populations in the region[113]. The loss of forest connectivity also pushes forest-dependent communities, including indigenous Adivasi groups, into deprivation and forced migration.

b) Water Pollution and Ecosystem Degradation

Coal mining contributes significantly to water pollution through acid mine drainage (AMD) and the release of heavy metals. AMD is a persistent problem in coal-rich regions of Northeast India, notably Meghalaya and Assam, where rivers like the Lukha and Lunar have turned acidic (pH as low as 3–4), decimating fish populations and rendering water unfit for agriculture and human consumption[114]. In Chhattisgarh, mining near rivers has destroyed catchments and floodplains, leading to siltation, pollution, and even changes in river courses, with severe consequences for both biodiversity and local communities[115].

c) Disruption of Protected and Sensitive Ecosystems

Fossil fuel exploration and extraction often encroach on protected areas and eco-sensitive zones, threatening unique and endangered species. For example, the approval of oil and gas exploratory drilling within the eco-sensitive zone of Assam's Hollongapar Gibbon Wildlife Sanctuary has raised alarms over the future of India's only ape, the western Hoolock gibbon, and other rare primates and mammals that depend on the sanctuary's forest corridors[116][117]. Similarly, proposed hydrocarbon exploration in the Gulf of Mannar Biosphere Reserve-a marine biodiversity hotspot-threatens dugongs, turtles, and coral reefs, with potential impacts on local fishing communities and marine food webs[118]. Onshore oil and gas extraction in Rajasthan and Gujarat has disrupted desert ecosystems, affecting species such as the critically endangered Great Indian Bustard (GIB).

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[112] Fernandes, A., Kohli, K., Madineni, A., Samdariya, V., & Muthu, A. (2018). How Coal Mining is Trashing Tigerland. Greenpeace India.

[113] Menon, V., Tiwari, S. K., Ramkumar, K., Kyarong, S., Ganguly, U., & Sukumar, R. (2017). Right of Passage: Elephant Corridors of India (2nd Edition). Wildlife Trust of India.

[114] India Acid Mine Drainage: Why Back 40 Threatens Our Waters

[115] Mines near rivers polluting water, affecting flow, in Chhattisgarh | Latest News India - Hindustan Times

[116] Centre Approves Oil & Gas Drilling in Hollongapar Gibbon Sanctuary, Raising Environmental Concerns

[117] Centre Approves Oil & Gas Drilling in Hollongapar Gibbon Sanctuary's Eco-Sensitive Zone

[118] Proposed hydrocarbon exploration in Gulf of Mannar raises concerns | Latest News India - Hindustan Times

4.5.2.2 Renewable Energy Sector

a) Land-Use Change and Habitat Encroachment from Solar Power

India's ambitious renewable energy targets have led to the rapid expansion of solar and wind projects, often on land that is ecologically valuable. A study by The Nature Conservancy and Microsoft found that over 85% of solar projects in India were built on agricultural or natural land, with only a small fraction sited on degraded land[119]. This trend risks diverting thousands of square kilometres of cropland and natural ecosystems-including grasslands and scrublands that are habitats for endangered species-for solar energy development.

The Khavda Solar Park in Gujarat, one of the world's largest renewable energy parks, is situated in a region that serves as habitat for flamingos, desert foxes, and migratory birds[120]. Conservationists have raised concerns that such projects, if not carefully planned, can threaten the survival of species like the Great Indian Bustard (GIB), which is already critically endangered. The Supreme Court of India has ordered undergrounding of transmission lines in GIB habitats to reduce fatal collisions-a measure that is costly but necessary for species survival[121].

b) Avian and Mammalian Mortality from Wind Energy

Wind farms, particularly in states like Tamil Nadu, Rajasthan, and Karnataka, have been associated with significant bird and bat mortality. Scientific studies have documented that the mean annual animal fatality rate per wind turbine is 0.26, with higher rates in areas along migratory flyways[122]. Raptors, cranes, and other large birds are especially vulnerable to collisions with turbine blades and power lines. Wind installations can also alter the distribution patterns of mammals such as blackbuck and golden jackal, which tend to avoid turbine-dominated sites.

c) Aquatic Ecosystem Impacts from Hydropower

Hydropower projects, both large and small, disrupt river connectivity, alter flow regimes, and fragment aquatic habitats. The Subansiri Lower Hydroelectric Project in Arunachal Pradesh, for example, is expected to block fish migration, change sediment flows, and threaten the livelihoods of downstream communities that depend on natural river cycles[123]. In the Western Ghats, small hydropower projects have been shown to reduce fish species richness and change the composition of freshwater communities, highlighting the need for robust monitoring and mitigation[124].

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[119] Ortiz, A., Negandhi, D., Mysorekar, S. R., Nagaraju, S. K., Kiesecker, J., Robinson, C., Bhatia, P., Khurana, A., Wang, J., Oviedo, F., & Ferres, J. L. (2022). An Artificial Intelligence Dataset for Solar Energy Locations in India. Scientific Data. https://doi.org/10.1038/s41597-022-01499-9

[120] Khavda Solar Park: Largest 30GW Hybrid Renewable Energy Plant

[121] An unusual contest: Great Indian Bustards vs great Indian green energy quest

[122] Windmills A Threat To Birds, Animals In Ch'durga, Gadag | Hubballi News - Times of India

[123] India's new mega-dam will roil lives downstream with wild swings in water flow every day

[124] Impacts of small hydropower projects on freshwater fish communities in the Western Ghats - Centre for Wildlife Studies

4.5.3 Policy and Regulatory Measures for Biodiversity in India's Energy Sector

- **International Frameworks and Standards**

  The energy sector's biodiversity governance is shaped by several international frameworks. The Convention on Biological Diversity (CBD) has specifically addressed mainstreaming biodiversity into the energy and mining sectors since 2017, when it became a focus area for the 14th Conference of Parties (COP-14). The Kunming-Montreal Global Biodiversity Framework (KMGBF), adopted in 2022, provides targets for halting and reversing biodiversity loss by 2030, with implications for energy infrastructure development[125].

  The Sustainable Development Goals (SDGs), especially SDG 15 ("Life on Land"), call for integrating biodiversity conservation into all sectors, including energy. The OECD[126] and IUCN[127] have developed sector-specific guidance and best practices to align renewable power expansion with biodiversity goals, emphasizing strategic planning, cumulative impact assessment, and the mitigation hierarchy.

  Industry-specific international standards include the International Council on Mining and Metals (ICMM) framework, which outlines best practices for biodiversity management. The Cross Sector Biodiversity Initiative (CSBI) provides practical tools like the Timeline Tool that helps energy companies integrate biodiversity considerations throughout project lifecycles[128].

  For disclosure and reporting, the Taskforce on Nature-related Financial Disclosures (TNFD) has developed sector-specific guidance for metals, mining, and energy companies. This framework uses a LEAP approach (Locate, Evaluate, Assess, Prepare) to help companies identify, assess, and disclose nature-related dependencies, impacts, risks, and opportunities[129]. The Global Reporting Initiative (GRI) also offers standards for environmental reporting that energy companies can adopt.

- **National Regulatory Framework**

  India's commitment to biodiversity conservation has taken a significant step forward with the October 2024 update of its National Biodiversity Strategy and Action Plan (NBSAP). This revised strategy is now fully aligned with the Kunming-Montreal Global Biodiversity Framework (KMGBF) and lays out a clear roadmap to halt biodiversity loss by 2030 and to achieve a state of harmony with nature by 2050[130].

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[125] India launches updated National Biodiversity Strategy

[126] OECD (2024), Mainstreaming Biodiversity into Renewable Power Infrastructure, OECD Publishing, Paris, https://doi.org/10.1787/357ac474-en.

[127] Renewable energy and nature | IUCN

[128] UNEP-WCMC (2017) Mainstreaming of Biodiversity into the Energy and Mining Sectors: An Information Document for the 21st Meeting of the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA-21). UNEP-WCMC, Cambridge, United Kingdom.

[129] Anjanappa, J., S. Samant, B. Thakur (2024). Mainstreaming Biodiversity into Power Sector Planning and Policy to Deliver Better Outcomes for Nature and the Climate. Climate Investment Advisory Group (CIAG).

[130] India launches updated National Biodiversity Strategy

At the core of India's legal and institutional framework for biodiversity conservation is the Biological Diversity Act of 2002, which was amended in 2023. This legislation is designed to implement the country's obligations under the Convention on Biological Diversity (CBD), with an emphasis on conservation, sustainable use, and equitable benefit-sharing. It operates through a decentralized, three-tier structure: the National Biodiversity Authority (NBA) at the central level, State Biodiversity Boards (SBBs) at the state level, and over 270,000 Biodiversity Management Committees (BMCs) at the local level. These institutions collectively enable localized monitoring and participatory governance of biodiversity.

The National Biodiversity Action Plan (NBAP) complements this legal framework by integrating biodiversity considerations into sectoral and intersectoral planning, including within the energy and infrastructure sectors. It serves as a guiding document for both national and state-level biodiversity action[131]. For the energy sector in particular, the Ministry of Environment, Forest and Climate Change (MoEFCC) mandates biodiversity assessments for large-scale energy infrastructure through the Environmental Impact Assessment (EIA) Notification of 2006. This requires projects—both fossil fuel-based and renewable—to evaluate biodiversity and ecosystem impacts as a prerequisite for environmental clearance.

Despite these frameworks, several gaps persist in the integration of biodiversity concerns within energy planning. Research has identified challenges such as inadequate biodiversity impact assessments, inconsistencies in regulatory enforcement, and limited cross-sectoral coordination[132]. Policies like the Electricity Act of 2003 and the National Energy Policy do not explicitly mandate biodiversity conservation, although they require compliance with environmental regulations[133]. On the positive side, many State Action Plans on Climate Change (SAPCCs) have begun to include ecosystem restoration and biodiversity targets, particularly in the context of renewable energy expansion.

Recent government initiatives further reflect an evolving approach to biodiversity within development planning. Programs like Amrit Dharohar and MISHTI focus on wetland and mangrove conservation, integrating ecological considerations into energy and infrastructure development[134]. Together, these legal tools, policy instruments, and initiatives represent a growing, though still maturing, commitment to reconciling India's development ambitions with its biodiversity conservation goals.

[131] Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India. (2019). Implementation of India's National Biodiversity Action Plan: An Overview. MoEFCC.

[132] Anjanappa, J., S. Samant, B. Thakur (2024). Mainstreaming Biodiversity into Power Sector Planning and Policy to Deliver Better Outcomes for Nature and the Climate. Climate Investment Advisory Group (CIAG).

[133] Draft National Energy Policy

[134] Press Release: Press Information Bureau

- **Industry Initiatives and Corporate Commitments**

  a) Global Reporting Initiative (GRI) Standards

  GRI 101: Biodiversity 2024: The GRI updated its biodiversity reporting standard in January 2024, replacing GRI 304: Biodiversity 2016. The new standard aligns with the Kunming-Montreal Global Biodiversity Framework (KMGBF) and requires companies to disclose:

  - Adani Green Energy Limited (AGEL) became India's first renewable energy company to achieve GRI South Asia Charter Member Status in 2022, committing to SDG-aligned sustainability reporting.
  - Tata Power and NTPC align with GRI standards for biodiversity disclosures in their solar and thermal power projects.

  b) Taskforce on Nature-related Financial Disclosures (TNFD)

  TNFD provides sector-agnostic recommendations but offers supplementary guidance for metals, mining, and energy sectors (2023–2024).

  - Hindustan Zinc Limited (HZL): Published a TNFD-aligned report (2024), covering smelters, mines, and power plants. Disclosed risks to desert ecosystems and mitigation measures like habitat restoration.
  - Adani Green Energy: Implementing TNFD-aligned strategies, including bird diverter installations and partnerships for captive breeding of endangered species.

  c) Industry-Specific Initiatives

  - Cross Sector Biodiversity Initiative (CSBI): Adopted by ICMM members like Vedanta, it provides tools for applying the mitigation hierarchy (avoid, minimize, restore, offset). Tools like the Timeline Tool integrate biodiversity into energy project lifecycles (exploration to closure). These are used by companies like Greenko Group for hydropower projects in Andhra Pradesh.
  - Solar Energy Corporation of India (SECI): Sustainability guidelines require solar developers to allocate 2% of project costs to biodiversity conservation (e.g., native species plantations).
  - India Business & Biodiversity Initiative (IBBI): Guides companies like NTPC and Adani Green in aligning with CBD targets through biodiversity management plans.
  - LONGi-IUCN Partnership: Solar giant LONGi and IUCN collaborate to align photovoltaic projects with KMGBF goals, promoting "nature-positive" solar farms (e.g., water-saving barriers in coal mine dumps).

4.5.4 Biodiversity Actions in India's Energy Sector

4.5.4.1 Oil and Natural Gas Corporation (ONGC)

ONGC has implemented targeted biodiversity projects, including the translocation of eastern swamp deer from Kaziranga to Manas National Park in Assam, and conservation efforts for the critically endangered Western Hoolock Gibbon in Meghalaya. These initiatives are part

of ONGC's Environment Management Plan (EMP), which includes dedicated funding and the mandatory conduct of Environmental Impact Assessments (EIA) for all projects[135].

The eastern swamp deer translocation project represents a significant conservation achievement. In partnership with Wildlife Trust of India (WTI) and the Assam Forest Department, ONGC supported the first-ever mass capture and translocation of any large ungulate in India. Seventeen eastern swamp deer were successfully moved from Kaziranga to Manas National Park, with the first fawn born in March 2017 marking a milestone for the project. This initiative is particularly important as the eastern swamp deer faces a more urgent threat of extinction than India's rhinos, tigers, or elephants, with just about a thousand individuals remaining in a single population in Kaziranga.

ONGC's conservation efforts extend beyond project-specific initiatives. The company has formalized its commitment through a comprehensive Biodiversity Policy that outlines clear goals and actions to preserve and enhance biodiversity in its operational areas. Regular activities include tree plantation initiatives using native varieties of flora around project sites and the development of green belts around installations to retain biodiversity in surrounding areas.

These efforts have yielded measurable results: over 50 swamp deer have been successfully translocated, contributing to population recovery in Manas. In Meghalaya's community-managed forests, ONGC-supported initiatives have helped protect 85% of the Western Hoolock Gibbon's habitat, benefiting one of the world's most endangered primates with only about 3,000 individuals remaining in northeast India[136].

4.5.4.2 Adani Green Energy Limited (AGEL)

Adani Green Energy Limited (AGEL) has made biodiversity conservation a core pillar of its environmental strategy, underpinned by a company-wide commitment to achieve No Net Loss (NNL) of biodiversity by FY 2024–25. As a signatory to the India Business and Biodiversity Initiative (IBBI), AGEL aligns its biodiversity roadmap with global frameworks such as the Taskforce on Nature-related Financial Disclosures (TNFD), integrating nature-related risk assessments into its Environmental, Social, and Governance (ESG) governance[137]. This integrated approach ensures that expansion takes place only on uninhabitable and uncultivable lands, thereby minimizing ecological disruption and prioritizing habitat preservation, ecological restoration, and sustainable land use—especially in the context of renewable energy development[138].

This commitment is particularly evident at AGEL's flagship 30 GW Khavda Solar Park in Gujarat, where biodiversity safeguards focus on protecting the critically endangered Great Indian

[135] ONGC Ltd CSR Spending Report of Rs. 634 Cr for FY 2023-24

[136] ONGC reports are currently not available online, since the websites appear to be under maintenance; hence this report relies on third-party information sources and analysis.

[137] adani-group-esg-report-fy-22-23-executive-summary.pdf

[138] Land Use and Biodiversity

Bustard (GIB). Guided by its NNL policy, AGEL has implemented several mitigation measures including underground cabling, insulation sleeves on transmission lines, and designated habitat restoration zones to limit ecological disturbance. These initiatives align with directives from India's Supreme Court, which mandated bird diverters on transmission lines in Gujarat and Rajasthan to safeguard the GIB, recognizing overhead lines as a major threat to the species. AGEL's compliance with these mandates has led to a significant 70% reduction in bird collisions through the use of bird diverters and flagged poles, demonstrating tangible biodiversity outcomes.

In parallel with site-level conservation, AGEL plays a key role in the Adani Group's broader reforestation and biodiversity agenda[139]. The group has pledged to grow 100 million trees by 2030 under the World Economic Forum's 1t.org Trillion Trees Platform—India's largest such commitment[140]. Of this, AGEL has contributed to the plantation of 7.85 million trees to date. The initiative includes 37.10 million mangrove trees aimed at enhancing marine biodiversity, protecting coastlines, supporting fisheries, and preventing saline water intrusion, while also generating livelihoods for coastal communities. The remaining 63.08 million terrestrial trees are intended to improve air quality, support groundwater recharge, stabilize soils, and enrich biodiversity. By emphasizing native species in its afforestation drives, AGEL ensures ecological resilience and contributes meaningfully to long-term environmental stewardship.

Through its holistic and science-aligned approach, AGEL is positioning itself as a leader in integrating biodiversity goals within the clean energy transition, demonstrating that renewable energy development and nature conservation can go hand in hand[141].

4.5.4.3 Greenko Group

Greenko has positioned sustainability and biodiversity conservation at the heart of its business strategy, demonstrating strong environmental, social, and governance (ESG) leadership across its operations. In FY 2023–24, the company avoided 9.4 million tonnes of CO_2 equivalent emissions, underscoring its commitment to decarbonization and climate action. As part of its sustainability roadmap, Greenko conducted comprehensive water audits across ten of its asset sites, with four achieving water-positive status and one nearing water neutrality—significantly reducing the projects' environmental impact on freshwater ecosystems[142].

Central to Greenko's ESG approach is the integration of biodiversity into infrastructure development. Through its "Mission 3: Biodiversity," the company has become a member of the India Business and Biodiversity Initiative (IBBI), signalling its commitment to mainstreaming biodiversity into operational and strategic planning. In FY 2023–24, climate change and biodiversity risk assessments were conducted across fourteen asset sites and at the

[139] Adani ESG 2023.pdf

[140] Growing 100 million trees by 2030 | 1t.org

[141] Adani Green Energy Limited (AGEL). (2023). ESG Report 2022-23: Building a Better Tomorrow. Adani Green Energy Limited.

[142] Greenko Group

Pinnapuram Pumped Storage Project (PSP), ensuring ecological considerations are embedded into the company's long-term decision-making[143].

Greenko's projects prioritize land-use planning to minimize ecological disruption, expanding only into low-impact zones while implementing compensatory afforestation and structured habitat protection measures. These efforts are closely aligned with national biodiversity conservation frameworks. The company has also adopted circular economy principles, establishing a repair facility for wind plant components, which enabled the reuse of 204 repaired parts across eight sites—reducing waste and resource use in its operations[144].

Beyond infrastructure, Greenko has launched several on-ground biodiversity initiatives. At its Rayala Wind Power Project in Andhra Pradesh, the company established organic farms and planted nectar-rich flora to support pollinator health, resulting in a 30% increase in butterfly diversity within the project area. Produce from these farms is used in the site's cafeteria, further promoting sustainability through local and organic sourcing.

Greenko's commitment to ecological stewardship extends to critical wildlife habitats. The company has adopted the Rollapadu Wildlife Sanctuary in Andhra Pradesh, a protected area established in 1982 for the conservation of the critically endangered Great Indian Bustard (GIB). The sanctuary, home to other rare species like the Lesser florican, Demoiselle crane, Black and White storks, and Harriers, has benefited from Greenko's habitat restoration efforts covering over 500 hectares of grassland ecosystems.

Furthermore, Greenko collaborates with WWF-India to support the conservation of Olive Ridley turtles along India's coastline. This initiative includes hatchery management, nesting site monitoring, community training, and awareness campaigns among fishing communities. Through this partnership, Greenko demonstrates how renewable energy companies can contribute meaningfully to biodiversity conservation even beyond their immediate areas of operation.

Together, these initiatives reflect Greenko's holistic and forward-looking approach to sustainability—where renewable energy development goes hand-in-hand with biodiversity resilience, ecosystem restoration, and community engagement[145].

4.5.4.4 NTPC Limited

NTPC Limited, India's largest integrated energy producer, has emerged as a frontrunner in biodiversity conservation within the power sector. It was the first public sector undertaking (PSU) to release a Biodiversity Policy in 2018, which was renewed in 2022 to reinforce its commitment to biodiversity conservation, restoration, and enhancement across the project lifecycle. Aligned with the UN Convention on Biological Diversity (CBD) and India's National

[143] Greenko Group. (2024). Crafting Tomorrow, Today: Storage, Stability, Sustainability – Integrated Report 2023-24. Greenko Group.

[144] Greenko Integrated Report 2022

[145] Greenko Group

Biodiversity Action Plan (NBAP), the policy forms a core component of NTPC's Environmental Policy and mainstreams biodiversity into its entire value chain. It mandates a precautionary approach in decision-making and addresses local biodiversity threats beyond NTPC's immediate business activities[146]. The policy guides NTPC's professionals in avoiding operations in areas with high biodiversity value, undertaking judicious site selection, and conducting biodiversity assessments for all new and existing projects. NTPC targets a "no net loss" of biodiversity at all operational sites and strives for a net positive impact wherever feasible. To mitigate unavoidable impacts, it prepares Biodiversity Management Plans that focus on rare, endangered, and medicinal species, while ensuring compliance with environmental, forest, and wildlife regulations.

NTPC's biodiversity initiatives are broad-based and collaborative. The company engages with local communities, regulatory agencies, and research institutions to promote biodiversity awareness and capacity-building. A major initiative is its five-year agreement with the Andhra Pradesh Forest Department for Olive Ridley Turtle conservation. Supported by NTPC's funding and community participation, the number of hatchlings released into the sea has increased by 2.25 times since the intervention began[147]. Afforestation is another major thrust area. NTPC has committed to planting 47 million tree saplings by 2032 and had already planted 39 million by FY 2023–24. Its renewable energy arm is also advancing biodiversity-conscious development through a 10 GW solar park in Rajasthan, integrating ecological safeguards into project design and operation.

Governance of NTPC's sustainability agenda is overseen by a Board-level Corporate Social Responsibility and Sustainability Committee and a management-level ESG and Climate Change Committee. The company's progress in sustainable water use has been recognized with an improvement in its CDP Water Security Rating from 'D' to 'C' in 2023. NTPC is also a signatory to the CEO Water Mandate, underscoring its commitment to responsible water and resource management[148].

4.5.4.5 Tata Power

Tata Power, one of India's largest integrated power companies, has made biodiversity conservation a core pillar of its sustainability strategy, aligning its operations with national and global environmental goals. The company's commitment is reflected in its stated objective of achieving "no net loss of biodiversity by 2030," as part of its broader decarbonisation and ESG roadmap. Tata Power's approach is holistic, spanning afforestation, species conservation, ecosystem restoration, and stakeholder engagement across its extensive portfolio of thermal, hydro, solar, and wind assets[149].

Tata Power's Board-level oversight ensures that biodiversity is integrated into all major business decisions. The company has adopted biodiversity risk assessments and Biodiversity

[146] NTPC Limited. (2022). Biodiversity Policy 2022. NTPC Ltd.

[147] NTPC releases Biodiversity Policy for conservation and restoration of biodiversity | NTPC Limited

[148] NTPC Limited. (2024). Business Responsibility and Sustainability Report – Financial Year 2023-24. NTPC Ltd.

[149] Tata Power Company Limited. (2024). Integrated Annual Report 2023-24. Tata Power.

Management Plans (BMPs) for key projects, implementing these in line with global best practices and international frameworks such as the UN Sustainable Development Goals (SDGs). Tata Power's Integrated Annual Report and Business Responsibility & Sustainability Report (BRSR) for FY24 highlight biodiversity as a material issue, with specific risks identified-including habitat fragmentation and loss of protected species-alongside mitigation strategies[150].

Flagship Initiatives and On-Ground Impact

- **Afforestation:** Since 1972, Tata Power has conducted mega afforestation drives, planting over 4.5 million native trees to restore and enhance green cover across its project sites and catchment areas. GhanVan is a large-scale afforestation initiative led by Tata Power in collaboration with the ICICI Foundation, aimed at promoting biodiversity conservation and community empowerment in Maharashtra's Western Ghats. The project focuses on planting 2.5 lakh indigenous trees across Khopoli and Bhira, enhancing ecological resilience and restoring degraded landscapes[151]. The "Tree Mittra" program alone has resulted in the planting of over a million trees annually, with a focus on indigenous species and ecosystem resilience[152].
- **Aquatic and Species Conservation:** Tata Power's five-decade-long "Act for Mahseer" initiative is a globally recognized conservation program that successfully brought the blue-finned mahseer off the IUCN Red List, demonstrating the company's long-term commitment to aquatic biodiversity[153]. The company also supports sea turtle monitoring, bird conservation around the Trombay Thermal Plant, and mangrove restoration in coastal areas.

  Tata Power has been a pioneer in corporate-led mangrove conservation in India. In 2012, the company initiated a project to plant and regenerate mangroves over 25 hectares in Navi Mumbai, collaborating with the M.S. Swaminathan Research Foundation (MSSRF) and the Maharashtra Forest Department. The project involved clearing blockages to restore tidal water flow for natural regeneration and planting approximately 50,000 mangrove seedlings in degraded areas. Local community members participated in the plantation efforts, receiving training from MSSRF experts. The project was estimated to cost around ₹55 lakh. Over time, Tata Power's mangrove restoration initiatives have expanded, leading to the restoration of over 250 hectares and a 30% increase in fish diversity in these areas.
- **Biodiversity Action Plans:** Tata Power is rolling out biodiversity assessments and action plans across all its thermal, hydro, and major renewable energy sites, aiming to complete assessments for all wind and large solar sites by 2023. These plans are tailored to local ecological contexts and are implemented in partnership with scientific institutions and local communities.

[150] Tata Power Company Limited. (2024). Business Responsibility and Sustainability Report – Financial Year 2023-24. Tata Power.

[151] Ghanvan

[152] Unveiling Tata Power's Sustainability Odyssey: An Interview with Mr. Himal Tewari, CHRO, Chief- CSR and Sustainability

[153] Unveiling Tata Power's Sustainability Odyssey: An Interview with Mr. Himal Tewari, CHRO, Chief- CSR and Sustainability

Tata Power's efforts have been recognized with the UNDP Mahatma Award for Biodiversity, underscoring its leadership in corporate biodiversity action. The company's "Climate Crew" program cultivates employee champions for sustainability, while the "Anokha Dhaaga" initiative empowers local communities through livelihood opportunities linked to conservation, such as the development of native products like tiger grass in Jharkhand.

Tata Power's sustainability reports detail its progress on biodiversity and water conservation, including rainwater harvesting, sewage treatment, and a pioneering water footprinting exercise at key locations. The company is also committed to zero waste to landfill and water neutrality by 2030, further supporting its biodiversity objectives.

4.5.4.6 NHPC Limited

NHPC Limited, India's premier hydropower company, has embedded biodiversity conservation into its core business strategy, guided by a comprehensive Biodiversity Policy (2023)[154] that extends its Corporate Environment Policy. This policy underscores NHPC's commitment to sustainable development, environmental stewardship, and the integration of biodiversity considerations at every stage of project planning, execution, and operation. The policy mandates strict compliance with all environmental, forest, and wildlife regulations, and emphasizes proactive biodiversity management, including the protection of indigenous and endemic species, habitat restoration, and voluntary conservation initiatives beyond statutory requirements. NHPC's approach is multi-tiered, with corporate, regional, and project-level responsibilities for planning, monitoring, and implementing biodiversity actions. The company ensures suitable budgetary provisions for biodiversity conservation and collaborates with state forest departments and expert organizations for afforestation, catchment area treatment, and the development of ex-situ conservation sites such as herbal parks, butterfly gardens, and orchidariums[155].

NHPC's hydroelectric projects are typically located in remote, biodiversity-rich areas of the Himalayas and Northeast India. Detailed Environmental Impact Assessments (EIA) are conducted for all projects, with project-specific conservation measures integrated into Environmental Management Plans (EMP). Key initiatives include:

- **Catchment Area Treatment (CAT):** NHPC implements extensive CAT measures (such as check dams, gabion walls, bioengineering, and native species plantation) to control soil erosion and enhance vegetation cover, resulting in the restoration of large tracts of degraded land[156].
- **Ex-situ and In-situ Conservation:** The company has developed botanical gardens, arboretums, orchidariums (e.g., at Subansiri Lower HE Project, Arunachal Pradesh), and butterfly parks (e.g., Teesta-V Power Station, Sikkim), in partnership with local forest departments, to conserve rare and endemic flora and fauna. In-situ measures include habitat improvement, anti-poaching activities, and the preservation of biologically rich areas, such as the Parbati Valley Conservation Cell near the Great Himalayan National Park.

[154] NHPC Biodiversity Policy, 2023.pdf

[155] NHPC, fisheries dept sign MoA | The Arunachal Times

[156] Key Areas - NHPC India

- **Compensatory Afforestation:** NHPC has afforested over 13,000 hectares of degraded/ non-forest land in lieu of forest land diverted for projects, planting more than 10 million trees across 16 projects. These plantations use local species and provide nesting grounds for birds and wildlife, contributing to landscape-level biodiversity enhancement.
- **Restoration of Muck Dumping Sites:** NHPC restores muck disposal and quarry sites using biotechnological approaches and native vegetation, converting degraded areas into lush green zones that blend with the natural landscape.
- **Community Engagement:** The company undertakes voluntary plantation drives, supports the preservation of traditional ecological knowledge, and collaborates with local communities for conservation awareness and sustainable livelihoods.

NHPC's sustainability reporting is aligned with GRI Standards and includes detailed disclosures on biodiversity, afforestation, and environmental management. In FY 2022-23, NHPC spent INR 127.31 crore on CSR, with a significant portion directed to environmental and biodiversity initiatives. The company's ESG performance is recognized as the highest among Indian power generating CPSEs by S&P Global[157].

Fish Ladders and Fisheries Management

NHPC, India's premier hydropower company, has recognized the critical need to sustain aquatic biodiversity, particularly migratory fish species that are adversely affected by dam infrastructure. In response, NHPC has implemented fish ladders at select projects—most notably at the Teesta Low Dam Project-III (TLDP-III) in West Bengal—to facilitate fish migration and maintain riverine ecology[158]. While the effectiveness of such structures in Indian rivers remains contested, NHPC continues to explore and implement them where feasible.

A prominent example is the Kurichhu Hydropower Project in Bhutan, constructed by NHPC, which features a pool-and-weir type fish ladder designed by the Central Inland Fisheries Research Institute (CIFRI). This structure includes submerged orifices and central notches, designed to release 0.8 cumecs of water to support fish movement. Despite these efforts, the South Asia Network on Dams, Rivers and People (SANDRP) has reported concerns about the ladder's efficacy, citing instances of overfishing at fish concentration points, which undermines the purpose of the ladder[159]. This illustrates that technical solutions alone are insufficient without adequate enforcement and community regulation.

In India, most hydropower projects still lack provisions for fish passage. For instance, projects under construction in Uttarakhand have generally excluded such features. Where mitigation is attempted, it often emphasizes fish breeding and stocking—rather than enabling natural migration—revealing a major gap in hydropower-related biodiversity conservation.

To strengthen its commitment, NHPC has initiated broader fisheries management strategies. For the Subansiri Lower Hydroelectric Project in Arunachal Pradesh, NHPC signed a

[157] NHPC Limited. (2024). Sustainability Report 2022-23: Clean Energy for a Sustainable Future. NHPC Limited.

[158] NHPC Limited. (2022). Hydropower for Sustainability: Sustainability Report 2021-22. NHPC Ltd.

[159] Fish Ladder at Kurichhu Hydropower Project, Bhutan: Some thoughts – SANDRP

Memorandum of Agreement (MoA) with the state's Fisheries Department to implement a Fisheries Management Plan[160]. This includes the establishment of hatcheries for species such as golden mahseer, snow trout, and Indian major carps, and the release of fingerlings both upstream and downstream of the dam to support ecological balance. NHPC also complies with regulatory requirements for maintaining environmental flows, collaborates with state agencies for biodiversity monitoring, and supports conservation efforts across project sites.

These actions align with broader national concerns, such as those raised by the National Mission for Clean Ganga (NMCG), which has acknowledged the severe impacts of dams on migratory species like hilsa and golden mahseer. The NMCG has launched strategies to restore aquatic biodiversity in the Ganga Basin, emphasizing that hydropower development must integrate meaningful ecological safeguards.

4.5.5 Key Constraints to Biodiversity Actions

Despite growing corporate commitments to biodiversity conservation, India's energy sector faces significant constraints in implementing effective biodiversity actions. These challenges span regulatory, technical, financial, and operational dimensions.

- **Regulatory and Policy Constraints:** The renewable energy sector lacks a dedicated legal framework for biodiversity integration. While the Biological Diversity Act exists, it isn't tailored for large-scale renewable deployment. This regulatory gap is evident in cases like the Great Indian Bustard (GIB) habitat in Gujarat and Rajasthan, where renewable energy projects were approved in critical ecosystems without adequate safeguards. As noted in recent analyses, government records often classify ecologically valuable grasslands as "revenue wastelands," making them available for industrial development without proper biodiversity assessments. The misclassification of Open Natural Ecosystems (ONEs) as wastelands has particularly affected species like the GIB, which has suffered population declines due to collisions with power lines from renewable energy installations. Even companies like Adani Green Energy, which has partnered with NGOs for GIB conservation through captive breeding programs, face the fundamental challenge that these birds will eventually need safe habitats free from overhead power lines-a constraint that requires systemic policy changes beyond corporate initiatives.
- **Technical and Implementation Challenges:** Energy companies struggle with the technical aspects of biodiversity conservation. For instance, while NTPC has established a dedicated biodiversity policy and is developing a 10 GW renewable energy park in Rajasthan, the practical implementation of biodiversity-friendly infrastructure at scale remains challenging. Similarly, ReNew Power has installed bird diverters on transmission lines in Gujarat to protect migratory flamingos, but these solutions address symptoms rather than root causes of habitat disruption. The "compensatory afforestation" approach often fails to deliver meaningful biodiversity outcomes. As highlighted in recent research, many compensatory plantations use exotic, fast-growing species with "zero native biodiversity conservation value," functioning primarily as carbon sinks rather than true ecosystem

[160] NHPC, fisheries dept sign MoA | The Arunachal Times

replacements. This represents a form of "greenwashing" that doesn't address the fundamental loss of habitat functionality.

- **Monitoring and Assessment Limitations:** Long-term biodiversity monitoring remains inadequate across the sector. While some progressive initiatives exist-such as Tata Power's "Act for Mahseer" program that successfully removed the Blue-Finned Mahseer from the IUCN's endangered list after 52 years of conservation efforts-most companies lack comprehensive biodiversity assessment frameworks. Only a few state forest departments, including those in Madhya Pradesh, Maharashtra, and Uttarakhand, have initiated systematic bird and butterfly counts in protected areas. ONGC's approach illustrates this constraint: while the company conducts Environmental Impact Assessments and allocates funds for biodiversity conservation in its Environment Management Plan, these efforts often focus on compliance rather than ecosystem-level outcomes. The lack of standardized, science-based monitoring protocols limits the sector's ability to measure true biodiversity impacts and adapt strategies accordingly.

4.5.6 Outlook

India's energy sector stands at a pivotal juncture where biodiversity conservation is emerging as a strategic imperative rather than a regulatory burden. The sector is witnessing several promising trends:

- The adoption of TNFD recommendations is gaining momentum among larger corporations, with expectations of faster and deeper integration compared to earlier climate frameworks
- Coal and Lignite PSUs have committed to ambitious afforestation targets of 15,350 hectares over the next five years, creating carbon sinks of approximately 2.5 million tonnes of CO_2 equivalent annually
- Innovative approaches like SiteRight[161] are enabling strategic land-use planning that could help India meet its renewable energy goals while protecting critical habitats.

Research by The Nature Conservancy indicates India has 12 times the land needed for solar and wind energy on degraded lands with low ecological value, presenting a significant opportunity to avoid the potential threat to 1.16 million hectares of forest land. The transition to renewables, while challenging, offers the energy sector a chance to emerge as a leader in biodiversity protection through mainstreaming the mitigation hierarchy, optimizing project footprints, and integrating biodiversity considerations throughout project lifecycles.

As India's updated National Biodiversity Strategy and Action Plan provides a roadmap to halt biodiversity loss by 2030, the energy sector's proactive embrace of natural capital accounting and biodiversity-inclusive planning will be crucial for securing both energy security and ecological resilience in the decades ahead.

[161] SiteRight | The Nature Conservancy India

4.6 Textiles sector in India

4.6.1 Overview

The textile and apparel industry contributes 2.3% to our GDP, 13% to industrial production, and 12% to exports. India exported textile items worth US$ 34.4 billion in 2023-24, with apparel constituting 42% of the export basket, followed by raw materials/semi-finished materials at 34% and finished non-apparel goods at 30%[162]. After agriculture, it is also the second largest employment generator, with over 45 million people employed directly, including many women and the rural population. As further evidence of this industry's inclusive nature, nearly 80% of its capacity is spread across the country's Micro, Small, and Medium Enterprises (MSME) clusters.

The global textile market size as of 2020 was USD 1,000 billion and is expected to grow at a compound annual growth rate (CAGR) of 4.4% between 2021 and 2028[163].

The Indian textile industry is highly complex, with numerous players involved. This poses significant challenges for garment manufacturers seeking to shift to sustainable practices. The supply chain's decentralised structure, lack of manufacturer abilities and cultural/language barriers hamper the adoption of sustainable initiatives.

[162] Press Release: Press Information Bureau

[163] Executive Summary - UNEP Sustainability and Circularity in the Textile Value Chain A Global Roadmap.pdf

> India has emerged as a major player in the cotton sector and may overtake China in the next decade in output"
>
> Terry P Townsend, Executive Director, International Cotton Advisory Committee

4.6.2 Biodiversity impacts of the textiles sector

The textile industry has a significant impact on the environment, due to its multiple intersections and dependencies on natural resources. With its high stakes in agricultural commodities and water sources, and significant purchasing power, apparel and textiles companies can drive meaningful change for nature and people across farms, landscapes, watersheds, and the entire fashion sector by making ambitious commitments and engaging in collaborative action. Here is an overview of how biodiversity underpins the textile industry:

1. Raw Material Sources

Many textiles originate directly from biodiversity—natural fibres, dyes, and auxiliary materials come from plants, animals, and even microorganisms. Raw materials used in the textile industry such as rayon, viscose, and lyocell are semi-synthetic fibres derived from wood pulp, such as eucalyptus and bamboo, which rely on sustainable forest biodiversity. Some of the commonly used fibre sources are also described below:

Plant-based fibres: Cotton is one of the most widely used natural fibres; its cultivation depends on healthy ecosystems and biodiversity (e.g., pollinators and soil microbes). Flax (linen), hemp, jute, ramie, etc., are derived from various plant species. The cotton production in India during 2023–24 was around 343.11 lakh bales (each bale is 170 kg), equivalent to 5.83 million tonnes[164]. The area under cultivation was around 12.47 million hectares[165], while the yield was 461 kg per hectare. India ranks as the second-largest cotton producer globally, contributing about 23.83% of the world's cotton production.[166].

Animal-based fibers like wool (from sheep), alpaca, cashmere, and silk (from silkworms) all rely on healthy populations of domesticated or semi-wild species. The wool production in India during 2023–24 was around 33.69 million kg, marking a slight increase of 0.22% over the previous year[167]. The top-producing states[168] were Rajasthan with 47.53% of national production, Jammu & Kashmir with 23.0%, Gujarat with 6.1%, Maharashtra with 4.7% and Himachal Pradesh with 4.2%[169]. However, unsustainable sheep grazing for wool in

[164] https://pib.gov.in/PressReleaseIframePage.aspx?PRID=2077745

[165] https://texmin.gov.in/sites/default/files/Note%20on%20Cotton%20Sector.pdf

[166] https://texmin.gov.in/sites/default/files/Note%20on%20Cotton%20Sector.pdf

[167] https://pib.gov.in/PressReleaseIframePage.aspx?PRID=2077745

[168] https://www.dahd.gov.in/sites/default/files/2024-10/AnnualReport202324.pdf

[169] https://www.indiastat.com/data/agriculture/wool-production/data-year/2024

fragile Himalayan ecosystems is contributing to significant biodiversity loss and ecological degradation. Some of the key impacts[170] are highlighted below:

Ecological Impacts of Unsustainable Grazing

a. **Alteration of Insect Populations** A 15-year study in the Spiti Valley by researchers from the Indian Institute of Science revealed that replacing native herbivores with livestock, such as sheep, led to a substantial decline in spider populations and a rise in ticks and mites. This shift disrupts predator-prey dynamics and increases the risk of vector-borne disease[171]

b. **Vegetation Degradation:** Overgrazing by sheep and other livestock has led to the degradation of alpine grasslands and forests. Grazing during the spring hampers the regeneration of seedlings, while trampling damages young plants and exposes roots, leading to plant mortality. Selective grazing alters plant community composition, favouring unpalatable species and reducing overall biodiversity[172]

c. **Soil Compaction and Erosion** Intensive grazing compacts the soil, reducing its porosity and aeration. This impairs seed germination and water infiltration, leading to increased surface runoff and soil erosion. The loss of vegetative cover further exacerbates these issues, resulting in degraded land[173]

Data Highlights

- **Arthropod Study** Monitoring over 25,000 arthropods across 88 taxa in Spiti Valley showed significant differences in insect populations between areas grazed by livestock and those grazed by wild herbivores[174].
- **Soil and Vegetation** Research in the southeastern Qinghai-Tibetan Plateau indicated that heavy grazing reduced aboveground biomass and soil organic matter, while increasing unpalatable plant species[175]

Silk farming (sericulture) is also practised in many regions in biodiversity-friendly ways, especially when linked with traditional agroforestry systems, host plant diversity, and low chemical input methods. Here's a quick breakdown of where and how this happens in India:

[170] https://iisc.ac.in/events/livestock-grazing-influences-insect-populations-in-the-himalayas

[171] https://phys.org/news/2025-02-livestock-grazing-insect-populations-himalayas.html

[172] https://www.schoolnet.org.za/PILAfrica/en/webs/10131/proble_7.htm

[173] https://www.schoolnet.org.za/PILAfrica/en/webs/10131/proble_7.htm

[174] https://www.eurasiareview.com/21022025-livestock-grazing-influences-insect-populations-in-the-himalayas

[175] https://www.tandfonline.com/doi/full/10.1080/11956860.2019.1710908

Biodiversity-Friendly Silk Practices in India

Tasar Silk – Forest-Based & Biodiversity-Rich

Tasar silk production is rooted in forest-based, biodiversity-rich regions across Jharkhand, Chhattisgarh, Odisha, West Bengal, and Maharashtra. It relies on naturally occurring host plants such as Terminalia arjuna and Terminalia tomentosa—commonly known as arjun and asan trees. The eco-friendly nature of this practice is underscored by the rearing of Tasar silkworms on these trees, which grow along forest fringes without the need for artificial inputs. This system promotes community forestry and the sustainable use of non-timber forest products. Crucially, the absence of pesticide use and reliance on natural cycles makes Tasar silk an environmentally responsible choice. Additionally, it fosters tree conservation and supports agroforestry-based livelihoods, strengthening both ecological and economic resilience in forest-dependent communities.

Eri Silk – Zero-Kill, Sustainable Option

Eri silk, primarily cultivated in Assam, Meghalaya, and Nagaland, represents a highly sustainable and ethical form of silk production. It is derived from silkworms that feed on host plants such as castor, tapioca, and kesseru, which are commonly found in home gardens and integrated into traditional tribal agroecological systems. Uniquely, Eri silk is known as “non-violent” or “ahimsa” silk, as the cocoons are harvested only after the moths naturally emerge, avoiding the killing of silkworms. This practice not only aligns with ethical and ecological values but also supports in-situ conservation of local plant species. Moreover, the host plants serve multiple functions, enhancing food security and contributing to diversified, organic farming systems in the region.

Muga Silk – Indigenous & Endemic

Muga silk, an indigenous and endemic silk variety, is uniquely produced in Assam, particularly in the Brahmaputra Valley. It is derived from wild and semi-domesticated silkworms that feed on native Som and Soalu trees. Known for its natural golden hue and durability, Muga silk production is deeply intertwined with the region’s ecological integrity. The silkworms are extremely sensitive to environmental pollution, which necessitates pristine and biodiverse surroundings for their cultivation. As a result, Muga silk encourages the preservation and plantation of native tree species and relies on minimal chemical input, making it both ecologically sensitive and supportive of sustainable forest-based livelihoods.

Additional Biodiversity Benefits

- **Pollinator Support:** Many sericulture plantations host flowering species that attract bees and butterflies.
- **Carbon Sequestration:** Tree-based sericulture systems (especially Tasar) help offset carbon emissions.
- **Livelihoods + Conservation:** Practised largely by tribal and marginal communities, creating incentives to protect local ecosystems rather than degrade them.

2. Natural Dyes and Finishes

Historically, natural dyes were derived from plants (like indigo and madder), insects (cochineal), and other biological sources. There is renewed interest in these due to environmental concerns with synthetic dyes.

3. Ecosystem Services Supporting Production

Ecosystems play a vital role in sustaining cotton and dye plant cultivation by supporting key ecological functions. Pollination, essential for crops like cotton and various natural dye plants, is facilitated by diverse pollinator species thriving in healthy ecosystems. Additionally, microbial biodiversity and soil invertebrates such as earthworms contribute to maintaining soil fertility and structure, which are critical for plant growth. The presence of natural predators and a balanced ecosystem further helps control pest populations, thereby reducing the reliance on harmful chemical pesticides and promoting more sustainable agricultural practices.

In India, cotton cultivation is responsible for **50 to 60 % of the country's insecticide use,** despite occupying only around 5% of the total cultivated area, leading to soil and water contamination that adversely affects various species.[176]. According to the Indian Council of Agricultural Research (ICAR) and several agronomic studies, cotton cultivation in India accounts for nearly 54% of the country's total insecticide usage by volume. This disproportionately high usage is largely driven by intense pest pressure, particularly from bollworms, whiteflies, and aphids. Prior to the introduction of Bt cotton in 2002, insecticide consumption in cotton was even higher, often exceeding 60% of the national total. While the adoption of Bt cotton initially led to a significant decline in insecticide use, this trend reversed over time as pests such as the pink bollworm developed resistance, leading to a renewed increase in pesticide applications.

The exceptionally high insecticide usage in cotton cultivation can be attributed to two key factors. First, cotton is typically grown as a monoculture with a long growing season, which makes it particularly susceptible to persistent and diverse pest attacks. Second, there has been a historical overreliance on chemical control methods rather than adopting integrated pest management (IPM) practices. This dependence on pesticides, without adequate use of ecological or preventive approaches, has significantly contributed to the heavy volume of insecticides used in cotton farming.

Also, the application of chemical fertilisers and pesticides in Indian cotton cultivation has exhibited notable trends over recent decades, influenced by technological advancements, policy interventions, and sustainable farming practices. Over the past few decades, fertilizer and pesticide usage in cotton cultivation across India has seen significant shifts, influenced by technological adoption, regional agronomic practices, and sustainability initiatives.

Between 1978–79 and 2009–10, fertilizer use in cotton cultivation grew at an average annual rate of 2.58% nationwide. The introduction of Bt cotton notably accelerated this

[176] 'Fashion industry degrading world's biodiversity' - Fibre2Fashion

trend, particularly in states like Haryana and Gujarat, which recorded steep annual growth rates of 14.95% and 13.97%, respectively, during the Bt adoption phase. However, the trends varied across regions. In Punjab, fertilizer application surged from under 80 kg/ha in 1996–97 to over 230 kg/ha by 2011–12, before declining to a range of 160–193 kg/ha in subsequent years. Similarly, Haryana saw an increase from under 60 kg/ha in 1996–97 to over 155 kg/ha by 2010, later stabilizing between 121–139 kg/ha.

Pesticide usage in India also followed an upward trajectory, with national pesticide consumption rising from 40,000 tons in 2005–06 to 63,000 tons by 2021–22, reflecting the expansion of input-intensive agriculture. Cotton remains the most pesticide-dependent crop, accounting for approximately 99% of chemical pesticide usage among crop groups. Integrated Pest Management (IPM) practices have shown promise in reducing chemical dependence. IPM adoption in cotton cultivation has resulted in a 29.96% to 50.5% decrease in chemical pesticide sprays, while the use of biopesticides—especially neem-based products—has grown significantly, increasing from 123 metric tons in 1994–95 to 7,682 metric tons in 2018–19.

Further promoting sustainability, the Better Cotton Initiative (BCI) has led to notable improvements. Between the 2014–17 and 2021–22 seasons, BCI farmers achieved a 53% reduction in overall pesticide use. The proportion of farmers using highly hazardous pesticides declined sharply from 64% to 10%, and the use of Monocrotophos fell from 41% to just 2%. Additionally, nitrogen fertilizer application per hectare decreased by 6%, contributing to lower greenhouse gas emissions.

Further, wetlands and forests help ensure clean water for crop irrigation and dyeing processes. The global textile industry utilises approximately 79 trillion litres of water annually.[177]. Textile production accounts for about 20% of global industrial water pollution, primarily due to the discharge of untreated effluents containing dyes and chemicals into water bodies.[178].

4. Cultural and Aesthetic Inspiration

Textile patterns and traditions often draw from the natural world, especially in indigenous and traditional textiles. Loss of biodiversity can also mean loss of cultural heritage. Biodiversity loss in turn, poses significant risks to the cotton and natural dye sectors, undermining both ecological stability and economic viability. One of the primary risks is increased crop vulnerability—monoculture systems, which dominate conventional cotton farming, are particularly susceptible to pest outbreaks and climate variability. The decline in biodiversity also affects the quality and availability of natural fibres and dye plants, as many of these rely on specific ecological conditions and native species that are disappearing. Additionally, ecosystem degradation—manifesting in the form of water scarcity, declining soil fertility, and erosion—leads to increased input costs and reduced productivity, threatening the long-term sustainability of the sector.

[177] Textile - Wikipedia

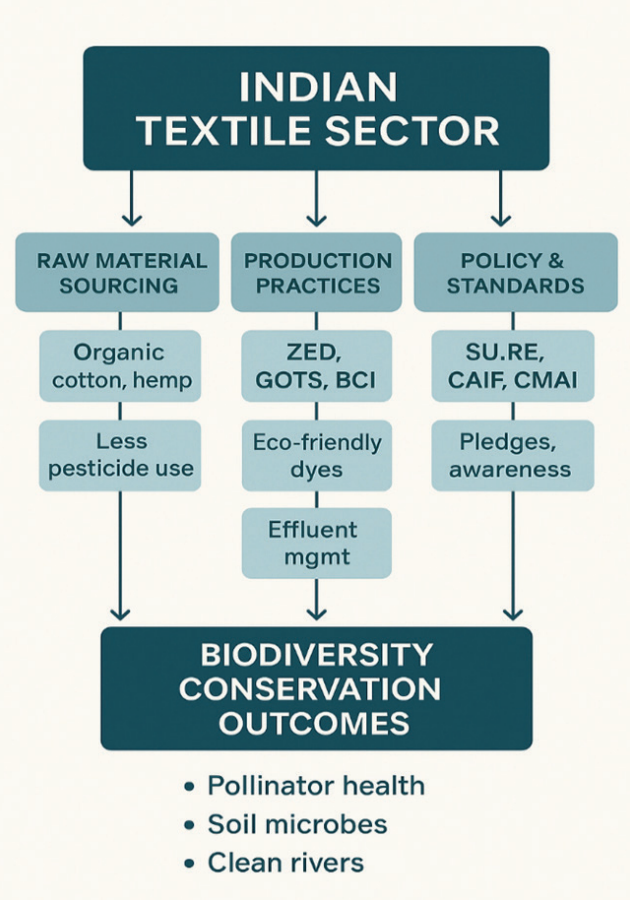
[178] Textile - Wikipedia

Sustainable textile production, including organic farming, regenerative agriculture, and forest stewardship (FSC-certified products), can help protect biodiversity while ensuring long-term viability for the sector.

4.6.3 Current sustainability and conservation initiatives- Textile Sector

The textile sector in India has been increasingly engaging in sustainability initiatives, including those that have implications for biodiversity conservation. These efforts often involve standards, protocols, pledges, and collaborative platforms as indicated in the illustration below, aimed at reducing environmental impacts across the textile value chain.

India's textile sector is gradually integrating biodiversity-conscious practices through a mix of national initiatives, global certifications, and collective pledges. While biodiversity is not always the explicit focus, many environmental standards indirectly contribute to it by promoting sustainable sourcing, chemical reduction, water conservation, and circularity. Some of the government initiatives which are specific to textiles and focused on biodiversity conservation are as below:



1. **Ministry of Textiles' Sustainability Initiatives:** The Ministry has established an Environmental, Social, and Governance (ESG) Task Force to promote sustainable practices within the textile industry. This task force aims to develop a roadmap for sustainable textiles, addressing environmental concerns and facilitating the industry's transition to socially compliant international norms[179].

   The Ministry of Textiles in India has undertaken several sustainability initiatives aimed at promoting environmental responsibility within the textile sector. Here's an overview of these efforts:

[179] Sustainability | Ministry of Textiles | GoI

Inception of Sustainability Initiatives

Establishment of ESG Task Force (July 2023): On July 20, 2023, the Ministry formed an Environmental, Social, and Governance (ESG) Task Force to drive discussions and implement initiatives promoting ESG principles in the textile industry[180]

Progress and Ongoing Efforts

- **ESG Task Force Meetings:** The Task Force convened on August 22, 2023, November 17, 2023, and May 22, 2024, to deliberate on strategies for sustainable textiles[181]
- **EU Collaboration – Seven Projects Launched (February 2025):** In partnership with the European Union, the Ministry launched seven projects across nine Indian states, aiming to enhance sustainability in the textile and handicraft sector. These projects are expected to benefit 35,000 individuals directly, including MSMEs, artisans, and farmer-producers, and economically empower around 200,000 women over the next 3 to 5 years[182].
- **Support for Startups under NTTM:** The Ministry approved several startups focusing on sustainability and innovation in technical textiles through the National Technical Textiles Mission's GREAT scheme, providing up to INR 50 lakhs per startup[183].

Future Plans with a Biodiversity Perspective

- **Sustainable Bharat Mission for Textiles:** This mission aims to integrate sustainability across the textile value chain, promoting resource efficiency and environmental stewardship[184].
- **Promotion of Recycled and Upcycled Products:** Plans are underway to provide dedicated spaces for recycled and upcycled textile products on government e-marketplaces, encouraging circular economy practices[185].
- **Certification of Sustainable Goods:** The Ministry emphasises the need for certification of sustainable and handmade goods to develop a future-ready and resilient textile industry[186]

These initiatives reflect the Ministry's commitment to fostering a sustainable and inclusive textile industry in India, with a focus on environmental conservation and biodiversity.

[180] https://ministryoftextiles.gov.in/sustainability

[181] https://ministryoftextiles.gov.in/sustainability

[182] https://www.eeas.europa.eu/delegations/india/european-union-and-ministry-textiles-launche-7-projects-boost-textile-and-handicraft-sector-india_en

[183] https://www.newindian.in/ministry-of-textiles-approves-startups-to-boost-innovation-and-sustainability

[184] https://thenewsmill.com/2025/02/eu-ministry-of-textiles-launch-7-projects-to-strengthen-indias-textile-and-handicraft-industry

[185] https://www.livemint.com/news/india/govt-to-set-up-task-force-to-address-environmental-concerns-in-textiles-11682172060587.html

[186] https://www.newindian.in/ministry-of-textiles-approves-startups-to-boost-innovation-and-sustainability

2. **Collaboration with the United Nations Environment Programme (UNEP):** The Indian government has partnered with UNEP to launch the 'Enhancing Circularity and Sustainability' project in the textiles and apparel sectors. This initiative focuses on minimising environmental impacts by promoting sustainable practices and circular production methodologies. Notably, 20 strategic research projects have been approved, with three dedicated to textile waste recycling[187]. These regulations and initiatives underscore India's commitment to integrating biodiversity conservation into its textile sector, encouraging sustainable practices and compliance with environmental norms.[188].

Key Objectives

- **Minimise Environmental Impact:** Promote sustainable practices to reduce the negative environmental effects of textile production[189].
- **Mainstream Circular Practices:** Integrate circular production methods within the textile and apparel sectors.
- **Capacity Building:** Enhance the capabilities of stakeholders across the textile value chain to adopt sustainable practices.

Biodiversity Significance: While the project primarily focuses on circularity and sustainability, its emphasis on reducing textile waste and promoting eco-friendly practices indirectly benefits biodiversity. By minimising pollution and encouraging the use of sustainable materials, the initiative supports healthier ecosystems.

Strategic Research Projects: Under the 'Enhancing Circularity and Sustainability' initiative, the Indian Ministry of Textiles approved 20 strategic research projects aimed at promoting sustainable practices in the textiles and apparel sectors. While the official documentation does not explicitly categorize projects based on biodiversity significance, several projects inherently contribute to biodiversity conservation through their focus areas.[190].

Projects with Biodiversity Relevance

- **Agro-Textiles:** These projects focus on developing textiles for agricultural applications, such as crop protection, soil conservation, and water management. By enhancing sustainable agricultural practices, these projects can indirectly support biodiversity by reducing the need for chemical inputs and promoting healthier ecosystems.
- **Textile Waste Recycling:** Projects aimed at recycling textile waste contribute to reducing environmental pollution and the demand for virgin materials. This reduction in resource extraction and waste can have positive effects on biodiversity by lessening habitat disruption and pollution.

[187] Indian Government and UNEP Collaborate to Promote Sustainability in Textile Industry

[188] https://pib.gov.in/Pressreleaseshare.aspx?PRID=1895997

[189]

[190] https://pib.gov.in/PressReleasePage.aspx?PRID=1790539

- **Geotextiles:** Geotextiles are used in infrastructure projects for soil stabilisation and erosion control. Their application can aid in land restoration and prevent habitat degradation, thereby supporting biodiversity conservation efforts.
- Agriculture Speciality Fibres: This project focuses on developing fibres specifically for agricultural use, potentially leading to more sustainable farming practices that are less harmful to surrounding ecosystems.

These projects are part of the National Technical Textiles Mission (NTTM) and align with broader goals of promoting sustainability and environmental stewardship in the textile industry.[191].

4.6.4 National and Industry-Led Standards & Protocols

Some relevant frameworks and initiatives connecting the sector to biodiversity are listed below:

1. Sustainable Textiles For Sustainable Development (SU.RE)

The Sustainable Textiles for Sustainable Development (SU.RE) initiative was launched on August 22, 2019, during the Sustainable Fashion Day at Lakmé Fashion Week in Mumbai. This initiative was a collaborative effort by the Ministry of Textiles, the Clothing Manufacturers Association of India (CMAI), IMG Reliance (now RISE Worldwide), and the United Nations in India. It marked India's first significant commitment by the apparel industry towards sustainable fashion practices.[192].

At its inception, 16 leading Indian fashion and retail brands signed the SU.RE pledge. These brands included[193] Aditya Birla Fashion & Retail, Arvind Fashions, Bestseller, Biba, Future Group, House of Anita Dongre, 109°F, Lifestyle, Levi's, Max, Raymond, Shoppers Stop, Spykar, Trends, W, Westside. These brands collectively represented an industry value of approximately ₹30,000 crore (around USD 4.2 billion)[194]. The SU.RE initiative aims to encourage these brands to develop sustainable sourcing policies, prioritise the use of certified raw materials, and implement processes that positively impact the environment. The goal is to shift a significant portion of their supply chains towards sustainability by the year 2025[195].

Sustainable Resolution (SU.RE) is the Indian Apparel Industry's largest voluntary commitment to sustainability is an initiative by the Clothing Manufacturing Association of

[191] https://www.fibre2fashion.com/news/agro-textiles-news/india-s-textile-ministry-passes-20-research-projects-worth-74-cr-283931-newsdetails.htm

[192] https://www.iafnet.com/2019/08/22/project-su-re-launched-on-sustainable-fashion-day-at-lakme-fashion-week

[193] https://apparelresources.com/business-news/sustainability/su-re-project-launched-16-retail-fashion-brands-promote-sustainability

[194] https://textilevaluechain.in/news-insights/union-textiles-minister-launches-project-su-re-on-sustainable-fashion-day-at-lakme-fashion-week-winter-festive-2019

[195] https://www.sustainableresolution.com/network

India (CMAI), Reliance Brands Limited (RBL) and the United Nations in India.[196], aiming to catalyse the industry's transition towards sustainability. It outlines a 5-point plan:

- Assess the environmental impact of current garment production.
- Develop sustainable sourcing which can provide certified and eco-friendly raw materials.
- Choose sustainable raw materials, which ensure traceability across the value chain.
- Efficiently informed consumers and participants about sustainability initiatives.
- Change a significant percentage of the supply chain to sustainable practices by 2025, aligning with the UN Sustainable Development Goals[197].

The SU.RE initiative supports biodiversity by reducing harmful chemical use, promoting sustainable land and water practices, minimizing textile waste, and encouraging the sourcing of eco-friendly materials that conserve ecosystems and reduce habitat degradation. These actions collectively help protect soil, water, and species across terrestrial and aquatic environments.

2. India Handloom Brand

The India Handloom Brand (IHB) was launched on August 7, 2015 by the Ministry of Textiles. This initiative aims to promote high-quality, authentic handloom products that meet stringent quality benchmarks and environmental standards[198]. Through this initiative, the promotion of traditional handloom products made using natural fibres and dyes serves not only to preserve cultural heritage but also to advance ecological sustainability. These products are deeply rooted in the use of indigenous and organically sourced materials, which are cultivated and processed through traditional farming and artisanal methods. This approach supports biodiversity by conserving native plant species, encouraging organic cultivation practices, and sustaining ecosystems that are integral to the production of natural fibres and dyes.

Standards and Benchmarks

The IHB sets rigorous criteria for products to ensure they are:

- **Authentic Handloom:** Produced using traditional handloom techniques[199]
- **High Quality:** Free from defects, with standards for raw materials, weaving, processing, and embellishments[200].
- **Eco-Friendly:** Manufactured with minimal environmental impact, adhering to the principle of "zero effect on the environment."

[196] Launch of Project Sustainable Resolution (SU.RE): Lakmé Fashion Week | United Nations in India

[197] SURE

[198] https://www.nhdc.org.in/internal.aspx?CatID=64&menuid=2

[199] https://www.indiahandloombrand.gov.in/pages/know-your-products

[200] https://toistudent.timesofindia.indiatimes.com/news/top-news/national-handloom-day-2022-the-legacy/76903.html

- **Socially Compliant:** Produced under fair labour practices, supporting weaver welfare[201].

These standards are designed to assure consumers of the product's quality and authenticity, while also promoting sustainable and ethical practices within the handloom industry.[202]

The India Handloom Brand (IHB) features a distinctive logo that represents a product's compliance with the quality and authenticity standards established by the initiative. Beyond assurance of craftsmanship, the logo also signifies a commitment to environmental sustainability and social responsibility. This branding enables consumers to easily identify genuine handloom products that uphold traditional artisan skills while promoting eco-friendly practices. Since its inception, the India Handloom Brand has registered nearly 2,000 products across 184 categories, indicating widespread industry adoption. By enhancing market access for weavers and raising consumer awareness about the cultural and ecological value of authentic handloom products, the initiative has made a substantial contribution to both livelihood preservation and sustainable consumption.

3. ZED Certification (Zero Effect, Zero Defect)

The ZED Certification (Zero Effect, Zero Defect) is a flagship initiative under India's Ministry of MSME (Micro, Small, and Medium Enterprises) that promotes quality manufacturing with minimal environmental impact. While the certification isn't biodiversity-specific, it indirectly contributes to biodiversity conservation through its eco-conscious manufacturing standards. It was launched to encourage MSMEs to improve the product quality ("Zero Defect"), environmental sustainability ("Zero Effect"), energy and resource efficiency as well as waste management and pollution control. Approximately 23,948 MSMEs have registered under the ZED Certification scheme.[203], out of which about 503 MSMEs have achieved ZED Certification[204]. This indicates that while there is awareness of the program, the actual adoption rate remains low, suggesting a need for increased outreach and support to encourage more MSMEs to pursue certification.

In the textile industry, the ZED (Zero Effect, Zero Defect) certification has played a significant role in advancing environmental sustainability. It has led to a reduction in the use of toxic dyes and harmful processing chemicals, thereby minimizing pollution and its adverse impacts on ecosystems. Additionally, the certification has encouraged the adoption of low-impact fibers and the use of natural dyes, which in turn supports biodiversity-friendly agricultural practices and reduces pressure on chemical-intensive crop systems.

[201] https://www.accessdev.org/wp-content/uploads/2024/09/State-of-Handloom-Sector-Report-2024.pdf

[202] https://socialwelfare.vikaspedia.in/viewcontent/social-welfare/entrepreneurship/indian-handloom/india-handloom-brand

[203] https://www.teriin.org/sites/default/files/files/Financing-Low-Carbon-Tranistion-for-India-MSME-Sector.pdf

[204]https://www.dcmsme.gov.in/Guidelines_MSME%20Sustainable%28ZED%29%20Certification%20Scheme.pdf

Voluntary Sustainability Standards (VSS) Relevant to Biodiversity

4. GOTS (Global Organic Textile Standard)

The **Global Organic Textile Standard (GOTS)** is a leading international certification that ensures textiles are produced organically and sustainably, encompassing environmental and social criteria throughout the supply chain. It promotes organic farming practices, bans hazardous inputs, and encourages water and biodiversity conservation[205]. India has consistently held the top position globally for GOTS-certified facilities.[206]. As of 2020, the country had 3,015 certified facilities, reflecting its significant role in organic textile production.[207].

Major Indian Businesses with GOTS Certification

Several prominent Indian textile companies have achieved GOTS certification, including:

- **Alok Industries Ltd.:** A vertically integrated textile company with GOTS-certified facilities[208]
- **Milan Group India:** Engaged in ginning, spinning, and knitting, the group holds GOTS certification for its sustainable practices.[209]
- **Shiva Texyarn Limited:** Based in Coimbatore, this company is GOTS-certified and focuses on producing eco-friendly textiles[210].
- **Organic & More (Net Paradigm India Pvt. Ltd.):** A government-recognised, ethically responsible apparel manufacturer specialising in organic cotton garments[211].
- **Herbal Fab:** A GOTS-certified organic fabric supplier offering a wide range of sustainable fabrics[212].

Impacts of GOTS on Biodiversity

GOTS certification contributes to biodiversity conservation through several mechanisms.

- **Organic Farming Practices:** GOTS mandates the use of organic fibers, which are cultivated without synthetic pesticides or genetically modified organisms, thereby preserving soil health and local ecosystems[213]

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[205] https://www.thewoolroom.com/us/blog/what-is-gots-certification-and-why-does-it-matter/?srsltid=AfmBOopBQZDs2EP3Xfg8wWEXxBpJ3EBRNXt-IG24bBWWVNEJGPPLhnF

[206] https://www.indiantextilemagazine.in/gots-certified-facilities-india-tops-the-list

[207] https://global-standard.org/images/resource-library/documents/GOTS_Word_Annual_Report_2020.pdf

[208] https://www.indiantextilemagazine.in/gots-certified-facilities-india-tops-the-list

[209] https://milangroupindia.com/certificates.aspx

[210] https://en.wikipedia.org/wiki/Shiva_Texyarn_Limited

[211] https://www.organicandmore.com

[212] https://herbalfab.com

[213] https://global-standard.org/the-standard/gots-key-features/ecological-and-social-criteria

- **Reduced Chemical Pollution:** By prohibiting harmful chemicals in processing, GOTS minimises water and soil contamination, protecting aquatic life and terrestrial biodiversity.[214]
- **Sustainable Land Use:** Organic farming under GOTS promotes crop rotation and polyculture, enhancing habitat diversity and reducing monoculture-related biodiversity loss
- **Ecosystem Health:** The standard's emphasis on environmental responsibility supports the overall health of ecosystems, benefiting various species and natural habitats.

5. OEKO-TEX® MADE IN GREEN label

The **OEKO-TEX® MADE IN GREEN** certifies textiles tested for harmful substances and produced in environmentally friendly and socially responsible facilities. The label is a comprehensive sustainability certification for textiles and leather products, ensuring they are[215]:

- Tested for harmful substances (via OEKO-TEX® STANDARD 100 or LEATHER STANDARD)
- Produced in environmentally friendly facilities (certified under OEKO-TEX® STeP)
- Manufactured under socially responsible working conditions

This label provides consumers with transparency and traceability, allowing them to verify the sustainable and ethical production of their textile products.[216]

Major Indian Businesses with OEKO-TEX® MADE IN GREEN Certification

Several prominent Indian textile companies have been awarded the OEKO-TEX® MADE IN GREEN certification, reflecting their commitment to sustainable and socially responsible manufacturing:

- **Welspun India Ltd.** A leading home textiles manufacturer, Welspun became the first in India to earn the MADE IN GREEN certification for bedding and bath products.
- **Trident Group:** Headquartered in Ludhiana, Punjab, Trident is a vertically integrated textile manufacturer specialising in yarn, bath products, and bed linen. The company has obtained the MADE IN GREEN label, underscoring its dedication to sustainable practices.
- **Shiva Texyarn Limited,** based in Coimbatore, Tamil Nadu, Shiva Texyarn is recognised for its sustainable textile production and holds OEKO-TEX® certifications, including MADE IN GREEN.

[214] https://consciousconvert.com/blogs/news/how-is-gots-good-for-you-and-the-environment?srsltid=AfmBOopvlPsk5dubIqzUbRr-7u3WjwT2aoz7nwsACjhpvpLu5QaAn0dK&ut

[215] https://www.hohenstein.in/en-in/oeko-tex/output-control/made-in-green

[216] https://www.hohenstein.us/en-us/press/press-releases/hohenstein-certifies-textiles-in-the-hamburg-sport-verein-hsv-fan-store-with-oeko-tex-made-in-green

- **Tex Corp,** located in Gurgaon, Haryana, Tex Corp is a major manufacturer of zippers and fastening products. The company is OEKO-TEX® certified, ensuring its products meet high safety and environmental standard.

The **OEKO-TEX® MADE IN GREEN** label, when implemented by companies like **Welspun India Ltd.,** contributes to **positive impacts on biodiversity,** even though the certification itself does not directly measure biodiversity.

Welspun India Ltd's MADE IN GREEN Label and its implications on Biodiversity:

Welspun became the first Indian company to receive the MADE IN GREEN label for both its bedding and bath product categories, marking a significant milestone in sustainable textile manufacturing. This internationally recognized label provides consumers with the assurance that the products are free from harmful substances, verified through the STANDARD 100 by OEKO-TEX certification. Additionally, it guarantees that the items have been manufactured in environmentally friendly and socially responsible facilities, as confirmed by compliance with the STeP (Sustainable Textile & Leather Production) certification.

How This Translates to Biodiversity Gains

- **Reduced Chemical Pollution:** The use of non-toxic dyes, pesticides, and chemical finishes in certified textile production prevents harmful substances from leaching into surrounding soil and water bodies. This helps safeguard aquatic life, beneficial insects, and soil microorganisms from chemical exposure. An important indirect benefit of this practice is the preservation of freshwater biodiversity, particularly in industrial hubs such as Gujarat, where companies like Welspun operate.
- **Sustainable Water Use:** The OEKO-TEX STeP certification encourages efficient water management throughout the production process. By minimizing water consumption and ensuring proper treatment of effluents, certified facilities place less stress on local water sources. This contributes to the protection of wetlands and riparian ecosystems, which are often at risk from overuse and contamination due to industrial activity.
- **Waste and Emission Controls:** Facilities certified under sustainable standards are required to manage waste and emissions responsibly. This significantly reduces the likelihood of hazardous chemical spills and airborne pollutants entering the environment. In turn, this protects nearby natural habitats and the diverse species that depend on them for survival.
- **Lower Resource Extraction Pressure:** Sustainable textile certifications promote the sourcing of raw materials through environmentally responsible methods. This reduces the need for deforestation, overgrazing, and land conversion - practices that are major threats to biodiversity, especially in cotton-growing regions.
- **Encouragement of the Circular Economy:** These standards also emphasize principles of the circular economy, including product durability, recyclability, and minimal-waste design. In the long term, this helps reduce the accumulation of textile waste in landfills, thereby preventing harm to adjacent ecosystems and improving overall environmental health.

Welspun's operations, primarily located in the Kutch region of Gujarat, are situated in close proximity to ecologically sensitive areas such as the Banni Grasslands and the Little Rann of Kutch. The Banni Grasslands are renowned for their unique biodiversity, serving as a critical habitat for a variety of native fauna and migratory bird species. Similarly, the Little Rann of Kutch is one of the last refuges of the endangered Indian Wild Ass, making it a vital conservation area. In this context, the adoption of cleaner and more sustainable industrial practices by companies like Welspun plays an essential role in reducing anthropogenic pressure on these fragile ecosystems, helping to safeguard their ecological integrity and biodiversity.

Trident Group, another leading Indian textile manufacturer, has integrated the **OEKO-TEX® MADE IN GREEN** label into its sustainability initiatives, yielding notable benefits for biodiversity in India.

OEKO-TEX® MADE IN GREEN Certification

Trident's home textile products, including towels and bed linens, are certified under the OEKO-TEX® MADE IN GREEN label.[217] This certification ensures that textile products meet rigorous sustainability and safety standards across the production cycle. Products are tested for harmful substances in accordance with the STANDARD 100 by OEKO-TEX, ensuring they are safe for human use. They are also manufactured in environmentally friendly facilities that meet the criteria of the STeP certification, which promotes sustainable production processes. Furthermore, the certification guarantees socially responsible working conditions throughout the supply chain. By carrying this label, products offer consumers transparency and traceability, enabling them to make informed choices about the ethical and sustainable origins of their textile purchases.

Biodiversity Impacts in India related to the OEKO-TEX® MADE IN GREEN label certification of the Trident group.

- **Water Conservation and Zero Liquid Discharge**

  At its Budhni manufacturing site, Trident recycles 100% of the water used in towel and sheeting production. [218] The company has established a Zero Liquid Discharge facility, ensuring that no liquid effluents are discharged into water bodies, thus minimising pollution and preserving the aquatic ecosystem.[219].

- **Sustainable Raw Material Sourcing**

  Trident utilises wheat straw as a raw material for paper production, preventing the cutting of approximately 5,000 trees.[220]. The company has dedicated over 10,000 acres of land for cotton farming and has planted more than 600,000 trees on its premises, enhancing local biodiversity.[221].

[217] https://www.indiantextilemagazine.in/trident-certified-with-oeko-tex-made-in-green-label

[218] https://www.hometextilestoday.com/manufacturing/trident-advances-its-sustainable-initiatives

[219] https://indiantextilejournal.com/trident-promotes-resource-conservation-and-waste-reduction

[220] https://indiantextilejournal.com/trident-promotes-resource-conservation-and-waste-reduction

[221] https://indiantextilejournal.com/trident-promotes-resource-conservation-and-waste-reduction

- **Integrated Pest Management (IPM)**

  Trident employs IPM practices that reduce reliance on chemical pesticides, minimising environmental impact while promoting biodiversity and protecting farmer health.[222].

  Trident's operations, especially in areas such as Budhni in Madhya Pradesh, contribute meaningfully to the preservation and enhancement of local ecosystems. By reducing water pollution through improved effluent treatment and responsible chemical management, the company supports healthier aquatic life in nearby rivers and water bodies. Tree plantation initiatives undertaken by Trident help increase green cover, creating habitats for a variety of native species and contributing to landscape-level ecological restoration. Additionally, the promotion of sustainable agricultural practices in surrounding communities supports soil health and conserves agrobiodiversity, reinforcing the region's ecological resilience.

  In summary, Trident Group's adoption of the OEKO-TEX® MADE IN GREEN label and its comprehensive sustainability initiatives contribute to conserve biodiversity and promoting environmental stewardship in India.

6. Better Cotton Initiative (BCI)

The Better Cotton Initiative (BCI) has been instrumental in promoting sustainable cotton farming practices in India since its inception in 2011. India stands as a significant participant in this program, boasting the largest number of farmers engaged in BCI activities globally. It encourages water stewardship, soil health, and reduced pesticide use - directly aiding biodiversity in cotton-growing regions.

Major Indian Businesses Participating in BCI

Several prominent Indian companies have aligned with BCI to enhance sustainability in their operations. Notable participants include:

- **Trident Group:** A leading textile manufacturer known for its commitment to sustainable practices.
- **Arvind Limited:** One of India's largest textile companies, actively involved in sustainable cotton sourcing.
- **Vardhman Textiles:** Engaged in producing eco-friendly cotton products.
- **Welspun India:** Recognised for integrating sustainable cotton into its product lines.
- **Raymond Ltd.:** Incorporating Better Cotton into its textile manufacturing processes. These companies are listed among the members of the Better Cotton Initiative, reflecting their dedication to sustainable cotton production.

[222] https://indiantextilejournal.com/trident-promotes-resource-conservation-and-waste-reduction

Impact of BCI Practices on Biodiversity and Environment[223]

The adoption of BCI practices by Indian businesses has led to significant environmental benefits.

- **Reduction in Pesticide Use:** BCI farmers in India have achieved a 53% decrease in pesticide usage, mitigating harm to beneficial insects and surrounding ecosystems[224].
- **Water Conservation:** There has been a 29% reduction in water usage for irrigation among BCI farmers, contributing to the preservation of local water resources.
- **Cost Efficiency:** Farmers have experienced a 15.6% reduction in overall farming costs (excluding land rental), indicating economic benefits alongside environmental gains. These outcomes highlight the positive influence of BCI-aligned businesses on promoting biodiversity and sustainable agriculture in India[225].

7. Textile Exchange Standards

The Textile Exchange is a global nonprofit organization that sets sustainability standards for the textile industry, focusing on reducing environmental impacts and promoting biodiversity. Their standards encompass various materials, including organic cotton, recycled fibers, and animal-derived products like wool and leather. It includes Organic Content Standard (OCS), Recycled Claim Standard (RCS), and Responsible Wool Standard (RWS), all emphasizing environmental and biodiversity impacts.

Major Indian Businesses Participating in Textile Exchange Standards

Several prominent Indian companies have adopted Textile Exchange standards to enhance sustainability in their operations. Notable participants include:

- **Aditya Birla Fashion and Retail Limited:** Engaged in sustainable fashion initiatives[226]
- **Vardhman Textiles:** Involved in producing eco-friendly cotton products[227]
- **Arvind Limited:** Actively involved in sustainable cotton sourcing
- **Welspun India:** Recognised for integrating sustainable cotton into its product lines
- **Trident Group:** Known for its commitment to sustainable practices.

These companies are listed among the members of the Textile Exchange, reflecting their dedication to sustainable cotton production[228]

[223] https://bettercotton.org/better-cotton-2023-24-annual-report-key-highlights

[224] https://bettercotton.org/field-level-results-impact/demonstrating-results-and-impact/farmer-results

[225] https://www.textileworld.com/textile-world/2024/09/better-cotton-launches-2023-24-annual-report-impact-expansion-and-farmer-resilience

[226] https://textileexchange.org/find-certified-company

[227] https://en.wikipedia.org/wiki/Vardhman_Group_of_Companies

[228] https://textileexchange.org/members

The adoption of Textile Exchange standards by companies in India has contributed to biodiversity conservation by reducing harmful chemical use, improving soil health, conserving water resources, and preserving natural habitats through sustainable agricultural and land management practices.

8. Responsible Wool Standard

The Responsible Wool Standard (RWS) is a globally recognised certification that addresses animal welfare, sustainable land management, and social responsibility in the wool supply chain. The RWS ensures:

- **Animal Welfare:** Sheep are treated ethically - access to food/water, and proper health care.
- **Land Management:** Pastures are managed to avoid overgrazing and restore degraded grazing lands.
- **Traceability:** From farm to final product, every step is tracked for transparency.
- **Social Responsibility:** Workers are treated fairly across the supply chain.

RWS is managed by **Textile Exchange,** a global non-profit promoting sustainable fibers.

Businesses following RWS:

India is a small but growing player in the RWS ecosystem, mainly through certified processors and exporters rather than producers (as most raw wool in India is coarse and used for carpets). The Responsible Wool Standard (RWS) is increasingly important for India's wool sector as it opens doors to global markets where sustainability certifications are a prerequisite. Leading international brands such as Patagonia and Stella McCartney now require RWS compliance from their suppliers, making it a critical credential for export-oriented growth. Beyond market access, RWS enhances the sustainability profile of Indian wool products, building trust with environmentally and socially conscious consumers. Importantly, RWS also addresses the land-livelihood nexus by enabling pastoral communities—particularly in fragile ecosystems like the Himalayas—to improve their incomes through certified wool production while simultaneously promoting better land management and ecological restoration practices. Some of the Indian businesses associated with RWS are as below:

- **Raymond Group:** Raymond Group is a prominent RWS (Responsible Wool Standard)-certified wool processor in India, known for its commitment to sustainable suiting fabrics. Although most of the RWS-certified wool used by the company is imported, it is processed responsibly within India, adhering to international environmental and ethical standards. Raymond is also exploring partnerships to develop regenerative wool supply chains domestically, aiming to eventually source certified wool from within India itself.
- **Jaya Shree Textiles (Aditya Birla Group):** Jaya Shree Textiles, a part of the Aditya Birla Group, specializes in wool blends and fine fabrics. While the company is not yet fully RWS-certified across all its product lines, it remains actively engaged in global conversations around sustainable fibre sourcing and has the infrastructure and capacity to process RWS-certified wool. As certified wool sourcing gains momentum

in India, Jaya Shree is well-positioned to play a key role in expanding responsible wool processing in the country.

- **Local Initiatives in Ladakh and Himachal Pradesh:** In regions like Ladakh and Himachal Pradesh, there is growing interest in aligning indigenous wool production—particularly Changthangi (Pashmina) wool—with Responsible Wool Standard principles. Though formal RWS certification has not yet been achieved, NGOs and local cooperatives are working toward developing models that integrate sustainable grazing, animal welfare, and traceability. These initiatives hold promise for future certification efforts focused on restoring degraded alpine grazing areas and supporting high-altitude pastoralist communities.

International Protocols Adopted in India:

9. Science-Based Targets initiative (SBTi) for Apparel & Textiles

Promotes climate targets that often intersect with ecosystem preservation. The Science-Based Targets initiative (SBTi) provides a framework for companies to set greenhouse gas (GHG) emission reduction targets aligned with climate science. In India's apparel and textile sector, several companies have committed to SBTi, aiming to mitigate climate change and its associated impacts on biodiversity[229]. As of April 2022, 79 Indian companies had joined the SBTi, leading among emerging economies. Within the textiles, apparel, footwear, and luxury goods sector, eight Indian companies have committed to SBTi targets. Notable participants include[230]

- **Welspun India Ltd.:** Committed to the SBTi Net-Zero Standard and Business Ambition for 1.5°C, striving to achieve net-zero emissions by setting targets aligned with the SBTi Net-Zero Framework.[231]
- **Arvind Limited:** Engaged in sustainable cotton sourcing and has committed to science-based targets to reduce its environmental footprint
- **Trident Group:** Known for its commitment to sustainable practices, including water conservation and renewable energy usage, aligning with SBTi goals
- **Vardhman Textiles:** Involved in producing eco-friendly cotton products and has taken steps towards setting science-based targets[232]
- **Raymond Ltd.:** Incorporating sustainable practices in textile manufacturing and committed to reducing GHG emissions in line with SBTi

These companies are listed among the members of the SBTi, reflecting their dedication to sustainable production[233].

229 https://sciencebasedtargets.org/blog/how-can-the-indian-corporate-sector-drive-net-zero

230 https://www.fibre2fashion.com/news/textile-news/welspun-india-commits-to-undertake-climate-action-aligned-with-sbti-278615-newsdetails.htm

231 https://www.fibre2fashion.com/news/textile-news/welspun-india-commits-to-undertake-climate-action-aligned-with-sbti-278615-newsdetails.htm

232 https://sciencebasedtargets.org/sectors/apparel-and-footwear

233 https://sciencebasedtargets.org/companies-taking-action

Although the SBTi primarily targets GHG emission reductions, the sustainability measures adopted by companies—such as reduced agrochemical use, water conservation, habitat preservation, and renewable energy adoption—also yield significant co-benefits for biodiversity by protecting ecosystems and supporting wildlife. These actions contribute to safeguarding India's rich biodiversity while aligning with broader climate and environmental goals.

Collective Action Platforms & Pledges

10. Fashion for Earth (WWF India + CMAI)

A platform encouraging sustainable practices in Indian fashion, with biodiversity and environmental conservation as core principles.

11. Sustainable Fashion Day – Lakmé Fashion Week

Showcases designers and collections with biodiversity-sensitive materials like hemp, peace silk, banana fibers, and plant-based dyes.

12. Circular Apparel Innovation Factory (CAIF)

The **Circular Apparel Innovation Factory (CAIF),** established in 2018 by Intellecap with support from the DOEN Foundation and Aditya Birla Fashion & Retail Ltd. (ABFRL), is an industry-led platform dedicated to fostering a circular economy within India's textile and apparel sector[234]. CAIF's mission encompasses enhancing the use of sustainable materials, maximising textile utilisation, promoting business model innovations, and increasing recycling efforts[235].

Major Indian Businesses Collaborating with CAIF

CAIF has partnered with several prominent Indian and global companies to drive circularity in the textile industry. Notable collaborators include: - Aditya Birla Fashion & Retail Ltd. (ABFRL), Shahi Exports, House of Anita Dongre, Trident Group, CL Gupta Exports, Raj Group, Jay Jay Mills, CTA Apparels[236] These collaborations aim to transition the industry from a traditional 'take-make-dispose' model to a more sustainable, circular approach[237].

Impact on Biodiversity in India

CAIF's initiatives contribute to biodiversity conservation in several ways:

- **Textile Waste Management** Through the "Closing the Loop on Textile Waste" (CTL) program, CAIF has diverted approximately 130,000 kg of post-consumer textile

[234] https://in.linkedin.com/showcase/circular-apparel-innovation-factory

[235] https://www.worldbenchmarkingalliance.org/wba-allies/circular-apparel-innovation-factory

[236] https://www.intellecap.com/in_the_media/textiles-goes-circular-coverage-of-circular-apparel-innovation-factory-caif-in-business-india-july-2024-issue

[237] https://www.researchgate.net/publication/345741434_The_Circular_Apparel_Innovation_Factory

waste from landfills between March and November 2023 in Bengaluru. This effort reduces environmental pollution and conserves natural habitat[238].

- **Promotion of Sustainable Materials** CAIF encourages the use of alternative fibers derived from agricultural waste, such as banana and pineapple fibers. These materials are less resource-intensive, reducing the strain on the natural ecosystem[239].
- **Empowerment of Waste Entrepreneurs** By supporting waste entrepreneurs in textile waste collection and recycling, CAIF fosters community-led conservation efforts, promoting sustainable livelihoods that are in harmony with environmental preservation[240].

Some of the major Indian textile manufacturers have also started adopting sustainable initiatives with a positive impact on Biodiversity.

- Recycling and Upcycling- reduces landfill waste, minimizes raw material extraction, and impacts habitats.
- Eco-conscious water management and dyeing process- Prevents contamination of rivers and soils, protecting aquatic and terrestrial biodiversity.
- Use of organic and regenerative fibres (e.g., organic cotton, hemp, bamboo)- Avoids pesticide use, improves soil health, and supports pollinator populations.

Real-world examples from industry leaders, including Aditya Birla Fashion and Retail, Arvind Limited, Welspun India and Raymond Limited, showcase the benefits of eco-friendly and innovative practices in the textile sector.

Sustainable Practices in the Indian Textile Sector

- **Renewable Energy Adoption:** Tamil Nadu's textile sector contributes over 50% of the state's renewable energy capacity.
- **Sustainable Processes in Clusters:** Tirupur showcases nearly 300 units connected to zero liquid discharge effluent treatment plants.
- **Recycled Fibers in Panipat:** Panipat's open-end spinners exclusively use recycled fibre, demonstrating a commitment to sustainable practices.

Transformation of Tirupur Hosiery Cluster: A Collective Sustainability Effort

The Problem (Pre-2011)

- Tirupur, a major knitwear export hub, faced **severe water pollution** due to untreated effluents from over **700 dyeing and bleaching units.**

[238] https://www.passionateinmarketing.com/alwaleed-philanthropies-global-partners-with-circular-apparel-innovation-factory-caif-and-enviu-to-scale-circular-textile-waste-management-ctwm-across-india

[239] https://www.intellecap.com/in_the_media/textiles-goes-circular-coverage-of-circular-apparel-innovation-factory-caif-in-business-india-july-2024-issue

[240] https://www.saamuhikashakti.org/partner/circular-apparel-innovation-factory

- The Noyyal River became heavily polluted, affecting agriculture, biodiversity, and livelihoods.
- In 2011, the Madras High Court ordered the closure of all polluting units until Zero Liquid Discharge (ZLD) norms were implemented.

Key Stakeholders in the Transformation

1. **Tirupur Exporters' Association (TEA)**
   - Spearheaded the movement to centralize and modernize effluent treatment.
   - Facilitated cooperation between exporters and government agencies.
2. **Industry Units (Textile Processors)**
   - Nearly 300 processing units pooled resources to invest in Common Effluent Treatment Plants (CETPs) with ZLD systems.
   - Cost-sharing model made advanced treatment technology affordable.
3. **Tamil Nadu Pollution Control Board (TNPCB)**
   - Enforced strict monitoring and compliance after the High Court ruling.
   - Guided technological implementation for sustainable outcomes.
4. **Tamil Nadu Water Investment Company (TWIC)**
   - Provided technical expertise to design and implement CETPs with ZLD.
   - Ensured water reuse and safe sludge disposal systems.
5. **State Government of Tamil Nadu**
   - Supported with land, policy incentives, and approvals.
   - Created an enabling regulatory environment for circular practices.
6. **Civil Society & Farmers**
   - Persistent advocacy for clean water and public health drove judicial action.
   - Their pressure catalysed institutional response and long-term vigilance.

Results & Biodiversity Impact

Pre-ZLD: The discharge of untreated dyeing effluents had severely contaminated the Noyyal River, harmed aquatic life, and degraded agricultural land.

Post-ZLD:

- 100% wastewater recycling, zero discharge into natural water bodies. Wastewater is treated and fully reused, minimising environmental discharge. Over 300 units linked to ZLD-CETPS
- Sludge and hazardous residues are properly managed, reducing soil and water toxicity. Improved soil quality in adjacent farmlands

- Local biodiversity in water bodies and surrounding ecosystems has begun to recover, though long-term monitoring is ongoing.
- Decline in river pollution, partial recovery of aquatic ecosystems
- Renewed trust between industry and community.

4.6.5 ESG and CSR trends in the Indian textile sector

The textile industry significantly impacts biodiversity through its extensive use of natural resources and production processes. To mitigate these effects, several companies have integrated biodiversity conservation and restoration into their ESG and Corporate Social Responsibility (CSR) initiatives. Below are examples of such efforts:

Environmental (E) Practices

1. Sustainable Raw Material Sourcing

- **Organic cotton, bamboo, hemp, Tencel™, banana fibers:** Less water-intensive, minimal pesticide use, and improved soil biodiversity.
- **Avoiding genetically modified seeds** in some farming programs supports native crop biodiversity.

Here are some standout **Indian textile companies and clusters** that are actively promoting **sustainability and biodiversity conservation** in their supply chains:

a. **Arvind Limited (Gujarat):** Arvind Limited has been at the forefront of sustainable cotton cultivation in Gujarat through its participation in the Better Cotton Initiative (BCI) and its own Sustainable Cotton Programme. These efforts involve working with thousands of farmers to promote organic and regenerative farming methods. Arvind's biodiversity-focused approach includes encouraging crop diversification, the use of natural pesticides, and farmer training in soil health and water conservation. A major milestone in its sustainability journey is the Water Innovation Centre at its Ahmedabad plant, which operates on a Zero Liquid Discharge (ZLD) model, saving millions of litres of water annually and serving as a benchmark in responsible industrial water use.

b. **Raymond Group (Maharashtra):** Raymond Group has integrated green manufacturing practices across its operations, with the Vapi plant equipped with Zero Liquid Discharge systems and advanced effluent treatment plants (ETPs) to minimize water pollution. The company has also invested in sustainable product lines, such as eco-friendly wool and natural dyes, reducing dependence on synthetic chemicals. Its community engagement initiatives involve partnerships with farmers to cultivate natural dye crops like indigo, thereby supporting the conservation of native plant species and contributing to agro-biodiversity preservation in the region.

c. **Tirupur Cluster (Tamil Nadu):** Tirupur stands out as India's first textile cluster to achieve 100% Zero Liquid Discharge compliance across all its units, setting a national precedent in industrial water management. The cluster has also embraced renewable energy, with widespread adoption of solar and wind power, significantly reducing carbon emissions and ecological stress on the local environment. Additionally, many units within Tirupur collaborate with cooperatives to promote organic cotton cultivation and the use of indigenous dye plants, enhancing regional biodiversity and sustaining traditional farming knowledge.

d. **FabIndia & Tula (Pan-India):** Tula is a small-scale but impactful brand that works with tribal and smallholder farmers in Tamil Nadu and Telangana to cultivate native cotton varieties organically. Its model emphasizes a fully traceable supply chain that upholds ecological and social sustainability. FabIndia, on the other hand, supports extensive artisanal and natural fiber supply chains across India. By using organic dyes and traditional handlooms that require no electricity, FabIndia helps conserve biodiversity, support village-level economies, and reduce overall carbon emissions.

e. **Vardhman Textiles (Punjab & Himachal Pradesh):** Vardhman Textiles has committed to sustainable cotton cultivation practices in partnership with the Better Cotton Initiative and WWF India. Their landscape-level conservation work includes a strong focus on water management and soil biodiversity, ensuring long-term ecological health in their operational regions. Additionally, Vardhman has engaged in afforestation drives, planting native species within and around their industrial areas to enhance green cover and promote local ecosystem restoration.

f. **Welspun India (Maharashtra & Gujarat):** Welspun India has adopted cutting-edge technologies like AI and blockchain to monitor and optimize sustainability metrics across its supply chain. Its circular fashion initiative, "Spun," repurposes pre-consumer textile waste into new products, reducing waste and resource use. Welspun's collaboration with WWF underscores its commitment to biodiversity conservation and includes projects focused on river rejuvenation and ecological restoration near its manufacturing units, especially in biodiversity-sensitive regions like Kutch.

2. Reduction of Agrochemicals and Hazardous Substances

- Adoption of ZDHC (Zero Discharge of Hazardous Chemicals) standards in dyeing and processing.
- Reduces toxic runoffs into rivers, protecting aquatic biodiversity.

3. Water Management

- Effluent treatment plants (ETPs), water recycling, and rainwater harvesting reduce contamination and overuse of local ecosystems.
- Supports wetland and riverine biodiversity.

- Zero Liquid Discharge (ZLD): Especially in clusters like Tirupur, where all units comply with ZLD norms.

4. Land Use & Ecosystem Restoration

- Some textile brands support regenerative farming that rebuilds soil health and supports pollinators and microbes.
- Afforestation & River Rejuvenation: Companies like Welspun work with local authorities and NGOs to restore water bodies and green belts near their industrial zones.
- Pollinator Habitat Protection: Encouraged by reducing pesticide use, maintaining buffer zones, and planting native flowering species.
- Certain projects aim to restore degraded grazing lands for wool production (e.g., Responsible Wool Standard).

5. Circular Economy Initiatives

- **Buy-Back Programs:** Some companies, like Welspun and Doodlage, have introduced take-back programs for post-consumer textile waste, promoting circularity.
- **Fabric Waste Recycling:** Units like Vardhman Renova repurpose pre-consumer waste into new yarns.
- **Upcycling:** Brands like I Was a Sari and Doodlage upcycle waste material into new apparel or accessories.

6. Capacity Building Programs

- **Farmer Training:** On sustainable cultivation methods, water management, and biodiversity-friendly pest control. Eg. Arvind Limited has trained thousands of cotton farmers in Gujarat on low-input, high-yield, biodiversity-conscious practices.
- **Worker Training:** On sustainable manufacturing, safe chemical handling, and green factory practices.
- **Artisan Skill Development:** NGOs and brands like Tula and FabIndia help revive and modernise traditional skills using eco-conscious methods.

7. Farmer-Centric Business Models

- **Guaranteed Buy-Back:** Small, ethical labels (like Tula) provide upfront price guarantees to cotton farmers growing organic cotton.
- **Fair Pricing & Long-Term Contracts:** Initiatives under the Better Cotton Initiative and Fairtrade give financial stability to farmers practising sustainable methods.
- **Agri-Input Support:** Some brands provide organic seeds, natural pesticides, and training to support biodiversity.

Social (S) Practices

8. Community Engagement for Biodiversity Protection

- Involvement of local communities in organic farming and sustainable harvesting of natural dyes (e.g., indigo, turmeric).
- Indigenous knowledge is integrated to preserve native plant species.

9. Capacity Building for Farmers and Workers

- Training programs (via BCI, GOTS, etc.) help cotton and jute farmers understand ecosystem services, soil health, and biodiversity.

10. Fair Trade & Traceability

- Brands promote transparency in sourcing, allowing consumers to support biodiversity-positive products.

Governance (G) Practices

11. Biodiversity Commitments in Sustainability Policies

- Large Indian textile companies (like Arvind, Welspun, and Raymond) now include biodiversity goals in ESG/sustainability reports.
- Some align with SDG 15 (Life on Land) and SDG 6 (Clean Water & Sanitation).

12. Third-Party Certifications & Audits

ESG-aligned firms often obtain certifications like:

- **GOTS:** The Global Organic Textile Standard (GOTS) is a leading international certification that ensures textiles are produced organically and sustainably, encompassing environmental and social criteria throughout the supply chain. India has consistently held the top position globally for GOTS-certified facilities[241]. As of 2020, the country had 3,015 certified facilities, reflecting its significant role in organic textile production[242].

- **Fairtrade:** India is one of the largest Fairtrade-certified cotton producers.
  - Fairtrade Certification covers:
  - Fair Prices: Farmers receive a minimum price plus a Fairtrade Premium.
  - Worker Rights: Freedom of association, safe working conditions, no child labor.
  - Environmental Standards: Restricted chemical use, soil/water conservation.
  - Empowerment: Cooperatives and small producer organizations have decision-making power.

[241] https://www.indiantextilemagazine.in/gots-certified-facilities-india-tops-the-list

[242] https://global-standard.org/images/resource-library/documents/GOTS_Word_Annual_Report_2020.pdf

Indian Businesses & Brands following Fairtrade

- **Rajlakshmi Cotton Mills (West Bengal)**
  Rajlakshmi Cotton Mills is one of India's pioneering and largest Fairtrade-certified garment exporters. The company sources organic Fairtrade cotton primarily from cooperatives like Chetna Organic, ensuring ethical sourcing and environmentally responsible production. Rajlakshmi supplies to several leading global ethical fashion brands, including People Tree (UK) and Nudie Jeans, and has played a key role in mainstreaming Fairtrade garments in international markets.
- **No Nasties (Goa)**
  No Nasties holds the distinction of being India's first fully Fairtrade and organic clothing brand. It offers apparel made entirely from 100% Fairtrade-certified cotton cultivated by Indian farmers. With a strong emphasis on transparency, No Nasties maintains a fully traceable supply chain—from farm to shelf—providing consumers with clear insight into the ethical origins of their garments.
- **Chetna Organic (Maharashtra, Andhra Pradesh, Odisha)**
  Chetna Organic is a farmer-owned cooperative certified under the Fairtrade system, operating across Maharashtra, Andhra Pradesh, and Odisha. The organization supplies organic and Fairtrade cotton to a range of Indian and international textile brands. In addition to market access, Chetna provides its farmer members with training, Fairtrade premiums, and sustainable agricultural inputs, thereby improving livelihoods and promoting environmentally sound farming practices.

- **Responsible Wool/Cashmere Standards**
  The **Responsible Wool Standard (RWS**) is a globally recognised certification that addresses animal welfare, sustainable land management, and social responsibility in the wool supply chain. Let's break down how it's being applied, especially in **India,** and how it connects to **restoring degraded grazing lands**

- **Rainforest Alliance (for natural rubber or cellulose-based textiles)**
  The Rainforest Alliance (RA) certification is gaining momentum in India, especially in natural rubber and cellulose-based textile supply chains (like viscose, lyocell, and modal). RA is preventing deforestation, helping preserve the high conservation value areas, and encouraging responsible agrochemical use, soil health and water conservation, as well as safe labour conditions and living wages. RA-certified rubber plantations are still limited in India, Indian manufacturers are increasingly sourcing RA-certified rubber from Southeast Asia for export products such as tires, footwear, and industrial goods.

- **Rainforest Alliance & Cellulose-Based Textiles**
  Cellulose-based fibres come from wood pulp, and RA certification ensures that the pulp is sourced from sustainably managed forests, is free from deforestation or illegal logging, and is also supporting indigenous and community land rights. Indian Companies Aligning with Rainforest Alliance for Cellulose Textiles include Aditya Birla Group – Birla Cellulose. Aditya Birla Group's Birla Cellulose is one of

the world's largest producers of viscose and modal fibres and has emerged as a key Indian company aligning with the Rainforest Alliance (RA) for sustainable cellulose textile production. A significant portion of its wood pulp is sourced from RA-certified forests, ensuring responsible forest management and biodiversity conservation. The company has also been recognized as a global leader in Canopy's Hot Button Ranking, which evaluates producers on their efforts to protect ancient and endangered forests. Birla Cellulose is committed to full supply chain traceability and adopts a strong focus on environmental sustainability across its operations.

Its flagship brand, Liva, is marketed as a sustainable fashion fabric and is often produced using pulp from RA-certified sources. Liva actively collaborates with leading Indian fashion brands such as Pantaloons, Global Desi, and Allen Solly to promote eco-friendly fashion. The brand emphasizes sustainable production methods throughout the value chain, including weaving, dyeing, and finishing processes, thereby reducing the environmental footprint of cellulose-based textiles.

Traceability & Standards Link

The Rainforest Alliance doesn't certify finished textiles but certifies the forests and plantations (where the raw pulp or rubber latex originates), and the chain of custody ensures traceability from forest to fiber manufacturer. So, Indian brands like Birla Cellulose source RA-certified pulp from abroad (e.g., South America or Southeast Asia), process it in India, and sell the final fibers to garment manufacturers globally. Indian Brands FabIndia, Biba, Global Desi, Pantaloons and AND are indirectly Using RA-Certified Fibers. These brands may not be directly RA-certified, but they use Livaeco or RA-aligned viscose.

13. Disclosures through ESG Frameworks

Many corporates in this sector use platforms like CDP, GRI, or BRSR (Business Responsibility and Sustainability Report) to disclose their actions on biodiversity. Some of the major Textile & Apparel Companies in India using these platforms for biodiversity-linked disclosures are highlighted below:

- **Arvind Limited**
  Arvind Limited is a leading Indian textile company that adheres to the Global Reporting Initiative (GRI) and Business Responsibility and Sustainability Reporting (BRSR) frameworks to disclose its sustainability performance. The company provides detailed reporting on its sourcing of organic cotton, sustainable dyeing technologies, and water use in biodiversity-sensitive regions. Given its large operational footprint in water-scarce areas such as Gujarat, Arvind is also an active participant in the CDP Water Disclosure program, reinforcing its commitment to responsible water management and ecosystem protection.

- **Raymond Group**
  Raymond Group reports its sustainability initiatives through both GRI and BRSR platforms. The company highlights its use of Responsible Wool Standard (RWS)-certified wool, which supports biodiversity-friendly grazing practices. Additionally, Raymond has invested in Zero Liquid Discharge (ZLD) units and afforestation efforts in Maharashtra, aligning its operations with water conservation and biodiversity restoration goals.

- **Welspun India**
  Welspun India is a proactive participant in multiple sustainability disclosure frameworks, including CDP for both water and climate, as well as GRI and BRSR. The company places strong emphasis on afforestation and biodiversity restoration near its industrial zones. It leverages blockchain technology to ensure traceability of sustainable cotton and to prevent sourcing from deforestation-linked supply chains. As a member of the Sustainable Cotton Challenge, Welspun is further advancing responsible sourcing in the cotton value chain.

- **Aditya Birla Group (Birla Cellulose)**
  Aditya Birla Group's Birla Cellulose has emerged as a global leader in sustainable viscose production, ranking at the top of Canopy's Hot Button Ranking for its commitment to protecting ancient and endangered forests. The group reports under GRI, CDP, and BRSR frameworks, disclosing the use of Rainforest Alliance-certified pulp and its commitment to zero deforestation and biodiversity-positive sourcing. Its Livaeco brand integrates QR-coded traceability, allowing consumers to track fibers back to responsibly managed forests, enhancing transparency and accountability.

- **Vardhman Textiles**
  Vardhman Textiles complies with both GRI and BRSR reporting standards and focuses on reducing environmental impact through innovation in materials and water management. The company's Renova line of recycled fibers helps reduce dependence on virgin raw material extraction, thereby easing pressure on natural ecosystems. Vardhman also emphasizes water stewardship in high-stress regions, indirectly supporting biodiversity by mitigating ecological degradation linked to unsustainable water use.

As regulations evolve, biodiversity-specific metrics (e.g., through TNFD – Taskforce on Nature-related Financial Disclosures) are expected to grow in Indian textile reporting.

4.6.6 Case studies of CSR-supported biodiversity conservation practices by the Indian Textile sector

4.6.6.1 H&M Group: Regenerative Agriculture in Satpura-Pench Corridor

In the **Satpura-Pench wildlife corridor** of Central India, H&M Group, in partnership with WWF, have initiated a regenerative agriculture project aimed at supporting smallholder cotton

farmers. This initiative focuses on enhancing on-farm biodiversity, improving soil health, and maintaining vital wildlife corridors. By adopting practices such as natural fertilisation, crop diversification, and habitat creation for beneficial insects, the project benefits both the environment and the farmers' economic well-being. As of 2023, 3,000 farmers are involved, with plans to expand to 6,000 by the end of 2025[243].

This region is a vital habitat for species such as tigers, leopards, sloth bears, and red-headed vultures[244]. The project aims to support smallholder cotton farmers in adopting regenerative farming practices that benefit both local communities and biodiversity.[245]

The Regenerative Agriculture project in Satpura-Pench was launched: 2021[246] in the Satpura-Pench corridor, Madhya Pradesh, India[247] with a focus on transitioning smallholder cotton farmers to regenerative agriculture to enhance biodiversity and community resilience[248]

Biodiversity and Ecosystem Impact

The initiative plays a critical role in preserving the Satpura-Pench wildlife corridor, which connects key protected forest areas and enables the safe movement of wildlife such as tigers and leopards. By promoting regenerative farming practices, the project helps minimize habitat fragmentation, thereby maintaining ecological continuity across this vital landscape. The elimination of synthetic pesticides and fertilizers contributes to healthier soils and supports pollinator populations, which are essential for sustaining ecosystem balance and agricultural productivity. Moreover, the project places strong emphasis on community engagement, fostering local ownership and governance of conservation efforts to ensure long-term ecological stewardship that is both sustainable and culturally aligned with local traditions.

Agricultural Practices and Farmer Benefits

Farmers involved in the initiative are trained in regenerative agricultural techniques such as intercropping, use of organic compost, and biological pest control. These practices enhance soil fertility, improve farm resilience, and reduce dependency on chemical inputs. Early results from the field show a decline in pest populations and a reduction in input costs, translating into improved economic outcomes for farmers. The project, which started with 150 farmers, has set an ambitious goal of scaling up to over 6,000 farmers within four years. This expansion aims to create a replicable model for landscape-level agricultural transformation that balances productivity with biodiversity conservation.

[243] https://hmgroup.com/wp-content/uploads/2022/03/HM-Group-Sustainability-Disclosure-2021.pdf

[244] https://www.wwf.se/english/hm-partnership-results/biodiversity

[245] https://hmgroup.com/our-stories/weaving-the-thread-between-nature-and-fashion

[246] https://www.linkedin.com/pulse/beyond-limits-24062024-limitlessinnovationluxury-9am5f

[247] https://hmgroup.com/sustainability/circularity-and-climate/biodiversity

[248] https://hmgroup.com/sustainability/circularity-and-climate/biodiversity

Integration into H&M's Supply Chain

H&M has incorporated cotton from this initiative into its product lines, including a mini summer capsule collection made from regenerative cotton. This move aligns with H&M's broader commitment to sustainability and responsible sourcing[249]

H&M and a Resilient Value Chain for Biodiversity Conservation in India

H&M Group has been actively working toward making its global supply chain more sustainable and resilient. In India—one of H&M's key sourcing hubs—there is an opportunity to further align with biodiversity conservation efforts while reinforcing value chain resilience. One such Initiative by H&M is "Biodiversity Threads", a collaboration between H&M, local farmer cooperatives in Madhya Pradesh, and biodiversity NGOs to develop a regenerative cotton program that includes native plant species, supports pollinators, and incorporates nature-positive certifications.

These initiatives reflect a growing commitment within the textile industry to integrate biodiversity conservation into CSR strategies, aiming to mitigate environmental impacts and promote sustainable development[250].

4.6.6.2 ITC textile and paper Division's Biodiversity Conservation in Sarapaka, Telangana

ITC Limited has implemented a biodiversity conservation program in Sarapaka, Telangana, covering 1,000 acres. This initiative is part of a broader effort spanning 470,000 acres across 38 districts in 10 Indian states. The program focuses on protecting biodiversity within agricultural value chains, involving communities in landscape restoration, and implementing nature-based solutions to revive ecosystem services.[251].

ITC Limited has implemented a comprehensive biodiversity conservation initiative in Sarapaka, Telangana, aligning with its commitment to sustainable development and environmental stewardship. This initiative is particularly significant due to its proximity to ITC's Paperboards & Speciality Papers Division (PSPD) unit in Sarapaka, near Bhadrachalam, Bhadradri Kothagudem district.[252]

Key Components of the Sarapaka Biodiversity Conservation Initiative

1. **Soil and Moisture Conservation (SMC) Measures:** Under the Mission Sunehra Kal program, ITC, in collaboration with the local forest department, has implemented various SMC activities to enhance soil fertility and water retention. These measures include construction of two mini percolation tanks, 20 rockfill dams, 15 stone gully plugs, and four

[249] https://fashionunited.uk/news/fashion/h-m-presents-presents-first-mini-collection-made-from-regenerative-cotton/2024061776109

[250] Biodiversity - H&M Group

[251] Learning from Sweden to make textiles climate-smart | ITC

[252] https://www.itcportal.com/sustainability/biodiversity-conservation.aspx

sunken ponds. These structures aim to increase moisture levels in approximately 250 acres of forest area, thereby reducing soil erosion and promoting vegetation growth.

2. **Afforestation and Habitat Restoration:** ITC has undertaken afforestation efforts to restore degraded forest lands, which contribute to enhancing biodiversity by providing habitats for various flora and fauna, improving carbon sequestration and mitigating climate change impacts
3. **Community Engagement and Livelihood Support:** The initiative emphasises community involvement by engaging local communities in conservation activities, thereby fostering a sense of ownership and responsibility towards the environment and providing alternative livelihood opportunities through sustainable practices, reducing dependency on forest resources.

Integration with ITC's Textiles and Paperboards Operations

The Sarapaka initiative complements ITC's broader sustainability goals, particularly in its Paperboards & Speciality Papers Division (PSPD). The PSPD unit in Sarapaka sources pulp from its in-house mill, and the conservation efforts contribute to a sustainable supply of raw materials through responsible forestry practice. It also maintains an ecological balance in the surrounding areas, which is crucial for the long-term viability of the paper and textiles industry.

Recognition and Awards

ITC's commitment to biodiversity conservation has been acknowledged through various accolades, including the **UNDP Mahatma Award** in 2023, recognising its self-sustaining, human-centric approach to environmental stewardship.

4.6.6.3 Tirupur hosiery cluster biodiversity-focused initiatives

1. **Afforestation Initiatives:** The "Vanathukul Tirupur" initiative, led by the NGO VETRY and supported by local garment units, has resulted in the planting of approximately 1.5 million saplings over eight years. This large-scale afforestation effort aims to increase green cover, improve air quality, and support local biodiversity by creating habitats for various species.
2. **Water Body Rejuvenation:** Efforts have been made to rejuvenate local water bodies, which are crucial for maintaining aquatic ecosystems and supporting biodiversity. Restoring these water bodies helps in sustaining various life forms and contributes to the overall health of the environment.
3. **Sustainable Water Management:** The implementation of Zero Liquid Discharge (ZLD) systems in Tirupur's textile processing units ensures that wastewater is treated and recycled, preventing pollution of local waterways. This practice protects aquatic life and maintains the integrity of freshwater ecosystems.

4.6.6.4 Welspun Group's Biodiversity Initiatives

1. **Tree Plantation Programs:** Welspun India Limited has undertaken extensive tree plantation drives in regions like Anjar, Vapi, and Dahej in Gujarat, planting over 36,000

saplings. These efforts have transformed arid landscapes into green areas, enhancing local biodiversity and contributing to environmental sustainability[253].

2. **Green Corridors and Habitat Restoration:** Welspun Enterprises constructs projects that minimize impacts on wildlife habitats and sensitive ecosystems. Their efforts include creating green corridors and restoring degraded ecosystems to protect biodiversity hotspots[254].
3. **Community Engagement in Conservation:** Through the Welspun Foundation for Health and Knowledge (WFHK), the company engages in environmental conservation activities, including sustainable road building and safety education, benefiting over 800,000 individuals[255].

Welspun Group – Biodiversity & Environmental Initiatives

Initiative Area	Description
Water Body Restoration	Rejuvenated **Kamvari River** near Anjar, Gujarat – improved water table & aquatic biodiversity.
Afforestation Drives	Planted **over 100,000 trees** near facilities to combat land degradation and enhance biodiversity.
Eco-restoration of Wasteland	Transformed **degraded land** around Anjar industrial areas into green zones.
Wetland Development	Constructed **artificial wetlands** to treat wastewater and provide habitats for birds and fish.
Zero Liquid Discharge (ZLD)	Factories in Gujarat operate on **100% ZLD**, preventing pollution of local ecosystems.
Rainwater Harvesting	Extensive systems across campuses to reduce reliance on freshwater and recharge groundwater.

Welspun Group – CSR Initiatives Linked to Biodiversity & Sustainability

CSR Focus Area	Program Details
Water Conservation	Constructed **400+ check dams,** farm ponds, and recharge wells benefiting **over 200 villages.**
Smart Agriculture	Promotes **natural farming, micro-irrigation,** and soil health with 5,000+ farmers.
Sustainable Livelihoods	Trains rural youth and women in **organic farming, nursery management, and textile-related skilling.**
Community Forest Creation	Developed **community green belts** in collaboration with Panchayats and local eco groups.
Sanitation & Clean Water	Supports clean drinking water access and **hygiene education** in biodiversity-vulnerable villages.

[253] Tree Plantation- CSR Projects India

[254] Welspun Enterprises | Infrastructure Developer in India

[255] welspunenterprises.com/admin/uploads/sustainability-report/WEL - Sustainability Report.pdf

Reporting & Recognition

- **BRSR Compliant –** Biodiversity impact integrated under SEBI's Principle 6 (environment).
- **GRI Reporting –** Discloses environmental KPIs (reforestation, water bodies, energy).
- **CDP Water Security –** Reports efforts in high-stress water zones like Gujarat.
- **Aligned with UN SDGs –** Especially SDG 6 (Clean Water), SDG 15 (Life on Land), and SDG 13 (Climate Action).

Innovation for Sustainability

- **Blockchain-enabled Cotton Traceability –** Prevents raw material sourcing from deforestation or illegal farming.
- **Sustainable Product Lines –** Offers products made from recycled PET bottles, organic cotton, and eco-viscose.
- **Green Manufacturing –** Solar and wind energy used across facilities; explores circular economy models.

4.6.6.5 Vardhman Textiles' Biodiversity-focused initiatives

Vardhman Textiles has implemented a comprehensive biodiversity conservation strategy as part of its broader sustainability and ESG commitments. Key initiatives include[256]:

Afforestation & Ecosystem Restoration

- **Degraded Land Restoration:** Planting approximately 700,000 bamboo saplings across 1,200–1,500 hectares to rehabilitate degraded land.
- **Miyawaki Forests:** Establishing dense, native forests on government land using species like neem, arjun, and moringa.
- **Tree Plantations in Madhya Pradesh:** Over the past decade, planting around 250,000 native trees, including palash, babool, and eucalyptus, across operational sites.

Sustainable Sourcing & Raw Materials

- **Cotton Sourcing:** In FY 2024, 31% of cotton and 29% of total raw materials were sustainably sourced, supporting biodiversity conservation in agricultural and forest areas[257].
- **Better Cotton Initiative (BCI):** Active membership since 2011, with Project Pragati supporting over 9,000 farmers in Gujarat and plans to expand to Karnataka[258].

[256] https://www.vardhman.com/Document/ESG/ESG%20Databook.pdf

[257] https://www.vardhman.com/Sustainability/Economic

[258] (9) "GreenWeave" a Sustainable Future: Vardhman's Commitment to ESG Excellence | LinkedIn

Policy & Governance

- **Biodiversity Protection and No Deforestation Policy:** This policy emphasises avoidance, minimisation, and restoration of biodiversity impacts, with oversight by the ESG Committee[259].
- **Awareness & Capacity Building:** Regular training programs and celebrations like World Environment Day and Van Mahotsav to promote biodiversity awareness among employees and communities.

ESG Integration & Green-Weave Initiative

- **Green-Weave Program:** Launched in collaboration with EY Parthenon, this initiative aims to enhance ESG performance, with a target to reduce greenhouse gas emissions by 46.2% by 2030.
- **Ecosystem Services Assessment:** Recognising dependencies on pollination, soil fertility, and climate regulation, Vardhman is integrating ecosystem service assessments into its risk management framework.

Through these initiatives, Vardhman Textiles demonstrates a strong commitment to biodiversity conservation, integrating environmental stewardship into its core business operations.

4.6.6.6 Other initiatives

Trident Group's Green Belt Initiative:

Trident Group, a prominent textile conglomerate, has demonstrated a strong commitment to biodiversity through its Green Belt initiative. The company's CSR arm, Trident Foundation, has successfully planted over 1 million trees across various locations. This extensive afforestation effort not only supports ecological balance but also enhances local biodiversity, contributing to a healthier environment for surrounding communities.

Grasim Industries' Livaeco Initiative:

Grasim Industries has launched 'Livaeco,' a sustainable brand of viscose fabric that emphasises environmental conservation. Livaeco focuses on saving water, increasing forest cover, and reducing CO2 emissions. The initiative ensures that the fabric is sourced from certified sustainable forests, thereby promoting responsible consumption and contributing to biodiversity preservation.[260].

These examples illustrate the Indian textile sector's commitment to sustainable practices that conserve biodiversity, support local communities, and promote ecological balance.

[259] https://vardhman.com/Document/Report/Company%20Information/Policies/Vardhman%20Textiles%20Ltd/Biodiversity_Protection_and_No_Deforestation_Policy.pdf

[260] Top 10 Companies for CSR in Environment Conservation in 2023 - The CSR Journal

4.6.7 Challenges and gaps in the biodiversity conservation practices by the Indian Textile sector

The Indian textile sector, while increasingly adopting sustainability measures, still faces several challenges and gaps in effectively conserving biodiversity. Here's a breakdown:

1. Textile Operations & Biodiversity: Limited Awareness and Prioritization

Biodiversity is a low priority: Many textile businesses prioritise water, energy, and chemical management, while biodiversity often remains an overlooked aspect. There's limited awareness of how textile operations directly or indirectly affect biodiversity (e.g., habitat loss, water pollution).

In India, despite being one of the largest textile producers globally, there's limited mainstream awareness of how textile operations impact biodiversity, both directly and indirectly. Some of the significant reasons behind low awareness in India are as follows:

- Focus on livelihoods & employment (the sector employs 45 million people) often overshadows ecological considerations.
- Lack of publicly available environmental audit data from most textile manufacturers.
- Absence of biodiversity considerations in sustainability communication (most focus on water or carbon metrics).
- Limited consumer pressure for "biodiversity-safe" fashion.

2. Water Pollution and Eutrophication:

The Indian textile industry significantly contributes to water pollution and eutrophication, adversely affecting aquatic ecosystems and biodiversity. Despite the adoption of Zero Liquid Discharge (ZLD) in some clusters like Tirupur, not all regions follow strict wastewater treatment norms. Effluents containing toxic dyes, heavy metals, and microfibers continue to affect aquatic ecosystems and soil biodiversity.

3. Use of Harmful Chemicals:

Conventional dyeing and finishing processes involve chemicals that are harmful to both human health and ecosystems. Lack of strict enforcement of chemical management protocols (e.g., ZDHC standards) across smaller and informal units is a concern.

4. Monoculture and GM Cotton Cultivation:

The widespread use of Bt cotton and monoculture practices reduces agricultural biodiversity and soil health. The use of pesticides and herbicides harm beneficial insects, birds, and the surrounding flora and fauna.

5. Fragmented Efforts & Lack of Integrated Approaches:

Most biodiversity initiatives are isolated or CSR-driven, lacking integration with business strategy or landscape-level conservation. Absence of standardized biodiversity benchmarks or KPIs in sustainability reporting frameworks.

a. Siloed Sustainability Initiatives

- Companies often treat water, waste, and emissions separately from biodiversity.
- Even CSR projects on tree plantation or water conservation rarely tie back to ecosystem services or local species conservation.

b. No Common Biodiversity Framework

- Unlike carbon accounting (which has standardised protocols), there's no unified biodiversity assessment framework adopted widely across India's textile sector.
- This leads to inconsistent impact metrics and disconnected efforts.

c. CSR Core Strategy

- Most biodiversity-related work is still under CSR or philanthropy, not embedded into supply chain management or product design.
- For example, ITC and H&M have strong pilots, but there's no sector-wide push to mainstream such initiatives.

d. Weak Inter-Stakeholder Coordination

- Fragmentation exists between brands, suppliers, NGOs, and policymakers.
- Suppliers often lack knowledge or incentives to invest in nature-positive practices unless the buyer insists, and buyers rarely coordinate with each other.

6. Informal Sector and Supply Chain Complexity:

A large portion of the textile industry is unorganized, especially in dyeing, printing, and finishing. These units often lack the capacity or incentive to adopt biodiversity-conscious practices.

Informal Sector & Supply Chain Complexity

India's textile sector is deeply fragmented, with:

- Around 80% of garment manufacturing units operating in the informal or semi-formal sector
- A multi-tiered supply chain, especially for cotton:
  farmer → aggregator → ginner → spinner → weaver → dyer → finisher → garment unit → exporter/brand

This complexity poses several challenges for biodiversity-positive practices to scale.

1. **Lack of Traceability**
   - Cotton or dyes from unsustainable sources can easily mix into the supply chain.
   - Small-scale players often lack the tools or incentives to document sourcing, let alone assess biodiversity impact.

2. **No Access to Green Finance or Incentives**
   - Informal actors **cannot access ESG-linked financing,** government subsidies, or brand-driven sustainability programs that could support biodiversity-safe practices (like bio-pesticides, rainwater harvesting, or natural dyes).

3. **Fragmented Accountability**
   - In a chain where responsibility is diffused, no one actor feels fully accountable for biodiversity loss — making collective action very difficult.
   - Brands may commit to biodiversity targets, but subcontractors upstream often aren't included in those commitments.

What's Needed: A Biodiversity-Conscious Supply Chain

- **Inclusive Traceability Systems:** Platforms like TraceBale or blockchain-based tools must be adapted to reach informal players.
- **Local Biodiversity Training + Mapping:** Cluster-level training for small units on how their operations impact local species, water bodies, and soil life.
- **Incentives for Informal Units:** Link biodiversity-positive behaviour to access to orders, microloans, or subsidies from CSR programs or state schemes.
- **Brand-Led Integrated Models:** Brands should build long-term sourcing relationships that include biodiversity KPIs not just at the farm, but across dyers, weavers, and finishers.

7. Data Deficiency and Impact Monitoring: A Hidden Barrier to Biodiversity in India's Textile Value Chain:

Few companies track the actual impact of their biodiversity initiatives, making it difficult to scale or refine practices. Absence of region-specific biodiversity data linked to textile clusters hampers informed action.

Despite growing sustainability efforts by Indian textile brands and global buyers, most initiatives do not measure biodiversity impact - and where they do, the data is:

- Scattered (across farm-level audits, water quality reports, or NGO field notes)
- Non-standardized (no shared metrics for "biodiversity impact")
- Largely qualitative (e.g., "awareness raised," "tree cover improved")
- Short-term (one-off studies vs. long-term ecological monitoring)

What's Needed

Action	Description
Baseline Mapping	Conduct biodiversity assessments in priority sourcing geographies (farmlands, dyeing clusters, etc.)
Monitoring Frameworks	Align with global protocols (e.g., **GBF Targets, TNFD, or SBTN**) to track biodiversity gains/losses
Tech Tools	Use remote sensing, bioacoustics, camera traps, and citizen science to collect ecological data
Indicators	Develop **textile-relevant biodiversity KPIs:** e.g., pollinator counts, aquatic species richness, water quality, native species regeneration
Transparency	Publicly report impact via sustainability disclosures (e.g., GRI, BRSR) and encourage third-party verification

"What gets measured gets managed — and biodiversity will only become central to textile sustainability once we track it like we track carbon or water."

8. Regulatory Gaps and Weak Enforcement:

Inconsistent enforcement of environmental norms across states. Biodiversity laws (like the Biological Diversity Act, 2002) are not well-integrated with industrial environmental compliance frameworks. Some of the key regulatory gaps are as follows:

a. Biodiversity is Not part of a Compliance Metric

- Textile factories are not required to assess or report biodiversity risks — only pollution levels or waste management.
- Even environmental impact assessments (EIAs) for large units often ignore biodiversity (or use outdated/desktop-level species data).

b. No Mandate for Biodiversity Integration in Cotton or Agro-Inputs

- Pesticide-intensive cotton farming, which severely affects pollinators and soil life, is regulated by the Insecticides Act — not biodiversity-linked laws.
- No biodiversity due diligence is required for supply chains, farming practices, or factory expansions.

c. Weak Enforcement at Local Levels

- State Pollution Control Boards (SPCBs) are overburdened and underfunded.
- Even when environmental violations are identified (e.g., untreated effluent discharge in dyeing clusters), fines are minimal and rarely enforced.

d. CSR & ESG Guidelines Lack Teeth

- India's CSR guidelines encourage biodiversity projects, but there's no standard or audit process.

- ESG reporting norms (like BRSR) are evolving, but biodiversity is still non-core, compared to carbon or energy.

What Needs to Change

Reform Area	Recommendation
Policy Mandates	Require biodiversity risk screening for new textile projects and expansions
Disclosure Norms	Mandate biodiversity KPIs in BRSR and sustainability reporting for textile firms
EIAs	Strengthen biodiversity components in environmental assessments — using current, local species data
Incentive Schemes	Link government textile incentives (e.g., PLI, TUFS) to biodiversity-safe practices
Multi-Agency Action	Coordinate Ministry of Environment, Ministry of Textiles, and State Boards to jointly monitor ecological impact

4.6.8 Opportunities with the Indian Textile sector for further action to boost biodiversity

India's textile sector—rich in history, craft, and scale - has a significant role to play in supporting biodiversity. From sourcing raw materials to waste management, the sector intersects with ecosystems at multiple points. Here's how we can leverage that:

1. Promoting Biodiverse Raw Material Cultivation

- Diversify fibre crops: Move beyond monoculture cotton to include indigenous and biodiverse fibres like hemp, flax, ramie, jute, banana fibre, lotus stem, etc.
- Revive indigenous cotton species like Desi cotton (Gossypium arboreum), which are more resilient and need less water and pesticides.

2. Supporting Regenerative & Organic Agriculture

- Encourage farming systems that improve soil health, pollinator populations, and surrounding habitats.
- Build partnerships with textile brands to source organically and regeneratively grown fibres.

3. Eco-Friendly Dyes and Processing

- Natural dyes (from plants, minerals, and insects) reduce water pollution and protect aquatic biodiversity - Invest in R&D for scalable natural dye solutions, train artisans and industries in safe dye extraction and application methods, create policies favouring eco-certifications and clean processing.

4. Sustainable Manufacturing and Circularity

- Reduce textile waste that ends up in landfills or pollutes ecosystems.
- Reuse and recycle textiles through circular economy models.

5. Revival of Traditional Textile Ecosystems

- Indian handlooms and artisanal textiles are often deeply integrated with local ecological knowledge. Support clusters that use eco-conscious practices and indigenous biodiversity (e.g., wild silks like eri and muga).
- Develop Geographical Indication (GI) tags that include biodiversity conservation as a criterion.

6. Biodiversity Impact Assessments

- Textile companies can integrate biodiversity impact into ESG frameworks. Encourage mandatory biodiversity audits for textile manufacturing zones.
- Partner with NGOs and local communities to monitor biodiversity health in areas affected by textile operations.

7. Policy & Public-Private Partnerships

- Government and industry collaboration can fast-track biodiversity-sensitive approaches.
- Create incentives for biodiversity-friendly textiles (tax benefits, grants, awards).
- Launch awareness campaigns linking sustainable fashion to biodiversity conservation.

The Indian textile sector, with its global influence and local depth, has the power to become a biodiversity champion. With the right investments, collaborations, and policies, it can not only reduce its impact on ecosystems but also actively contribute to their restoration.

4.7 Automobile Sector in India

4.7.1 Overview

Automotive manufacturing in India accounts for 49% of the country's manufacturing gross domestic product (GDP), 7.5% of the overall GDP, and 32 million jobs, thus making it a recognized core sector.[261].

In FY2024, the **total turnover** of the automotive industry in India was INR 20 Lakh crores.[262]. The **Indian automotive market demand was pegged at 3,641,233 units in 2022** and is expected to grow at a Compound Annual Growth Rate (CAGR) of 9.7% from 2023 to 2030[263].

India is the fourth-largest automotive market in the world, with a penetration of 33 automobiles per 1,000 people. India, the world's third-largest producer of Greenhouse Gases (GHG) (after China and the United States of America), accounts for 90% of the carbon dioxide (CO2) emissions from road transportation[264].

[261] India Automotive Sustainability Evolution

[262] India's Automobile Industry: Growth & Trends | IBEF

[263] India Automotive Market Size & Share | Industry Report, 2030

[264] https://www.capgemini.com/in-en/insights/expert-perspectives/sustainability-in-automotive-industry-an-india-perspective/

4.7.2 Biodiversity impacts of the automotive sector

The automotive sector's interface with biodiversity is multifaceted and expands along the value creation chain. In the journey from raw material extraction to the production, use and later to waste management of automobiles, there is a range of ecological impacts of high relevance to biodiversity conservation. Exploiting raw materials is especially often related to serious intrusions into ecosystems and habitats. A lot of the mining sites providing raw materials to the sector, are in regions rich in species and fragile ecosystems. The sector depends directly as well as indirectly on biological diversity, intact ecosystems and ecosystem services, such as:

- Allocation of renewable resources, e.g. filling elements like coconut, optical pleasing wood for armatures, natural rubber for tyres and leather for seats
- Regulated services, e. g. water supply for production processes, sink functions for car emissions
- Supply of bioenergy plants to produce biofuels.
- Steel production relies on coal, emitting CO2 and air pollutants like nitrogen and sulphur oxides.
- Aluminium production is energy-intensive, leading to indirect GHG emissions and the release of perfluorocarbons and water pollutants.
- Plastic production contributes to GHG emissions throughout its lifecycle, including during raw material extraction, processing, and transportation.
- Water contamination via discharge of surfactants, detergents, dust, mud, oil, and grease poses toxicity risks to animals and disrupts nutrient balances in water bodies due to the presence of phosphates found in some acids.

Biodiversity and Environmental Impacts of the Sector in India

The growth of the automotive and electric vehicle (EV) sector has led to several environmental concerns, particularly related to biodiversity and ecosystem health. One of the major impacts is land use and habitat disruption. The construction of manufacturing plants, supporting infrastructure, and expanding transport networks often results in habitat loss and fragmentation, threatening local wildlife and reducing ecological connectivity. Additionally, pollution from vehicle emissions and industrial waste contributes to the degradation of air, water, and soil quality, further harming surrounding ecosystems.

The sector's transition toward EVs, while reducing tailpipe emissions, brings new challenges related to resource extraction. The rising demand for minerals such as lithium and cobalt—critical components in EV batteries—has intensified mining activities, many of which are situated in ecologically sensitive and biodiverse regions. These mining operations can lead to deforestation, soil erosion, water contamination, and disruption of local communities and species, highlighting the need for more responsible sourcing and environmental safeguards in the EV supply chain.

Key Data and Trends (2024–25)

- **EV Adoption Surge:** India's EV adoption rose dramatically from 0.7% of total motor vehicle sales in 2020 to 6.3% in 2024, with nearly 5 million EVs on the road
- **Policy Initiatives:** The government has launched green initiatives to reduce carbon emissions, including the implementation of BS-VI norms and promoting compressed biogas
- **End-of-Life Vehicle Management:** Draft rules propose an Extended Producer Responsibility system for car manufacturers, ensuring responsible disposal of vehicles, including EV.
- **Sustainability Focus:** The Indian automotive industry is transforming with government subsidy schemes under the National Electric Mobility Mission Plan (NEMMP) and the Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles (FAME) scheme.

Emerging Trends

The automotive and electric vehicle (EV) industry is undergoing a significant transformation driven by a convergence of climate, technology, and geopolitical factors. Climate considerations are now at the forefront, with sustainability becoming a core priority for manufacturers and policymakers alike. There is growing emphasis on reducing greenhouse gas emissions and transitioning to greener technologies, including electric mobility and low-carbon manufacturing practices.

Technological advancements are accelerating this shift. The sector is experiencing rapid innovation, particularly in battery-swapping technologies that enhance convenience and reduce charging downtime. The two-wheeler EV market is also expanding swiftly, offering scalable solutions for urban mobility and last-mile transport.

At the same time, global supply chain dynamics are prompting a strategic pivot toward localization. In response to globalization fractures and import dependencies—especially for critical EV components—efforts are being made to strengthen domestic manufacturing and build resilient local supply chains. This shift not only improves economic self-reliance but also supports more transparent and sustainable production practices.

Industry Initiatives

- **Sustainable Manufacturing:** Corportaes like Tata Motors, Maruti, Hyundai, TVS, Hero, and Ashok Leyland are investing in sustainable manufacturing practices to reduce environmental impact
- **Supply Chain Transparency:** There's a growing emphasis on transparency in the supply chain to address ecological impacts and promote industry-wide sustainable practices.

India's automotive sector is at a pivotal point, integrating biodiversity considerations into its operations and strategies. The convergence of policy support, technological innovation, and consumer demand is steering the industry towards a more sustainable and environmentally conscious future.

4.7.3 Regulatory and policy landscape for the Indian automobile sector for Biodiversity conservation and restoration

4.7.3.1 India-Specific Frameworks and Regulations

Some of the important standards, protocols, and initiatives that intersect with biodiversity conservation and the automobile sector are highlighted below:

Though not traditionally biodiversity-focused, India's regulatory framework increasingly integrates environmental safeguards that indirectly promote biodiversity conservation. These apply particularly to auto manufacturing operations, supply chains, and emissions.

As part of its commitment to reduce carbon emissions, the Indian government has implemented various measures to support the transition to sustainable and green mobility. These initiatives include imposing stricter regulations on conventional single-fuel vehicles and offering incentives to encourage the adoption of alternative, eco-friendly vehicles and fuels.[265]. Some of the regulations and government initiatives which facilitate biodiversity conservation are mentioned below:

1. **Environment Impact Assessment (EIA) Notification, 2006**

   Mandatory for new automobile manufacturing plants and expansion projects.

   Biodiversity relevance:

   - Projects near **eco-sensitive zones (ESZs),** national parks, or **wildlife sanctuaries** require additional scrutiny.
   - Companies must submit a **Biodiversity Management Plan** if local flora/fauna are at risk.
   - Impacts on **wetlands, migratory routes, and forest patches** are assessed.
   - Stipulates **mitigation measures** and **biodiversity management plans.**

2. **Hazardous Waste Management Rules, 2016**

   - **Who it applies to:** All auto OEMs and component manufacturers.
   - **Biodiversity relevance:**
     - Improper disposal of solvents, oils, and batteries harms soil, water bodies, and terrestrial/aquatic species.
     - Mandates safe handling of waste that could otherwise damage ecosystems.

   Mitigates contamination-related biodiversity risks.

[265] Sustainable Innovations Revolutionizing the Automotive Industry

3. BS-VI Emission Norms

- **Administered by:** Ministry of Road Transport & Highways (MoRTH)
- **Biodiversity relevance:**
  - Curtails emissions of NOx, SOx, PM2.5, which damage plant life, alter soil chemistry, and reduce insect populations (e.g., pollinators).
  - *Improves **air and water quality** → key for preserving biodiversity in urban and peri-urban areas.*

4. The Production Linked Incentive scheme under the National Programme on Advanced Chemistry Cell (ACC) Battery Storage.

The scheme has a budget of INR 18,100 Cr, and it aims to fortify the Electric Mobility and Battery Storage ecosystem in the country. This initiative seeks to boost India's manufacturing capabilities in Advanced Chemistry Cell (ACC) by establishing Giga-scale ACC and battery manufacturing facilities, emphasising substantial domestic value addition. Beneficiary firms are required to achieve a minimum domestic value addition of 25%, progressively increasing it to 60% within five years[266].

5. National Biodiversity Action Plan (NBAP)

- While not auto-specific, companies with large manufacturing footprints (like auto OEMs) are expected to align with India's NBAP.
- Focuses on minimizing negative impacts on ecosystems and habitats near industrial zones.

6. Corporate Environmental Responsibility (CER)

- Under MoEFCC guidelines, industries (including automobile) are required to invest in activities that support environmental and biodiversity conservation.

4.7.3.2 Global Standards Adopted by Indian Auto Companies

1. ISO 14001 – Environmental Management System

- Widely adopted by Indian auto manufacturers.
- Encourages sustainable resource use and waste minimization, which reduces the ecological footprint.

2. Science-Based Targets Initiative (SBTi)

- Some Indian auto majors (like Tata Motors, Mahindra) have adopted SBTi, indirectly contributing to biodiversity conservation through emissions reduction.

3. Taskforce on Nature-related Financial Disclosures (TNFD) – Emerging adoption

- TNFD is gaining traction globally.

[266] Sustainable Innovations Revolutionizing the Automotive Industry

- Focuses on nature-related risks; Indian auto firms are beginning to explore its relevance in reporting and strategy.

4.7.3.3 Voluntary Corporate Pledges & Collective Action

1. India Business & Biodiversity Initiative (IBBI)

- Supported by CII and GIZ.
- Encourages companies, including auto firms, to integrate biodiversity in their supply chains, landscaping, and CSR efforts.

2. RE100 / EV100 / EP100 (by The Climate Group)

- Some auto companies (especially EV players) are part of these coalitions that promote clean energy, efficient energy use, and electric mobility — all of which reduce pressure on ecosystems.

3. Automotive Industry Standards (AIS) by ARAI

- While mostly focused on safety and emissions, improved emission standards like BS-VI (Bharat Stage VI) significantly reduce pollutants affecting flora and fauna.

4. Society of Indian Automobile Manufacturers (SIAM) – Six Pillars of Sustainability

SIAM has introduced a comprehensive framework encompassing six key initiatives[267]:

- **Javik Pahal (Biofuels):** Promoting biofuels derived from renewable biological materials
- **Vidyutikaran (Electrification):** Advancing electric mobility solutions
- **Gas Gatisheelta (Gaseous Fuels):** Encouraging the use of CNG and LNG[268]
- **Harit Hydrogen (Green Hydrogen):** Fostering hydrogen-based mobility
- **Chakriyata (Recycling):** Focusing on recycling and circular economy practices
- **Surakshit Safar (Safe Journey):** Enhancing road safety measures[269].

4.7.3.4 Sectoral Trends And ESG Integration

- **Lifecycle Assessments (LCAs):** Indian automotive companies are adopting LCAs to evaluate the environmental impact of their products throughout their lifecycle, promoting sustainable practices.

[267] https://www.business-standard.com/industry/auto/indian-auto-industry-is-driving-sustainable-mobility-through-6-initiatives-123080100328_1.html

[268] https://sundayguardianlive.com/business/govt-seeks-better-use-of-auto-sector-sops-by-industry-focus-on-sustainability

[269] https://www.business-standard.com/industry/auto/indian-auto-industry-is-driving-sustainable-mobility-through-6-initiatives-123080100328_1.html

- **Material Circularity:** The industry is focusing on recycling, refurbishing, and reusing materials to reduce dependency on virgin resources, thereby minimizing environmental impact.
- **Extended Producer Responsibility (EPR):** Automakers are increasingly accountable for the end-of-life management of their products, ensuring responsible recycling and disposal practices[270].

4.7.4 Case studies of best practices for Biodiversity conservation and Restoration by the Automobile sector

Few case studies highlighting best practices for biodiversity conservation by the automobile sector in India, focusing on leading companies that have integrated ecological restoration and biodiversity preservation into their operations:

1. Tata Motors – Biodiversity Park, Pune (Maharashtra)

Tata Motors has transformed a once barren, rocky basalt landscape adjacent to its Pimpri plant in Pune into a thriving 245-acre **biodiversity-rich wetland.** Initiated in the 1960s, prior to the establishment of the manufacturing facility, this pioneering ecological restoration project exemplifies the company's commitment to environmental stewardship[271].

The Pimpri Biodiversity Park stands as a model for ecological restoration and corporate-led environmental stewardship. Spread across a once-arid and rocky terrain, the park now thrives with over 150,000 trees, comprising 98 indigenous and 49 exotic species. This extensive green cover has not only transformed the landscape visually but also ecologically, offering a resilient habitat for diverse flora and fauna. The park has emerged as a sanctuary for local wildlife, with biodiversity surveys recording 48 species of birds, 16 species of butterflies, and 7 reptile species. Its significance as a breeding ground for Painted Storks and Grey Herons highlights the effectiveness of the conservation efforts in creating a stable and undisturbed environment. Enhancing this biodiversity further is the park's in-house nursery, which raises native saplings and supports continual afforestation.

A key challenge addressed in the development of the park was the lack of water availability due to the region's arid conditions. In response, Tata Motors constructed a weir to harness monsoon runoff, resulting in the formation of four ponds and two lakes. These water bodies play a critical role in supporting the local ecosystem and contribute significantly to groundwater recharge. The design also integrates wastewater recycling and rainwater harvesting, demonstrating a comprehensive and sustainable approach to water resource management. Innovation has been central to the park's afforestation strategy. In a creative adaptation to the harsh substrate, drum nurseries fashioned from recycled barrels were used to grow saplings, which were then planted in soil pits enriched

[270] https://www.pwc.in/assets/pdfs/esg-consulting/esg-in-the-automotive-sector.pdf

[271] https://www.tatasustainability.com/pdfs/TheWebLife.pdf

with topsoil transported from nearby agricultural areas. This method has proven effective in ensuring healthy tree growth in challenging conditions.

The park is further enriched by a range of thematic zones, including a butterfly garden, a medicinal plant section, a bamboo grove, and sacred groves. These spaces not only enhance biodiversity but also foster environmental awareness and cultural appreciation. Together, they make Pimpri Biodiversity Park a vibrant, living example of how degraded urban landscapes can be revitalized through ecological planning, innovative techniques, and long-term commitment.

The Bombay Natural History Society (BNHS) honoured Tata Motors with an award in the "Conservation and Restoration of Habitat" category, acknowledging the company's significant efforts in biodiversity conservation at the Pimpri site. This initiative not only enhances the local biodiversity but also serves as a model for integrating ecological considerations into industrial operations. It reflects Tata Motors' broader commitment to sustainable development and environmental responsibility. The park has over 500 species of flora and fauna, it serves as a model for urban industrial biodiversity integration, it is also frequently visited for educational trips.

2. Mahindra & Mahindra – Hariyali Project (Pan-India)

Launched in 2007, Mahindra & Mahindra's Project Hariyali is a flagship corporate social responsibility (CSR) initiative focused on environmental sustainability through afforestation. With a long-term vision to mitigate climate change and restore ecological balance, the project has grown into a **pan-India movement** rooted in the belief that sustainable development must begin with a greener planet. Over the years, Project Hariyali has successfully planted more than **18 million trees** across diverse geographies in India, including urban centers, degraded farmlands, watershed areas, and forest peripheries.

What sets Hariyali apart is its strong emphasis on biodiversity. The project prioritizes the plantation of indigenous and ecologically appropriate tree species, ensuring that new green zones support local ecosystems. Species such as neem, jamun, peepal, banyan, and amaltas are commonly planted—not only for their carbon sequestration potential but also for their role in reviving pollinator populations and sustaining native flora and fauna. These plantations have led to the visible return of birds, butterflies, and small mammals in formerly barren or degraded areas.

From the arid zones of Rajasthan to the coastal plains of Tamil Nadu and the biodiversity hotspots of the Northeast, the project's geographic spread reflects Mahindra's commitment to a nationwide ecological revival. Each site is selected based on local environmental needs, and implementation is done in partnership with local communities, NGOs, municipal bodies, and forest departments. This collaborative model fosters not just environmental but also social impact, creating a sense of community ownership and responsibility.

A notable feature of Project Hariyali is the active participation of Mahindra employees under the company's Employee Social Options (ESOPs) program. Thousands of employees

volunteer in plantation drives annually, reinforcing a culture of environmental stewardship across the organization. Additionally, the project involves schoolchildren, youth groups, and panchayats to spread awareness about biodiversity and climate change, thereby planting the seeds of environmental consciousness across generations. Beyond trees, the project promotes soil and water conservation, particularly in watershed areas. The plantations have helped prevent erosion, rejuvenate soil fertility, and improve groundwater levels. In urban areas, Hariyali has contributed to reducing the urban heat island effect and enhancing city-level biodiversity.

Aligned with the United Nations Sustainable Development Goals (SDGs)—particularly SDG 13 (Climate Action) and SDG 15 (Life on Land)—Project Hariyali exemplifies how businesses can lead the way in ecological restoration. Mahindra & Mahindra continues to monitor the plantations and adapt practices to ensure long-term sustainability, integrating Project Hariyali into its broader environmental, social, and governance (ESG) framework.

In essence, Project Hariyali is not just about planting trees—it is about planting resilience, biodiversity, and community empowerment, ensuring that future generations inherit a greener and more balanced ecosystem.

3. Maruti Suzuki India Ltd – Ecological Restoration at Manesar Plant (Haryana)

Project: *Greenbelt Development and Biodiversity Zones*

Maruti Suzuki India Ltd. (MSIL), India's leading automobile manufacturer, has consistently integrated environmental stewardship into its business ethos. Among its various green initiatives, the ecological restoration project at the Manesar manufacturing facility in Haryana stands out as a testament to how industrial growth can coexist with ecological responsibility. Spread across approximately 600 acres, the Manesar plant is not just a hub of manufacturing excellence but also an evolving model for industrial biodiversity conservation.

Recognizing the environmental challenges that large-scale manufacturing facilities can pose—such as habitat fragmentation, groundwater depletion, and air pollution—Maruti Suzuki took early steps to minimize its ecological footprint. The company envisioned the Manesar plant not as an isolated industrial complex, but as a thriving green zone harmoniously integrated with the surrounding natural environment.

The ecological restoration effort began with detailed baseline studies to understand the original landscape, soil quality, native species, and hydrological patterns. Maruti Suzuki collaborated with ecological experts, landscape architects, and environmental NGOs to develop a scientifically informed restoration plan. One of the project's central pillars was the plantation of native species of trees, shrubs, and grasses suited to Haryana's semi-arid ecosystem. Species like neem, amaltas, Indian laburnum, babool, and indigenous grasses were prioritized to support local wildlife and ensure long-term resilience.

Today, more than 300,000 trees and plants enrich the Manesar plant premises. The restoration has fostered microhabitats that have attracted birds, butterflies, small mammals, and reptiles back to the area. Several bird species, including peacocks, lapwings, and drongos, have been observed nesting within the green zones, signalling a successful revival of biodiversity. Importantly, the green cover acts as a natural buffer, improving air quality, stabilizing local temperatures, and aiding rainwater percolation. In parallel with plantation activities, Maruti Suzuki has focused on water conservation. A network of rainwater harvesting structures and check dams has been created within the plant boundaries to capture runoff, reduce erosion, and replenish groundwater levels. The treated wastewater from the manufacturing process is fully recycled for horticulture and cooling towers, ensuring that water resources are used efficiently and sustainably.

Employee engagement has been another crucial aspect of the project. Maruti Suzuki encourages its employees and their families to participate in plantation drives, environmental awareness programs, and biodiversity documentation activities. This involvement not only reinforces a culture of sustainability but also ensures that ecological restoration is perceived as a shared responsibility rather than a corporate checkbox.

The ecological restoration at Manesar is aligned with broader environmental goals, including India's national commitments under the Convention on Biological Diversity and the Sustainable Development Goals (SDGs), particularly SDG 13 (Climate Action) and SDG 15 (Life on Land). By embedding ecological thinking into its operational blueprint, Maruti Suzuki demonstrates that environmental leadership is an integral component of corporate success in the 21st century.

Looking ahead, the company aims to enhance biodiversity monitoring using technology, diversify native plantations further, and share its learnings with other industries and stakeholders. Through this initiative, Maruti Suzuki has not only transformed its Manesar plant into a manufacturing powerhouse but also into a living example of industrial ecological restoration.

4.7.5 Challenges and Gaps for biodiversity conservation and restoration by the Automobile Industry in India

Some of the key challenges faced by corporates in adopting practices which enable biodiversity conservation are as below:

1. Limited Integration into Core Business Strategy

In many companies, biodiversity efforts continue to be treated as standalone CSR projects, separate from the core business strategy. Environmental Management Systems (EMS) that are in place tend to focus more on emissions control and waste management, while biodiversity indicators remain largely overlooked or underdeveloped.

2. Inadequate Site-Level Biodiversity Assessment

There is often a lack of comprehensive baseline biodiversity surveys conducted before the establishment of industrial plants. As a result, companies rarely undertake regular

monitoring or impact assessments to understand how their operations impact surrounding ecosystems.

3. Urban and Industrial Land Use Conflicts

Automobile manufacturing units are frequently located in peri-urban or rural zones, where land use conflicts are common. This often results in habitat fragmentation, disruption of wildlife movement corridors, and the conversion of ecologically sensitive lands into built infrastructure, causing long-term ecological degradation.

4. Poor Stakeholder and Community Engagement

Biodiversity initiatives rarely incorporate local ecological knowledge or actively involve community stakeholders. Consequently, opportunities to co-create conservation strategies in collaboration with NGOs, scientific experts, and indigenous communities are often missed.

5. Low Awareness and Capacity within Industry

In-house expertise on biodiversity management is generally limited across most industrial sectors. Sustainability teams are typically more focused on areas such as carbon reduction, energy efficiency, and water conservation, with biodiversity receiving less attention or institutional support.

6. Monitoring and Reporting Gaps

Most companies do not have clear Key Performance Indicators (KPIs) to monitor biodiversity outcomes. Additionally, there is minimal alignment with global biodiversity-related frameworks such as the Global Biodiversity Framework (GBF), the Science-Based Targets for Nature (SBTN), and the Taskforce on Nature-related Financial Disclosures (TNFD), resulting in weak reporting and limited comparability.

7. Lack of Collaboration Across the Supply Chain

Biodiversity considerations seldom extend beyond direct operations, with Tier-1 and Tier-2 suppliers generally excluded from sustainability programs. There are also no consistent biodiversity codes or mandatory standards implemented across the value chain to ensure ecosystem-friendly practices.

8. Regulatory and Policy Discrepancies

The enforcement of biodiversity-related regulatory norms, such as compensatory afforestation requirements, is often weak. Moreover, there are limited policy incentives to encourage private sector innovation or leadership in biodiversity conservation.

9. Short-Term perspective in CSR Planning

Corporate biodiversity projects frequently operate on a short-term basis, receiving one-time funding without plans for long-term maintenance. These fragmented efforts lack landscape-level coordination, reducing their potential for meaningful and sustained conservation outcomes.

4.7.6 Opportunities for Further Action by the Automobile Industry in India for Biodiversity Improvement

1. Integrate Biodiversity into Corporate Strategy

Corporates should align their biodiversity goals with leading global frameworks such as the Global Biodiversity Framework (GBF), Science-Based Targets for Nature (SBTN), and the Taskforce on Nature-related Financial Disclosures (TNFD). Integrating biodiversity into Environmental, Social, and Governance (ESG) metrics and sustainability reporting can help institutionalize conservation commitments and improve accountability.

2. Develop Site-Specific Biodiversity Action Plans (BAPs)

It is essential to conduct baseline ecological assessments at all factory locations to understand the local biodiversity context. Based on these assessments, companies should develop customized Biodiversity Action Plans that cater to the unique ecological characteristics of each site. Continuous monitoring of local flora and fauna should be undertaken to track biodiversity trends and assess the impact of industrial operations.

3. Adopt Nature-Based Solutions (NbS)

Nature-based solutions offer effective ways to enhance biodiversity while providing ecosystem services. Companies can establish green buffers, wetlands, rain gardens, and green roofs to manage stormwater and enhance habitat value. Techniques such as creating Miyawaki forests and planting native species can be used to rehabilitate degraded factory lands. In surrounding areas, promoting permaculture and agroforestry practices can further support biodiversity and sustainable land use.

4. Collaborate with Local Communities and Ecological Experts

Engagement with rural communities, students, and local NGOs is vital for the success of plantation drives and conservation programs. Incorporating local ecological knowledge (LEK) into planning and maintenance activities can lead to more contextually appropriate and sustainable outcomes. Companies should also support biodiversity education and awareness programs to build a culture of conservation in the broader community.

5. Green the Supply Chain

Biodiversity-positive practices should be promoted across the supply chain, including among suppliers and logistics partners. Companies can set expectations around eco-certification, green procurement, and sustainable sourcing. Sharing biodiversity-related data and good practices across the value chain can strengthen collective impact and foster innovation.

6. Establish Biodiversity Corridors

Collaborating with local governments and forest departments can enable the creation or restoration of biodiversity corridors, such as wildlife movement routes, pollinator pathways, and riverine or riparian habitats near manufacturing zones. These corridors are critical for maintaining ecological connectivity and species mobility.

7. Promote Biodiversity Research and Innovation

Investing in research and development can lead to breakthroughs in ecological restoration and biodiversity management. Companies can support studies on urban ecology and emerging biodiversity technologies. The use of artificial intelligence, drones, and remote sensing tools can improve the accuracy of biodiversity mapping and impact assessment. Partnerships with academic institutions can also facilitate biodiversity audits and innovation pilot projects.

8. Enhance Monitoring and Reporting

Companies should define clear Key Performance Indicators (KPIs) for biodiversity, such as species richness, tree canopy cover, and pollinator presence. These indicators should be regularly reported through Biodiversity Impact Reports, ideally integrated into annual sustainability disclosures to ensure transparency and continuous improvement.

9. Participate in Public-Private Biodiversity Platforms

Joining collaborative platforms such as the India Business & Biodiversity Initiative (IBBI) and the Natural Capital Coalition can amplify corporate efforts. Through such partnerships, companies can contribute to landscape-level conservation programs and engage in joint policy advocacy for biodiversity protection.

10. Long-Term Vision through CSR and Philanthropy

Corporate Social Responsibility and philanthropic investments should support long-term ecological restoration projects with timelines extending five to ten years. These investments can also fund conservation NGOs, seed banks, wildlife rescue centers, and the development of urban biodiversity parks, thereby creating enduring environmental and social value.

4.8 Plastics and Packaging Sector

4.8.1 Overview

The plastic value chain spans from the extraction of raw material for plastic production over several steps to the end-of-life management and disposal of plastic waste. The plastics sector engages a broad spectrum of stakeholders from the public, private, and civil sectors at the national, state, and local levels, all of whom have defined roles and responsibilities.

The key stakeholders involved across different stages of the plastic value chain are plastic producers and processors, consumers, and waste managers. They are supported by connected stakeholders: industry associations, waste management companies, transporters, and importers/exporters. The common stakeholders across the entire value chain include financial institutions, civil society organizations, and regional, national, and international governmental and non-governmental institutions.

Plastic packaging is at the center of a new era in the Indian packaging industry. Its versatile usage is becoming the foundation for many industries for product packaging. Compared to other packaging types, plastic packaging containers provide unique benefits, such as high impact strength, stiffness, and barrier properties, which have expanded the market for plastic packaging in recent years. The India Plastic Packaging Market size is worth USD 22.44 Billion in 2025, growing at a 3.09% CAGR and is forecast to hit USD 26.13 Billion by 2030[272]. Plastic is

[272] Report on Packaging Industry in India

one of the most prominent packaging materials. The material's lightweight and low-cost nature instantly distinguished it among all the end-users. This robust growth is driven by various factors such as rising disposable incomes, urbanization, increased demand for processed and packaged goods, and a thriving e-commerce sector. Moreover, government initiatives focused on organized retail and food safety are further propelling demand for high-quality, standardized packaging solutions.

However, the plastic packaging market also exerts significantly adverse impacts on the environment and biodiversity. Due to this reason, the sector in India is expected to be significantly challenged due to dynamic changes in regulatory standards, primarily due to increasing environmental concerns. The government is responding to public concerns regarding plastic packaging waste and implementing regulations to minimize environmental waste and improve waste management processes[273].

4.8.2 Biodiversity impacts of the sector- Plastics and Packaging

Environmental pollution, including air and water pollution and climate change driven by human activities, poses significant threats to biodiversity by disrupting ecosystems, altering temperature patterns, and impacting the survival of various species. A critical contributor to this issue is plastic pollution, which has emerged as a pervasive and detrimental force affecting the biodiversity of both terrestrial and marine ecosystems. The use and disposal of plastics is a transboundary threat to biodiversity and natural ecosystems due to their low degradation rate and unsustainable production. Global plastic production has reached 368 million metric tons (Mt) annually and is estimated to double within 20 years (Lebreton and Andrady, 2019).

Single-use plastics, including bags, straws, cutlery, and packaging materials, account for a large portion of India's waste. Despite regulatory bans, 43% of India's total plastic waste still consists of single-use plastics, largely due to weak enforcement and a lack of affordable alternatives. The government's ban on certain single-use plastics, introduced in 2022, has been difficult to implement, as these plastics remain cheap and readily available[274].

Marine and Aquatic Life: Oceans and rivers are major recipients of plastic waste. Marine animals, such as turtles, fish, and seabirds, often ingest plastic debris, mistaking it for food, which can lead to injury, malnutrition, and death. Entanglement in plastic waste, such as fishing nets and plastic bags, often cause physical harm and death to marine species.

A study focusing on Ashtamudi Lake in Kerala, a Ramsar wetland, found microplastics in fish, shellfish, sediment, and water samples. The highest concentration was observed in shellfish, with 40.9% containing microplastics, followed by fish at 19.6%. These findings underscore the pervasive nature of plastic pollution in aquatic environments and its potential impact on food safety and public health[275].

[273] https://www.mordorintelligence.com/industry-reports/india-plastic-packaging-market

[274] Is India the World's Largest Plastic Polluter? Causes and Solutions | Plastics For Change

[275] https://en.wikipedia.org/wiki/Ashtamudi_Lake

Terrestrial Wildlife: Terrestrial animals, including livestock, are also at risk from ingesting or becoming entangled in plastic waste. This can lead to digestive issues, starvation, and injuries. Plastics can disrupt the natural behaviour and habitat of wildlife, affecting biodiversity and ecosystem balance.

A 2024 study published in Environmental Pollution reported the presence of microplastics in the scat of mid-sized cat species, such as fishing cats and jungle cats, in India. This indicates that microplastics are entering the food chain of terrestrial predators, potentially affecting their health and the broader ecosystem[276].

Ecosystem Disruption: Plastic pollution can alter natural habitats and ecosystems. For instance, plastics can block sunlight from reaching coral reefs, affecting their health and the marine life that depends on them. In soil, plastics can impede water infiltration, affect soil fertility, and harm microorganisms essential for ecosystem functioning.

Microplastics in Agriculture and Water Sources: Studies have found that microplastics are now present in 83% of tap water samples across India, and they are also making their way into agricultural soils through contaminated irrigation water and wastewater sludge. This poses a significant threat to food safety and soil health. A 2024 study highlighted that India is projected to release approximately 391,879 tonnes of microplastics into water bodies, making it the second-largest contributor globally after China[277]. The Ganga River, one of India's most significant waterways, has been identified as having one of the highest concentrations of microplastics among major global rivers. Sources of this pollution include urban runoff,

[276] https://www.sciencedirect.com/science/article/abs/pii/S0013935125004694

[277] https://www.sciencedirect.com/science/article/abs/pii/S1474706525000920

industrial discharges, and improper waste management practices[278]. The infiltration of microplastics into aquatic ecosystems poses threats to aquatic life through ingestion and bioaccumulation, potentially entering the human food chain and affecting health.Bottom of Form

Health Hazards for All Species: The widespread open burning of plastics contributes to air pollution, releasing harmful chemicals such as dioxins, furans, and Polychlorinated biphenyls (PCBs). These toxic chemicals have been linked to severe health issues, including respiratory diseases, cancer, and reproductive problems. In cities like Delhi, where air quality is already a major public health issue, burning plastic only worsens the situation.

4.8.3 Regulatory and policy landscape- Plastics and Packaging

India is one of the world's largest consumers of plastic, with consumption estimated at over 16 million tons annually. However, inadequate waste management systems lead to approximately 26,000 tons of plastic waste being generated daily, of which only a fraction is recycled. Much of this plastic waste ends up in landfills, water bodies, and oceans, causing severe environmental degradation and health hazards.

The regulatory and policy landscape for the Indian plastic and packaging sector, with a focus on biodiversity conservation and restoration, is evolving rapidly. India has recognised the adverse impacts of plastic pollution on ecosystems and biodiversity and is taking steps through legislation, policies, and action plans. Here's a comprehensive overview:

1. Key Legislations and Policies

a. Plastic Waste Management Rules, 2016 (Amended in 2021 & 2022)

- **Extended Producer Responsibility (EPR):** Extended Producer Responsibility (EPR) is a regulatory mechanism that mandates producers, importers, and brand owners (PIBOs) to take responsibility for the management of plastic waste generated from their products. Under this framework, PIBOs are obligated to collect back a specified percentage of post-consumer plastic waste, ensuring it is properly recycled or disposed of. They are also required to incorporate a defined percentage of recycled content into their packaging materials. Compliance with these obligations must be documented through the submission of annual EPR reports on the Central Pollution Control Board's (CPCB) online portal, reinforcing transparency and accountability in plastic waste management.
- **Ban on Single-Use Plastics (SUP):** Effective July 1, 2022, items like plastic cutlery, straws, and earbuds are banned.
- **Environmental Relevance:** Aims to reduce plastic waste leakage into ecosystems, directly benefiting terrestrial and aquatic biodiversity.

[278] https://www.downtoearth.org.in/waste/in-2024-india-to-be-among-top-4-contributors-of-microplastics-released-into-waterbodies-95883

b. **Environment (Protection) Act, 1986: The Environment (Protection) Act, 1986 serves as** India's overarching legislation for environmental protection, providing a comprehensive legal framework to safeguard the environment. It empowers the central government to formulate specific rules and standards aimed at controlling and reducing pollution across various sectors. This includes the regulation of industrial pollution and waste, such as packaging waste, through the development of targeted rules and guidelines. The Act plays a foundational role in enabling other regulatory measures related to environmental sustainability and resource conservation.

c. **Solid Waste Management Rules, 2016:** The Solid Waste Management Rules, 2016 provide a comprehensive framework for the segregation, collection, transportation, and disposal of solid waste in India. These rules emphasize the importance of decentralized waste processing, encouraging local-level solutions such as composting and material recovery. They also place a legal obligation on urban local bodies to ensure effective plastic waste management, including the implementation of source segregation and the promotion of recycling and reuse practices to reduce environmental impact.

2. Policies Linked to Biodiversity Conservation

- **National Biodiversity Action Plan (NBAP), (Updated in 2024):** Identifies pollution from plastic waste as a threat to biodiversity and encourages sustainable packaging and material innovations.
- **National Action Plan for Climate Change (NAPCC):** As part of the Mission on Sustainable Habitat under the NAPCC, sustainable waste management practices and eco-friendly materials are promoted. It also supports circular economy models that minimise habitat disruption.

3. Circular Economy and EPR Integration

- **India's Circular Economy Commitments:** MoEFCC has developed frameworks to phase out problematic plastics and promote sustainable alternatives.
- **State Action Plans:** Many states have localized versions of EPR implementation, with biodiversity conservation integrated into waste management objectives.

4. Role of Institutional Bodies- Central Pollution Control Board (CPCB) and State PCBs

The Central Pollution Control Board (CPCB) has multiple guidelines for varied plastic waste disposal. Its role is to Monitor and enforce the compliance with plastic waste and packaging regulations. It also conducts impact assessments on plastic pollution in rivers, forests, and coastal zones—key habitats for biodiversity.

5. Industry and Innovation Guidelines

BIS (Bureau of Indian Standards) and Food Safety and Standards Authority of India (FSSAI) regulate packaging materials for food and other uses, ensuring environmental safety standards are met. They have identified specifications for materials,

dimensions, testing methods, and safety requirements. The Food Safety and Standards (Packaging and Labelling) Regulations, 2011, also specify the types of materials that can be used for packaging food items, including plastics. They also outline requirements for labelling, ensuring consumer safety and transparency.

6. International Commitments Influencing Domestic Policy

- **Basel Convention:** India is a party and aligns its hazardous waste rules with its mandates, especially concerning plastic waste trade.
- **UNEA's Global Plastics Treaty (In Progress):** India is actively participating in negotiations, potentially influencing future laws. It aims to end plastic pollution by 2040. It focuses on a full lifecycle approach including design, production, use, and disposal.

7. Circular Economy & Resource Efficiency

- **Draft National Resource Efficiency Policy:** It aims to promote resource efficiency and circular economy principles across sectors, including plastics.
- **India Plastics Pact:** A collaborative initiative to create a circular economy for plastics, focusing on reducing, reusing, and recycling plastic packaging.
- **National Circular Economy Roadmap:** Outlines strategies for reducing plastic waste and promoting sustainable materials usage.

4.8.4 Current sustainability and conservation initiatives- Plastics and Packaging

The market for recycling waste plastic in India reached 9.9 million tons in 2023. It is projected that by 2032 this figure could rise significantly to 23.7 million tons. The country generates a significant amount of plastic waste, estimated to be around 26,000 tons per day.[279]. Despite this high volume of plastic waste, India's recycling infrastructure remains limited, leading to improper disposal of plastic waste and environmental pollution.

Some of the collective standards, protocols, and pledges that are relevant to the intersection between biodiversity conservation and the plastic and packaging sector in India are as below:

Relevant Standards, Protocols & Pledges (National + Global) by industry bodies and corporate initiatives:

1. Sustainable Packaging Charter – CII-ITC Centre of Excellence for Sustainable Development

Voluntary commitment by Indian companies to reduce virgin plastic use, utilise recyclable/ biodegradable materials, and improve circularity in packaging. It encourages corporate-led biodiversity-safe packaging practices.

[279] India's plastic recycling market and innovation landscape - Innovate UK Business Connect

2. Circular Economy Ecosystems

The **India Plastics Pact (IPP),** launched in 2021 by the Confederation of Indian Industry (CII) and WWF India, is a pioneering initiative aimed at transforming the plastics value chain through voluntary and time-bound commitments. It brings together key stakeholders—particularly major FMCG and packaging companies—to collectively address the environmental impact of plastic use. The P act sets ambitious targets to be achieved by 2030, including the elimination of unnecessary plastics, ensuring that all plastic packaging is either reusable or recyclable, and mandating the use of at least 25% recycled content in plastic packaging. In addition, the IPP emphasizes improving the recyclability and compostability of plastic materials, promoting reusable packaging models, and supporting restorative material flows that minimize the ecological footprint of plastic consumption. Through collaborative action, the IPP seeks to drive systemic change toward a circular plastics economy in India.

3. Ecolabeling and Certification Standards

Ecolabeling and Certification Standards play a vital role in promoting environmentally responsible packaging. The BIS Eco Mark serves as a national certification for products and packaging that meet defined eco-friendly criteria, helping consumers make sustainable choices. Additionally, the Forest Stewardship Council (FSC) certification, widely used for paper-based packaging, ensures that forest resources are managed responsibly and sustainably. By adopting such certification systems, companies contribute to the health of ecosystems and reduce the biodiversity risks associated with unsustainable sourcing of packaging materials.

4. Biodiversity-Inclusive ESG Reporting

Biodiversity-Inclusive ESG Reporting is gaining momentum with the introduction of enhanced disclosure requirements such as the Business Responsibility and Sustainability Reporting (BRSR) framework mandated by SEBI. These norms encourage companies to disclose their use of eco-friendly materials, assess and report the impact of waste on natural ecosystems, and identify biodiversity-related risks within their packaging practices and supply chains. By fostering greater transparency, such reporting enables investors and consumers to better understand and evaluate the biodiversity footprint of corporate operations.

India has collaborated with international organisations and governments to leverage expertise and resources for sustainable plastic recycling. In 2021, India became the first Asian country to launch a Plastics Pact.[280]. Targets include making 100% of plastic packaging reusable or recyclable and effectively recycling 50% of plastic packaging by 2030.

[280] India Plastics Pact

5. Plastic Neutrality

Plastic neutrality means a company measures the amount of plastic it introduces into the environment and ensures an equivalent amount is removed and responsibly processed (recycled or reused), often through third-party partnerships.

- **Dabur India Ltd.** achieved plastic neutral status in 2021. It is the first Indian consumer goods company to do so. It collected and processed over 27,000 MT of post-consumer plastic waste in FY 2021-22, more than it generated. The Dabur team works across all states and UTs through a network of local recyclers and NGOs. The corporate operates as per the Plastic Waste Management (PWM) Rules and EPR guidelines. The efforts are preventing plastic leakage into the ecosystem, which is key for safeguarding urban and rural biodiversity. It is leading to a reduction in microplastics in soil and water, benefiting pollinators, aquatic species, and birds. It also supports informal sector workers through safe and dignified employment in waste collection.
- **Nestlé India** has committed to 100% plastic neutrality by 2025. Nestle's efforts have recovered and co-processed around 26,000 MT of plastic waste in 2022. It has partnered with NGOs and waste management firms to improve last-mile plastic recovery. It is also focusing on recyclable packaging: shifting to paper-based straws, mono-materials, and less complex laminates. It is mitigating the damage to marine ecosystems by recovering ocean-bound plastics. The circular packaging innovation reduces reliance on virgin plastic derived from fossil fuels, thereby conserving biodiversity-rich zones impacted by extraction. All these efforts contribute to the cleanup of coastal and wetland habitats, crucial for migratory birds and endangered species.
- **The Better India (The Better Home brand)** became India's first D2C brand to go plastic-neutral. It offsets all plastic use via certified recovery partners. It champions low-waste lifestyles and biodegradable packaging and supports plastic recovery from eco-sensitive zones, contributing to biodiversity restoration.
- **Tata Consumer Products** is working towards plastic neutrality across all packaging. It has transitioned to FSC-certified paper and recyclable materials. The transition is ensuring that the forests and biodiversity are protected through ethical sourcing. It is also reducing the risk of packaging waste in rural and forested areas.
- **Hindustan Unilever (HUL)** is working to reduce virgin plastic use by 50% and achieve plastic neutrality. The HUL team has recovered one lakh+ MT of plastic waste in 2022. The circular packaging innovations are reducing ecological extraction pressure. HUL has also scaled-up waste picker empowerment programs, integrating informal workers into biodiversity-linked sustainability chains.
- **Flipkart** has pledged to have 100% plastic-neutral e-commerce shipments. The effort is to eliminate single-use plastics; invest in recycled alternatives. The endeavour is to prevents plastic ingress into rural supply routes and ecosystems. It encourages consumer awareness and responsible disposal.

Some of the Third-Party Partnerships facilitating progress towards plastic neutrality are in the table below:

Partner	Role
Re-Purpose Global	Certifies brands as plastic-neutral and manages recovery programs.
Plastics for Change	Engages informal waste pickers and recycles ocean-bound plastics
Saahas Zero Waste	Collection, segregation, and safe disposal of post-consumer waste

The overall environmental and biodiversity impact of sustainable packaging and waste management initiatives is significant and multifaceted. Efforts to recover ocean-bound plastic contribute directly to the protection of marine ecosystems, preventing pollution that endangers aquatic life. Diverting plastic waste from forests, wetlands, and river systems plays a critical role in preserving wildlife habitats and maintaining ecological balance. These actions also help improve soil and water quality by reducing the presence of harmful microplastics in natural environments. Furthermore, such initiatives support the livelihoods of thousands of individuals working in the informal waste economy—many of whom operate in biodiversity-rich rural regions—thereby linking environmental sustainability with social equity.

6. Sustainable Packaging Innovations

Biodegradable and compostable materials are emerging as key solutions in reducing the environmental footprint of packaging. Leading companies such as Tetra Pak, UFlex, and Amcor are actively investing in sustainable alternatives like plant-based polymers, paper-based materials, and compostable packaging. A notable innovation is UFlex's Post Consumer Recyclate (PCR) film, which is produced entirely from recycled PET. This not only reduces dependency on virgin plastic but also supports the conservation of natural resources.

In parallel, lightweighting and material reduction strategies are being adopted by major FMCG brands including Unilever, Nestlé, and ITC. These companies are optimizing packaging design by reducing the thickness and weight of plastic materials, thereby decreasing the volume of plastic used per unit product. Such efforts contribute directly to lowering plastic waste generation and minimizing environmental impact across the product lifecycle.

7. Extended Producer Responsibility (EPR) Implementation

Major corporations such as Coca-Cola, PepsiCo, and Hindustan Unilever (HUL) are actively fulfilling their Extended Producer Responsibility (EPR) obligations through a range of impactful initiatives. These include establishing dedicated plastic collection networks, providing financial and institutional support to waste picker communities, and forming partnerships with recyclers like Banyan Nation and Saahas Zero Waste. While primarily designed to manage post-consumer plastic waste, these programs also contribute to ecosystem restoration by significantly reducing plastic leakage into natural habitats such

as rivers, oceans, and forests. This not only curbs pollution but also supports biodiversity conservation in vulnerable ecosystems.

8. Plastic Offsetting Programs

A growing number of startups and direct-to-consumer (D2C) brands, such as The Better Home and Beco, are taking proactive steps to become plastic neutral. These companies assess their plastic footprint and offset it by partnering with verified waste recovery organizations. Through collaborations with platforms like RePurpose Global and Plastics for Change, they are promoting community-centric waste recovery models that not only reduce plastic pollution but also generate livelihoods and support environmental justice. This approach reflects a shift toward more responsible and inclusive sustainability practices within the emerging business landscape.

9. Marine and Wildlife Protection Projects

PepsiCo India, in collaboration with UNDP, has launched initiatives in cities such as Mumbai aimed at recovering ocean-bound plastic while promoting biodiversity-sensitive coastal management. These efforts not only address marine plastic pollution but also contribute to the protection and restoration of coastal ecosystems. Similarly, Coca-Cola's "World Without Waste" initiative partners with NGOs to implement large-scale beach clean-ups and river rejuvenation projects, which play a crucial role in enhancing aquatic biodiversity by improving habitat quality and reducing plastic-related threats to marine and freshwater species.

10. Biodiversity-Focused Packaging Policies

Godrej Consumer Products has integrated biodiversity considerations into its packaging lifecycle by carefully selecting raw materials that do not harm forest ecosystems or encroach upon sensitive habitats. This approach ensures that the company's sourcing practices support environmental sustainability and ecosystem integrity. Similarly, Tata Consumer Products demonstrates its commitment to sustainable forestry by sourcing paper packaging exclusively from FSC-certified forests, thereby promoting responsible forest management and contributing to the conservation of biodiversity.

11. R&D for Eco-Aligned Innovations

Firms are investing in innovative technologies and applications such as enzyme-based degradation, algae-based packaging, and mycelium composites, which have a minimal impact on natural ecosystems.

4.8.5 ESG and CSR trends- Plastics and Packaging

In India, the drive towards sustainability has led to a notable shift in the packaging industry, with several companies taking the lead in providing eco-friendly solutions. Some of the top sustainability packaging providers prioritize innovation, environmental responsibility, and a commitment to reducing the ecological footprint. ESG practices are becoming increasingly

important for plastic manufacturers in India as they align with sustainability goals, regulatory compliance, and corporate responsibility. Some ways in which Indian plastic manufacturers are implementing ESG principles are highlighted below:

1. Environmental Practices:

- Sustainable Sourcing & Recycling: Many companies incorporate post-consumer recycled (PCR) plastics and biodegradable materials into production.
- Waste Management & Circular Economy: Initiatives like extended producer responsibility (EPR) programs ensure proper plastic waste collection and recycling.
- Energy Efficiency: Adoption of solar and wind energy, along with energy-efficient manufacturing techniques, reduces carbon footprints.
- Water Conservation: Many manufacturers are implementing rainwater harvesting and wastewater treatment plants.

2. Social Practices:

- Worker Welfare & Safety: Compliance with labor laws, fair wages, and improved working conditions in factories.
- Community Engagement: Participation in environmental clean-up drives, education programs on plastic waste, and rural development projects.
- Health & Safety Standards: Adoption of global safety practices for employees, including proper handling of chemicals and plastics.

3. Governance Practices:

- Regulatory Compliance: Adherence to environmental laws like the Plastic Waste Management Rules, 2016, and global sustainability standards.
- Transparent Supply Chains: Ensuring ethical sourcing of raw materials and avoiding child labor or exploitative practices.
- ESG Reporting & Audits: Large manufacturers are publishing sustainability reports in line with SEBI's Business Responsibility and Sustainability Reporting (BRSR) requirements.

4. Circular Economy & Innovation (C) Practices:

- Biodegradable & Compostable Plastics: R&D investment into sustainable alternatives like bioplastics.
- Reusable Packaging Solutions: Development of reusable and refillable packaging models for FMCG and retail industries.
- Advanced Recycling Technologies: Adoption of chemical recycling and mechanical recycling to reduce plastic waste.
- Examples of Indian Companies Implementing CESG:

- Reliance Industries: Investment in circular economy initiatives and recycled PET production.
- UFlex Ltd.: Focus on sustainable packaging solutions and bio-based plastics.
- Varun Beverages: Recycling initiatives and PET bottle collection programs.

In India, the plastic and packaging sector is gradually adopting several good practices aimed at biodiversity conservation and ecosystem restoration. A notable trend is the shift toward sustainable packaging materials, such as biodegradable, compostable, and recycled alternatives, which help reduce plastic pollution in natural habitats. Companies are increasingly integrating Extended Producer Responsibility (EPR) by investing in waste collection and recycling systems that prevent litter from reaching rivers, forests, and coastal ecosystems.

Some firms are also partnering with local communities and environmental NGOs to support cleanup drives, mangrove restoration, and awareness campaigns around plastic waste management. Additionally, innovations in design, like reducing packaging layers or eliminating unnecessary plastic components, are helping minimise environmental footprints. These actions are often tied to broader ESG commitments, with businesses monitoring biodiversity impact as part of their sustainability reporting. Collectively, these efforts reflect a growing alignment between corporate responsibility and ecological stewardship in the sector.

These efforts are often guided or supported by industry platforms like **FICCI's Circular Economy Committee** or **ASSOCHAM's Plastic Waste Management Task Force,** which help align corporate strategies with environmental goals. Such cross-sectoral collaborations signal a promising shift toward integrating biodiversity conservation into the core strategies of packaging and plastic-intensive businesses.

4.8.6 Case studies of best practices- Plastics and Packaging

1. Reliance Industries Limited (RIL)

Reliance Industries Limited (RIL) has launched the Recron Green Gold initiative to turn plastic waste into high-quality polyester fibre. The fibre is then used to create textiles for a variety of markets, including clothing, home furnishings and even car interiors. At the moment, they recycle around two billion plastic bottles annually, with sights set on managing even more over the coming decade. They're working with local communities, NGOs and waste collectors to expand their work and make it easier for other businesses to adopt similar sustainable practices.

Reliance Industries – Recron GreenGold Initiative

Reliance Industries Limited (RIL), through its Petrochemicals division, has been a frontrunner in integrating sustainability with industrial innovation. One of its standout

initiatives in this direction is the Recron® GreenGold program, which exemplifies circular economy principles in the textile and polyester value chain. This initiative, driven by RIL's subsidiary Reliance Polyester Ltd, focuses on creating high-quality polyester products by recycling post-consumer PET bottles, thus addressing two pressing environmental concerns—plastic waste and carbon emissions[281].

The Recron GreenGold initiative is built around a closed-loop system where used PET bottles are collected, cleaned, and transformed into Recron® GreenGold fibres and yarns, which are then used to produce apparel, home textiles, and industrial applications. What sets this program apart is its sheer scale and integration. With one of the world's largest bottle-to-fibre recycling capabilities, Reliance converts **over 2 billion PET bottles annually into sustainable** textile-grade polyester, reducing the burden on landfills and oceans.

In addition to mitigating plastic pollution, the initiative significantly reduces the carbon footprint of polyester production. According to Reliance, the carbon emissions associated with Recron GreenGold are up to **35% lower** compared to virgin polyester. This is achieved through energy-efficient manufacturing processes, optimized logistics, and a focus on renewable energy inputs. The process also saves considerable water and energy resources, aligning the initiative with India's larger climate and resource conservation goals[282].

The GreenGold portfolio caters to both Indian and global textile markets, making sustainable polyester a commercially viable and environmentally responsible choice. Major fashion and lifestyle brands have partnered with Reliance to incorporate GreenGold into their products, further amplifying its impact and outreach. Beyond production, RIL also invests in consumer awareness campaigns, highlighting the importance of recycling and sustainable fashion choices.

The Recron GreenGold initiative not only exemplifies Reliance's commitment to environmental stewardship but also reflects the company's strategic pivot towards sustainability-driven innovation. It serves as a model for how large corporations

[281] https://recrongreengold.com/product-info.html

[282] https://www.fibre2fashion.com/news/fibre-news/ril-gets-golden-peacock-award-for-recron-green-gold-207139-newsdetails.htm

can leverage scale, technology, and partnerships to foster a circular economy while contributing meaningfully to the Sustainable Development Goals, particularly SDG 12 (Responsible Consumption and Production) and SDG 13 (Climate Action).

2. Hindustan Unilever Limited (HUL)

HUL has collected and safely disposed more than 1.2 lakh tonnes of post-consumer plastic waste in aggregate since 2018, through collection and disposal partners across India. In 2020, the company arranged environmentally friendly plastic waste disposal of over 58,000 tonnes. Along with collection and processing, the company is also progressing towards making its plastics packaging circular by eliminating unwanted plastics, using post-consumer recycled plastics (PCR) and recycling-ready structures.

HUL worked along with a start-up Banyan Nation and is using 25% r-HDPE in Surf Excel laundry liquid, Sunsilk and TRESemmé black shampoo bottles. Vim is using 50% r-PET in its liquid bottles. The company has also eliminated plastic coating from all its soap cartons (Dove, Lux, Liril) and Lifebuoy's soap stiffeners. The company has moved its shampoo sachet, soap wrapper and Vim bar flow-wrap to recycle recycle-ready structure. The company will continue to work towards creating a circular economy for plastics through its Less Plastics – Better Plastics – No Plastics approach.

HUL is also working closely with the Government and other partners, such as the United Nations Development Programme (UNDP), for end-to-end pilot projects for plastic waste management. So far, the project has reached out to more than 40,000 households, collected nearly 4,000 tonnes of plastic waste and onboarded more than 800 Safai Saathis (sanitation workers) in the project[283].

3. Hindustan Coca-Cola Beverages (HCCB)

HCCB launched the "World Without Waste" initiative in 2018, committing to making 100% of its packaging recyclable globally by 2025. The initiative **aims to use at least 50% recycled materials in packaging by 2030** and **collect and recycle a bottle or can for each one sold by 2030.** Coca-Cola India recently launched Coca-Cola in **100% recycled plastic (rPET) bottles** in smaller pack sizes, including 250 ml and 750 ml bottles.

Hindustan Coca-Cola Beverages (HCCB) has adopted a comprehensive approach to sustainable packaging and waste management through strategic partnerships and community engagement. In collaboration with UNDP, Saahas Zero Waste, and the Indian Pollution Control Associations, HCCB has established Material Recovery Facilities (MRFs) across urban and peri-urban areas to strengthen collection and recovery infrastructure. By 2022, these efforts led to the recovery of over 40,000 metric tonnes of post-consumer packaging waste in India. On the innovation front, HCCB has made significant strides in sustainable packaging by transitioning to rPET bottles (recycled PET), adopting lightweight packaging to reduce material usage, and actively exploring bio-based resins as a scalable alternative for the future. Additionally, HCCB's

[283] Plastic Waste Management- CSR Projects India

community-based waste management initiatives include meaningful engagement with waste picker communities, providing them with personal protective equipment (PPE) kits, health insurance, and avenues for formal employment, thereby supporting both environmental goals and social inclusion.

Hindustan Coca-Cola Beverages (HCCB)'s plastic recovery and waste management programs are making significant contributions to the protection of aquatic and urban biodiversity. Along coastal areas such as Mumbai and Chennai, ocean-bound plastic recovery initiatives are preventing the entry of plastic waste into estuaries and mangroves, thereby safeguarding marine biodiversity including Olive Ridley turtles, mangrove crabs, and estuarine bird species. In freshwater systems, the program has supported river clean-up and plastic interception efforts in rivers like the Yamuna and Mithi, reducing plastic accumulation in vital wetlands that serve as habitats for amphibians, fish, and waterfowl. Furthermore, HCCB's collaboration with local municipalities has helped reduce plastic litter in urban ecosystems such as lakes, gardens, and green belts, thereby minimizing spillover into ecologically sensitive zones and supporting the health of urban biodiversity.

4. Procter & Gamble India (P&G)

P&G has collected, processed, and recycled over 19,000 MT of post-consumer plastic packaging waste from across the country, which is more than the amount of plastic packaging in its products sold in a year. The company is working with recycling partners across 75 cities in India to collect plastic, which is then sent to different recyclers, waste-to-energy plants, and cement kilns. In addition to recycling, the company has also made a deliberate effort to reduce the packaging material and, in the last 5 years, has reduced usage of the packaging material by more than 5,000 MT[284].

P&G is among the few companies in India to also use recycled material in the packaging of its baby care and feminine care products, which will reduce the usage of 500 MT of virgin plastic annually. The liquid detergent bottles used by P&G are recyclable.

These initiatives contribute to mitigating the adverse effects of plastic pollution on biodiversity. By reducing plastic waste, P&G India helps protect terrestrial and aquatic ecosystems from the harmful impacts of plastic debris, which can lead to ingestion and entanglement of wildlife, habitat disruption, and the introduction of microplastics into food chains.

[284] Sustainability: Procter & Gamble India becomes 'plastic waste neutral' - India CSR

Some further innovative initiatives contributing to India's sustainable packaging landscape are highlighted below:

1. **Uflex Limited:** Innovating Sustainable Films and Laminates: Uflex Limited is a pioneer in sustainable packaging solutions, offering a range of eco-friendly materials. Their offerings include biodegradable films, compostable pouches, and recyclable laminates. Uflex is at the forefront of research and development, constantly pushing the boundaries of sustainable packaging technologies.

2. **Uravu Labs:** Transforming air into clean, safe drinking water with cutting-edge technology. Uravu Labs pioneers sustainable solutions with biodegradable materials, focusing on water conservation and eco-friendly practices. Innovating for a greener future. Uravu is solving the problem of extensive use of groundwater and single-use plastic in packaged beverages, which is a $2 trillion market.

   Uravu has developed a technology that uses air to generate potable drinking water by using only renewable energy sources. Uravu uses glass bottle packaging to provide this 100% renewable water to its customers, which prevents use of single use plastic bottles. These glass bottles are then returned by the customers and are reused and recycled under Uravu's Water-as-a-Service model. So far, Uravu has saved 3,50,000 Liters of groundwater and prevented the use of 250,000 bottles of single use plastic by serving 100% renewable water to its customers in re-usable glass bottles.

3. **Ecovative Design:** Mushroom-Based Packaging Solutions: Ecovative Design brings cutting-edge sustainable packaging solutions to India. Known for their mycelium-based packaging, they use mushroom roots to create biodegradable and compostable materials. This revolutionary approach offers a natural alternative to traditional packaging materials, reducing the reliance on non-renewable resources.

4. **Smaart Rice Straw:** Eco-friendly straws combat ocean pollution, offering a sustainable alternative to plastic and paper. The product by Smaart Eats LLP is the result of nature-loving enthusiasts looking to contribute to efforts to save our planet. Plastic and paper straws are polluting our oceans and consequently unsettling the entire ecosystem, affecting not only marine life but impacting human health as well. A single straw may not be much, but when 3 billion plastic straws are dumped into the ocean, it makes up to 4% of the world's plastic waste. Hence to solve to this problem, the company made straws which are made of Rice Flour + Tapioca Starch + Water. The straws are 100% bio-degradable, compostable, sustainable, cruelty free, safe for consumption, vegan and gluten free. So far the product has replaced more than 20 million plastic and paper straws with rice straws, which is equivalent to saving 10,000 trees and reducing 1000 metric tons of plastic waste.

5. **Greenhandle:** Connecting Businesses to Eco-friendly Packaging: Greenhandle is an eco-friendly packaging marketplace in India, connecting businesses with sustainable packaging solutions. The platform offers a wide array of green packaging alternatives, including biodegradable bags, compostable cutlery, and recycled paper products.

Greenhandle plays a vital role in making sustainable choices accessible to businesses of all sizes.

6. **Papel:** India's first plastic-free alkaline water in a 100% recyclable, 75% paper-based carton, championing sustainable living. Launched by Bellator Beverages, Papel is a plastic-free alkaline water in a 100% recyclable, 68% renewable, and 75% paper-based carton bottle. Papel's packaging is made up of 68% plant-based renewable material, marking a significant milestone in the quest for eco-friendly packaging alternatives. Compared to traditional packaging that needs 12 trucks to ship fully formed bottles, 1.5 million Papel packs can be loaded in just 1 truck, significantly reducing the carbon footprint and focusing on recyclability at a scale.

7. **Earthsoul India:** Sustainable Agricultural Packaging Solutions: EarthSoul India focuses on providing sustainable packaging solutions with a focus on agriculture. They offer compostable bags made from natural starches, catering to the agricultural sector's packaging needs. This approach aligns with the circular economy, where packaging materials return to the earth without causing harm.

8. **Paper Boat's Eco Revolution:** Sailing Towards Sustainability with Compostable Packaging: Paper Boat, an iconic Indian beverage brand, spearheads the transition to compostable packaging. Teaming up with compostable bags manufacturers, they've swapped out plastic for eco-friendly options like compostable tetra packs and cardboard. This strategic move not only curbs waste but also bolsters the compostable bags industry in India.

9. **FabIndia:** Forging a Path to Sustainability: FabIndia, a household name in ethnic products, champions sustainable packaging by embracing compostable alternatives. Collaborating with compostable bags manufacturers, they've bid adieu to traditional plastic bags, opting for compostable substitutes made from jute and biodegradable plastics. Their eco-conscious efforts propel the growth of compostable packaging in the country.

10. **Chumbak:** Vibrant and Eco-Friendly: Chumbak, renowned for its vibrant lifestyle offerings, prioritises compostable packaging to reduce its environmental footprint. Partnering with compostable bag manufacturers, Chumbak ensures its packaging—from paper bags to boxes and labels—is compostable and sourced sustainably. Their commitment not only preserves their unique brand identity but also fosters compostable packaging growth in India.

11. **Forest Essentials:** Beauty in Sustainability: Forest Essentials, a luxury Ayurvedic beauty brand, integrates sustainable packaging into its ethos. Through collaborations with compostable bag manufacturers, they introduce compostable options like glass jars and eco-friendly pouches. Forest Essentials' initiative not only minimises plastic waste in the beauty industry but also drives compostable packaging adoption in India.

4.8.7 Opportunities for further action- Plastics and Packaging

- **Create a Packaging-Biodiversity Scorecard for Industry Benchmarking:** Developing a standardized scorecard that evaluates the biodiversity impacts of packaging materials and processes can help companies assess and improve their environmental performance. This tool could rate packaging based on factors such as recyclability, use of virgin versus recycled content, sourcing from ecologically sensitive areas, and potential for ecosystem disruption. It would enable transparent benchmarking across industries and incentivize innovation in sustainable packaging.
- **Adopt Nature-Positive Design Across the Product Lifecycle:** Embedding nature-positive principles into every stage of the product and packaging lifecycle—from material sourcing and manufacturing to use and disposal—can significantly reduce ecological harm. This involves selecting renewable, biodegradable, or recycled materials, minimizing plastic use, designing for circularity, and ensuring that end-of-life packaging does not adversely affect ecosystems.
- **Collaborate on River and Coastal Plastic Removal Programs:** Cross-sector partnerships between corporates, civil society, and government agencies can enhance the effectiveness of plastic removal efforts in rivers and coastal areas. Engaging in joint clean-up operations, plastic interception projects, and local awareness campaigns can prevent plastic leakage into critical aquatic habitats and support broader marine conservation goals.
- **Link Plastic Recovery Initiatives with Biodiversity Restoration Projects (e.g., Mangroves, Wetlands):** Integrating plastic recovery programs with on-ground biodiversity restoration efforts can create dual environmental benefits. For instance, plastic clean-ups around wetlands, mangroves, and estuaries can be paired with habitat regeneration activities, such as replanting native vegetation or restoring hydrological flows. This not only reduces pollution but also strengthens ecosystem resilience and biodiversity outcomes.

5. CHALLENGES AND BARRIERS TO BUSINESS ENGAGEMENT IN BIODIVERSITY IN INDIA

Despite growing recognition of biodiversity as a critical factor in long-term business sustainability, Indian corporates face a complex web of structural, financial, policy, and knowledge-based barriers that hinder their effective engagement in biodiversity conservation. These barriers vary across sectors and business sizes, but together they create

a fragmented and often uncertain operating environment for biodiversity action. This chapter outlines the key challenges that continue to impede mainstreaming biodiversity in corporate strategies and operations.

- **Low Awareness and Institutional Capacity:** A fundamental barrier is the lack of awareness among businesses, particularly small and medium enterprises (SMEs) about how biodiversity underpins their operations. According to the India Business and Biodiversity Initiative (IBBI), only a small fraction of Indian companies has mapped their biodiversity dependencies and risks. Even fewer have formal biodiversity strategies in place. Internal technical capacity is also limited, with few organizations employing biodiversity specialists or integrating nature-based risk assessments into enterprise risk management systems. This gap is further reflected in the underutilization of biodiversity disclosure frameworks, with only 30 IBBI members submitting biodiversity disclosures in 2020.
- **Financial and Economic Constraints:** Biodiversity action often involves high upfront costs, long payback periods, and uncertain returns, making it unattractive in competitive markets. This is especially true for SMEs, which face difficulty accessing concessional finance, biodiversity-linked bonds, or climate funds. A report by Primus Partners estimated India's annual green capital gap at ₹11 trillion, with biodiversity conservation receiving a disproportionately low share. Traditional lenders continue to perceive biodiversity investments as high-risk, leading to underfunded conservation programs within corporate portfolios.
- **Fragmented Policy and Regulatory Landscape:** India's biodiversity policy framework—anchored by the Biological Diversity Act (2002) and its 2023 amendment—has seen improvements in streamlining compliance. However, implementation challenges remain, especially for businesses operating across multiple states, where interpretation and enforcement vary significantly. In sectors such as fisheries, mining, and agriculture, overlapping jurisdictions and ambiguous mandates from agencies like MoEFCC, NABARD, and State Biodiversity Boards deter coordinated corporate engagement. The lack of specific incentives or biodiversity-linked ESG regulations further reduces motivation to go beyond compliance.
- **Challenges in Measuring and Reporting Biodiversity Impact:** Unlike carbon, water, or energy footprints, biodiversity impacts are multidimensional, complex, and often site-specific. Standardized metrics are lacking, and existing tools like the IBBI Reporting Framework or TNFD beta framework are yet to be widely adopted. Measuring outcomes such as species richness, habitat integrity, or pollinator abundance requires advanced ecological knowledge and long-term data—resources that most companies do not have. This creates difficulties in setting measurable targets, tracking progress, or reporting in alignment with ESG and sustainability frameworks.
- **Insufficient Market Incentives and Misaligned Subsidies:** Market forces often disincentivize biodiversity-friendly practices. For example, agricultural subsidies continue to favor high-yield monocultures over biodiversity-rich crops like millets or pulses. There is also limited consumer demand for certified biodiversity-positive products, and certification mechanisms remain nascent. As a result, businesses lack sufficient financial or reputational incentives to invest in biodiversity-enhancing production and sourcing systems.

- **Short-Term CSR and ESG Planning Horizons:** Many biodiversity projects, especially those implemented under CSR, operate on short-term funding cycles that prioritize visible, time-bound results. However, biodiversity conservation—such as restoring wetlands or regenerating soil ecosystems—requires multi-year commitments. Without structured long-term planning and outcome-based funding mechanisms, CSR investments often remain fragmented, limiting their ecological impact and scalability.
- **Limited Technical Expertise and Knowledge Networks:** In several sectors, especially agriculture, textiles, and infrastructure, there is a lack of domain-specific guidance on biodiversity-positive practices. Few companies have access to ecologists, spatial planners, or biodiversity auditors who can guide decision-making. Partnerships with research institutions, BMCs, or NGOs remain underutilized, and corporate biodiversity literacy is low, even among sustainability officers. This results in ad-hoc or tokenistic efforts that fail to address underlying ecological concerns.
- **Stakeholder Engagement and Local Trust Deficits:** Effective biodiversity conservation often requires close collaboration with local communities, especially in ecologically sensitive landscapes. However, businesses frequently struggle to build trust with these communities, who may be wary of corporate motives or skeptical of conservation-linked livelihood models. Cultural misalignment, lack of participatory planning, and limited awareness of biodiversity benefits among rural stakeholders further compound the challenge.
- **Scalability and Context-Specificity of Biodiversity Projects:** Unlike standardized interventions such as solar energy or waste segregation, biodiversity solutions are inherently context-specific, shaped by local soil types, ecosystems, and cultural practices. This makes it difficult to scale successful pilots across diverse geographies. As a result, biodiversity strategies often remain confined to a few demonstration sites rather than being integrated across entire supply chains or operations.
- **Perceived Trade-Offs Between Productivity and Conservation:** In sectors like agri-business, food processing, and manufacturing, biodiversity goals are often viewed as competing with productivity, efficiency, or profitability targets. Businesses may perceive that biodiversity interventions will increase costs or reduce output, rather than viewing them as long-term investments in resource resilience and ecosystem health. This mindset continues to hinder deeper integration of nature-based considerations into business models.

6. OPPORTUNITIES AND RECOMMENDATIONS

Achieving India's ambitious climate and biodiversity goals requires greater engagement from the private sector. Businesses have a unique ability to lead the way by adopting sustainable practices, mobilizing crucial financial resources, and driving innovation for ecological well-being. While sustainability has gained momentum in corporate strategies, there is still significant room to expand private sector involvement through creative

financial mechanisms, collaborative initiatives, and targeted capacity-building efforts, supported by enabling policies.

Strategic recommendations for businesses to strengthen biodiversity action

- **Public-Private Partnerships (PPPs):** PPPs enable the private sector to contribute expertise and financial resources to public projects with biodiversity or climate objectives. For example, the Namami Gange program, India's national river-cleaning initiative, has engaged private companies in wastewater management and riverbank restoration. Companies like PepsiCo and Coca-Cola have partnered with local governments to support wastewater treatment facilities and tree plantations along riverbanks, supporting biodiversity while improving water quality.
- **Industry Alliances:** Industry bodies such as the Confederation of Indian Industry (CII) have established platforms like the CII-ITC Centre of Excellence for Sustainable Development, which provides a forum for companies to collaborate on environmental issues. The centre promotes knowledge-sharing, offers sustainability certifications, and supports corporate biodiversity initiatives through technical guidance and case studies.
- **Capacity Building and Training for Corporate Leaders:** Building capacity within the private sector for climate and biodiversity action is essential for translating corporate commitments into effective action. Training programs and knowledge-sharing initiatives can empower corporate leaders to adopt best practices, integrate sustainability into decision-making, and develop in-house expertise on biodiversity conservation.
- **Sector-Specific Training Programs:** Industry-specific training programs can be particularly impactful, offering companies tailored guidance on sustainable practices for their sectors. For example, the Business and Biodiversity Pledge initiative by the Ministry of Environment, Forest and Climate Change (MoEF&CC) offers biodiversity management training to companies in sectors like mining, pharmaceuticals, and infrastructure, where biodiversity impacts are direct and measurable.
- **Corporate Sustainability Certifications:** Certifications such as the ZED (Zero Effect, Zero Defect) certification in the textile industry, play a significant role in advancing environmental sustainability. It has led to a reduction in the use of toxic dyes and harmful processing chemicals, thereby minimizing pollution and its adverse impacts on ecosystems.
- **Integration of Biodiversity and Climate Metrics in ESG Training:** Given the rising importance of Environmental, Social, and Governance (ESG) factors in investment decisions, ESG training that includes biodiversity metrics can prepare companies to meet investor expectations and regulatory requirements. The International Finance Corporation's (IFC) 'Performance Standards on Environmental and Social Sustainability' have guided Indian companies in integrating biodiversity into their ESG metrics, particularly in high-impact sectors like mining and forestry.
- **Biodiversity Indicators for Businesses (BIB):** Biodiversity indicators are crucial tools that help businesses assess, monitor, and mitigate their impacts on ecosystems. These indicators offer measurable data on factors like habitat loss, species population trends, and ecosystem health, enabling companies to align their activities with conservation goals. For example, tools like the Biodiversity Indicators for Business (BIB) provide frameworks for businesses to

evaluate their dependency and impact on biodiversity while identifying areas for improvement. By leveraging these metrics, companies can set tangible targets, such as reducing habitat destruction or improving sustainable sourcing practices. This not only enhances compliance with global frameworks like the Kunming-Montreal Global Biodiversity Framework but also aligns operations with investor expectations in Environmental, Social, and Governance (ESG) metrics. Ultimately, biodiversity indicators empower businesses to transition from reactive approaches to proactive strategies, fostering accountability and creating long-term value for both ecosystems and stakeholders.

Integration of biodiversity into ESG and CSR frameworks

- **Policy Reforms and Incentives:** Supportive policy reforms and incentives can encourage greater private sector involvement in biodiversity and climate projects. By simplifying regulations and providing financial incentives, the government can create an enabling environment for businesses to invest in environmental initiatives.
- **Expanding CSR Mandates for Biodiversity:** India's CSR mandate under the Companies Act of 2013 provides a structured framework for companies to invest in social and environmental causes. Currently, it is estimated that less than 3% of CSR funds are allocated to biodiversity. Expanding CSR guidelines to emphasize biodiversity specific projects, or offering tax incentives for biodiversity investments, could significantly increase corporate funding for conservation efforts. In FY 2022-2023, India's CSR spending on environmental sustainability totalled approximately ₹2,380 crore (USD 300 million), with potential to grow if more specific biodiversity requirements were introduced (Ministry of Corporate Affairs, 2024).
- **Green Tax Benefits and Subsidies:** Green tax benefits and subsidies can incentivize sustainable practices. For example, tax deductions for renewable energy investments and subsidies for sustainable agricultural practices motivate companies to adopt eco-friendly operations that also benefit biodiversity. Extending similar benefits to projects like wetland restoration and mangrove conservation would encourage biodiversity-positive investments by reducing operational costs.
- **Streamlining Regulatory Processes:** Complex regulatory procedures can deter private sector participation in environmental projects. Streamlining processes for biodiversity projects, such as simplifying the approval procedures for ecosystem restoration or sustainable development permits, can encourage private companies to engage more actively. The Ministry of Environment, Forest and Climate Change (MoEF&CC) has initiated efforts to digitize and expedite environmental approvals, which could help businesses integrate biodiversity conservation into their operations more efficiently.

Role of innovation and technology in biodiversity conservation

As ecosystems face unprecedented threats, innovation and technology have emerged as transformative tools to address these challenges. From advanced data analytics to cutting-edge genomic techniques, technology is reshaping the way we understand, monitor, and protect biodiversity.

- **Data Analytics and Visualization:** The vast complexity of biodiversity data often poses a challenge for decision-makers. Advanced data analytics platforms now enable

the integration and interpretation of diverse datasets, ranging from satellite imagery to field surveys. Tools like the UN Biodiversity Lab (UNBL) democratize access to spatial data, allowing stakeholders to visualize interactions between human activities and environmental trends. In India, platforms like the India Biodiversity Portal provide interactive dashboards and heatmaps, empowering policymakers and businesses to prioritize conservation efforts effectively.

- **Artificial Intelligence (AI) and Machine Learning:** AI and machine learning are revolutionizing biodiversity research by processing vast datasets to identify patterns and predict trends. For instance, AI-powered algorithms analyze data from camera traps and acoustic sensors to monitor species populations and detect illegal activities like poaching. Globally, AI is being used to model the impacts of climate change on biodiversity hotspots, enabling proactive conservation strategies.
- **Genomics and Environmental DNA (eDNA):** Genomic technologies and eDNA analysis are providing unprecedented insights into biodiversity. By analyzing genetic material from environmental samples, researchers can detect the presence of species and assess ecosystem health. This non-invasive method is particularly valuable for monitoring elusive or endangered species. In India, genomic tools are being explored to study genetic diversity and support species recovery programs under the National Biodiversity Strategy and Action Plan (NBSAP).
- **Remote Sensing and Geographic Information Systems (GIS):** Remote sensing technologies, such as satellite imagery and drones, offer a bird's-eye view of ecosystems. GIS tools integrate this data to map biodiversity-rich areas, monitor habitat changes, and assess the effectiveness of conservation initiatives. The Indian Space Research Organisation (ISRO) has been instrumental in using satellite technology to track deforestation and habitat degradation.
- **Blockchain for Transparency and Traceability:** Blockchain technology is ensuring transparency in supply chains, particularly in industries like agriculture and fisheries. By verifying sustainable sourcing practices, blockchain helps reduce biodiversity loss caused by unsustainable exploitation. This is especially relevant in India, where forest produce and fisheries are critical to local economies.
- **Citizen Science and Community Engagement:** Citizen science platforms like iNaturalist and the India Biodiversity Portal are mobilizing communities to contribute to biodiversity documentation. These platforms crowdsource valuable data while fostering public awareness and engagement. Such initiatives align with India's emphasis on community-driven conservation under the Biological Diversity Act, 2002.
- **India's Leadership in Biodiversity Innovation:** India has been at the forefront of integrating technology into biodiversity conservation. The Biological Diversity (Amendment) Act, 2023, aims to streamline compliance and encourage the use of innovative tools for sustainable resource management. Initiatives like the India Business and Biodiversity Initiative (IBBI) are fostering collaboration between businesses and conservationists to adopt tech-driven solution

7. CONCLUSION

India stands at a defining moment in the integration of biodiversity into business strategy. The evidence presented in this report reveals that while biodiversity has historically been seen as the domain of environmentalists and policymakers, it is now emerging as a core business issue—affecting supply chains, regulatory compliance, operational continuity, and brand equity. As the risks from biodiversity loss grow clearer, so too do the opportunities for businesses to lead the transition toward nature-positive growth.

Across sectors—ranging from agriculture and agri-business to textiles, mining, energy, and packaging—Indian companies are beginning to align their operations with ecological

stewardship. Some are adopting regenerative practices and nature-based solutions, others are investing in biodiversity assessments, circular economy innovations, and eco-restorative CSR projects. These developments signal a positive shift: from viewing biodiversity as a compliance requirement to recognizing it as a source of resilience, reputation, and future readiness.

However, the path ahead remains challenging. The report identifies a complex web of barriers—including low institutional capacity, fragmented regulations, limited access to finance, and insufficient biodiversity data. Biodiversity remains underrepresented in mainstream ESG reporting and sustainability disclosures. Corporate action is often localized or project-based, with limited integration into supply chain management or long-term strategy. Without a systemic shift, efforts risk remaining fragmented and failing to deliver impact at scale.

To navigate this transition, Indian businesses must adopt a strategic and integrated approach to biodiversity. This includes aligning with global frameworks such as the Kunming-Montreal Global Biodiversity Framework and TNFD, investing in innovation and green finance instruments, strengthening internal capacities, and embedding biodiversity into ESG and CSR architectures. Partnerships—with local communities, biodiversity boards, civil society, and academic institutions—must be at the heart of this process.

This report is both a diagnosis and a blueprint—highlighting where Indian industry stands and outlining how it can move forward. It calls upon businesses to view biodiversity not as a trade-off, but as a strategic enabler of sustainable growth and market leadership. Protecting India's natural capital is not only an environmental imperative; it is an economic necessity, a reputational advantage, and a legacy-building opportunity.

The coming years are critical. As the world moves toward a nature-positive future, India has the potential to be a global leader—leveraging its rich biodiversity, entrepreneurial dynamism, and policy ambition. Let this report serve as a call to action for Indian companies to rise to the challenge, seize the opportunity, and ensure that business and biodiversity flourish together—for people, planet, and prosperity.