THE ECONOMICS SOCIETY
SHRI RAM COLLEGE OF COMMERCE

BEYOND CONSERVATION: UNDERSTANDING INDIA'S WILDLIFE ECONOMY

Research Report 2025-26

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INTRODUCTION AND OVERVIEW

This report examines wildlife from the Indian subcontinent and goes beyond economic, social and governance factors. Wildlife and wildlife biodiversity, the foundation of the planet's ecological balance, play a crucial role in sustaining human life and our ecosystems. Human survival is heavily dependent on wildlife, as it provides items essential for human survival, like food security, medicine, and climate regulation. And yet, one of the biggest misconceptions regarding wildlife is that people assume that it has only ecological significance. In reality, wildlife is also an integral part of our economy, governance systems, and social structures.

In recent decades, the pressure on wildlife has increased significantly due to the rapid economic development and industrialisation. Overpopulation has led to over-acquisition of land, leading to the loss of land for wildlife. These factors have intensified the already concerning human-wildlife conflict. In turn, this has further led to habitat fragmentation, biodiversity loss, and many such negative implications. At the same time, however, wildlife-related sectors, such as eco-tourism, marine fisheries, deep-sea mining, etc., have also seen tremendous growth and have become vital sectors in the economy. This dual reality suggests that we need to re-examine the importance of wildlife, both from an ecological and economic lens.

Wildlife has a significant effect on the economy, making both direct and indirect contributions to the GDP of an economy. It contributes directly to the GDP through sectors like tourism, eco-tourism, etc. Indirect contributions to GDP are implicitly linked to the multiplier effect that the initial spending by tourists creates. Tourism operations entail the purchase of goods and services from other businesses and payment of wages to local workers. This creates a ripple effect in the economy and ends up generating additional economic activity. The wildlife economy consists of the intersection of ecology, economy, governance, and society.

From an ecological perspective, many species have been getting endangered and extinct, due to human activities like rapid industrialisation, hunting, poaching, etc. In light of this, the Government has introduced various schemes for the protection of wildlife, the most prominent being the Environment Protection Act, 1986. There are also various constitutional provisions protecting the wildlife and the environment. Still, various challenges like funding gaps, over-commercialisation,

etc., persist in the Indian wildlife framework. Finally, there are also ethical dilemmas faced with regard to the wildlife economy, with constant debates about whether a specific species should be protected or their hunting should be allowed, the right to ancestral lands, and many other such debates. There is another ongoing debate about whether specific species should be kept in captivity or not. While keeping them in captivity ensures their protection, it may make them experience negative emotions like stress or anxiety, and long periods of captivity make them lose their ability to survive in the wild. This report will holistically explain all aforementioned challenges and strive towards better solutions, better paths moving forward, and a better environment.

PURPOSE OF WRITING AND METHODOLOGY

PURPOSE OF WRITING

Wildlife is not merely an ecological asset, but it is also an integral part of our economy, governance systems and social structures. Traditionally, it was only looked at through an ecological lens. However, in recent decades, it has also started being looked at through an economic lens, and people have started acknowledging that it is closely correlated with our economy, livelihoods, public finances and employment levels. The central aim of this report is to analyse and comprehend the correlation between the ecological and economic aspects involved herein and the impacts of wildlife on the Indian economy. The report also looks at the costs and benefits of wildlife conservation from an economic lens.

Another major purpose of the report is to critically analyse India's wildlife policy and legal framework. By analysing key policies like the Wildlife Protection Act, 1972 and its amendments, the report aims to effectively gauge whether the implementation of the policy is successful and effective, identify the gaps in implementation, and provide solutions to fill those gaps. We also look at multiple aspects of wildlife on the Indian economy, such as tourism, illegal trading of animals, the human-wildlife conflict, etc. This way, the report not only covers the direct impacts of wildlife on the economy, such as contributions to GDP, but also offers a comprehensive understanding of the indirect impacts of wildlife on the economy, such as ecosystem stability, employment levels, agricultural welfare, etc.

As previously mentioned, the report analyses how this conflict disproportionately harms the poor, people living in rural areas, and the underprivileged, highlighting the need for more equitable solutions to the human-wildlife conflict.

Finally, this report aims to meaningfully contribute to the ongoing debate regarding the use of wildlife, where one side aims to give up profits and development to protect the wildlife, while the other ignores the environmental impacts of their actions in order to maximise profits. This report aims to seek a middle ground by providing a comprehensive understanding of the trade-offs of wildlife conservation.

It integrates economic, legal and social perspectives in order to provide a comprehensive understanding of the wildlife economy as a whole, which can help strike the perfect balance between profits & development and wildlife conservation.

METHODOLOGY

Our research attempts to explain wildlife conservation from an economic perspective within the Indian subcontinent. It investigates the changes in wildlife policies, conservation efforts, and the economics of wildlife over time, along with how these changes have led to the present situation. Since the theme dealt with here incorporates environmental and social aspects, this research largely relies on qualitative methods. Data have been gathered by reviewing various books, research articles, and government publications on wildlife conservation and wildlife economics.

The paper begins with a probe into the major themes and issues connected to wildlife conservation. To name a few, aspects concerning wildlife policies, economic impacts, climate change, and conflicts between human beings and wildlife are discussed. The reasons behind the same and consequent effects on the economy are also looked at. An in-depth analysis is made of the importance of wildlife for the Indian economy, especially through its direct financial gains from tourism and national parks. Along with that, the study also throws light on the influence of climate change on biodiversity and hence discusses habitat degradation, marine biodiversity, and the measures implemented by the government to tackle these issues.

This research also delves into the legal framework, policies, and governance arrangements for wildlife conservation. Additionally, it investigates the problems of human-wildlife conflict, poaching, and illegal trade in wildlife products to get a clear picture of the difficulties in wildlife protection. Moreover, the study considers financial and institutional barriers, such as a shortage of funds and inadequacy of systems, to arrive at potential workarounds. It also includes the contribution of public-private partnerships towards the enhancement of conservation initiatives. Animal rights, captivity, and climate justice are some of the ethical considerations that also find their place in the discussion.

In the conclusion, the study brings together the main findings to understand the overall impact of wildlife on the economy. This contributes to giving a comprehensive view of the significance of wildlife conservation and its role in sustainable development.

CONCEPTUAL FRAMEWORK

CONCEPTUAL FRAMEWORK

Various elements of human existence, including our culture and livelihoods, have depended on wildlife. It was historically respected and even worshipped in some cultures, and humans and wildlife coexisted. With the advent of industrialisation and the desire for quick economic growth, this balance vanished. This has resulted in loss of biodiversity and climate change, and has hampered the economy by hurting livelihoods and putting opportunities for ecotourism at risk. In this context, the idea of a wildlife economy has gained importance. It is a concept that attempts to balance economic growth and ecological conservation by acknowledging that wildlife is not just a resource to be mined or a temporary investment that generates quick profits. It is instead treated as a long-term asset that redefines the economic potential of a region and provides sustainable economic benefits.

The wildlife economy aims to strike a balance between two worlds: one of economic development, the other of conservation of culture and livelihoods. By doing so, it can lead to sustainable and inclusive growth. A similar concept is presented in community economics, which lies at the intersection of two concepts that often appear contradictory: community and economy. However, when approached thoughtfully, they can complement each other effectively. Community economy fosters the prosperity of society as a whole by promoting inclusive growth, rather than concentrating economic power in the hands of a few. It is based on 2 principles:

1) The local community should be the core focus of economic development.

2) Any development activity should be based on indigenous resources.

The creation of such an economy largely focuses on supporting marginalised people, especially in developing nations. Local communities play a pivotal role in overall development, and community economics helps such communities in reaching their full potential by providing mechanisms to support them. Leveraging local communities would assist in reducing inequalities and achieving sustainable development. Some methods to achieve this include local investment initiatives and common management of assets like wildlife and water for prudent usage.

Such efforts are closely related to ecology, which establishes a relationship between living things and the environment. Studying ecology gives us insights regarding how ecosystems function and assists in the

development of plans for environmental conservation.

Ecological economics argues that the economy is both a component of and dependent upon the natural environment. It claims that both concepts are interdependent and seeks to align short-term goals with long-term welfare. It criticises traditional development, which was solely growth-focused, and calls for policies that protect the economy and the environment.

The parlance of the terms "Ecology", "Wildlife Economy", and "Community Economy" is quite indistinguishable from one another. These terms are often used interchangeably, but they actually stem from different conceptual lenses within economics, sustainability, and environmental studies. The definition of Ecology has evolved throughout the years from the vantage point of various scholars. The classical definition of Ecology (Ernst Haeckel, 1866) stems from the Greek word *"oikos"*, referring to a home. As per Haeckel, Ecology is "the study of the natural environment, including the relations of organisms to one another and to their surroundings." Progressing through the thresher of time, this definition catapulted into the modern version of what we perceive to be Ecology. Australian ecologists Herbert G. Andwertha and Charles Birch, in their famous publication *"The Distribution and Abundance of Animals" (1954),* explained Ecology through the core tenets of environment-dependence and described Ecology as the study of "everything that might influence an organism's chance to survive and reproduce." In the simplest of terms, "Ecology" refers to the science of how nature works. It is the scientific study of organisms and their environment, emphasising the core interactions that organisms undertake with their surroundings. It showcases the interdependent nature of interactivity between living entities and abiotic factors of nature. Ecology encompasses both wildlife and community economies in its broad scope. The term "Wildlife Economy" focuses on how wildlife and biodiversity can generate sustainable economic value while treating wildlife as a crucial economic asset. It emblazons the concept of wildlife and biodiversity through the kaleidoscope of a yield or revenue-generating virtue. It reframes wildlife from a resource extraction apparatus into an asset to be invested in for long-term social, cultural, and economic returns, using typical economic instruments such as Payments for Ecosystem Services (PES), green bond financing, and eco-branding certifications. The postulation of the concept of a Wildlife Economy has often been emphasised via monetary valuations. The income aspect of wildlife goes beyond primary benefits, into a source of population empowerment tool (Katarina Eloffsen and Tobias Haggmark 2018, Economics of Wildlife Management: An Overview).

The notion of a "Community Economy" is built around the contribution of local, people-centred communities at its core. It includes the concepts of local ownership and empowerment through community forestry, local cooperatives, and NGOs. Conclusively, Ecology" is the science, "Wildlife Economy"

is its application, and "Community Economy" is a social system ensuring the preservation of both society and economy.

The interdependencies between people, planet, and profit are becoming increasingly evident; we are embedded in nature, not external to it. More than half of the global GDP is highly or moderately dependent on nature and its services, and around two-thirds of food crops rely at least partly on animal pollination. As per the World Economic Forum's report (July 2020, New Nature Economy Report-2: The Future of Nature and Business. Volume 2), the global food, land, and ocean use system, encompassing its entire supply chain, accounts for approximately $10 trillion of GDP (12% of global GDP) and up to 40% of employment. The wildlife economy contributes directly to GDP through revenues from wildlife tourism and regulated use, and indirectly through the wider economic effects generated by related industries. Direct contributions to GDP are primarily made through wildlife tourism, which encompasses the entirety of accommodation revenue and charges for accessing national parks and sanctuaries. Other pivotal additions can be made through "Regulated and Consumptive" use industries, like fisheries, game meat and products, and sport fishing as well. The fishing industry in itself adds roughly 1% to India's GDP and about 5% to the global agricultural GDP. Aquaculture is a broader sector that encompasses fisheries in its scope. This sector provides livelihoods to millions of individuals across various segments of the value chain, especially in the export sector. The export sector, in particular, is a major source of livelihood for rural women.

Indirect contributions to GDP are implicitly linked to the multiplier effect that the initial spending by tourists creates. Tourism operations entail the purchase of goods and services from other businesses and payment of wages to local workers. This creates a ripple effect in the economy and ends up generating additional economic activity.

A wide array of tourism-related and auxiliary industries, such as transportation, hospitality, and local handicrafts, circulate money from the core wildlife economy into the wider market. Wildlife economy also promotes diverse employment opportunities for local people, including roles as safari or tourist guides. Moreover, it advocates for local cuisine and souvenirs and, hence, creates additional income for the cultural and heritage-based local economy. Certain aspects of the wildlife economy are onerous to quantify for GDP calculation, but are a critical addition to the economic sectors. One of the major indirect contributions to GDP is that of wildlife-induced pollination. Nature inspires new industrial products and technologies, generating economic opportunities. For example, the streamlined body structure of aquatic and aerial organisms has inspired the genesis of modern aeronautical transportation. This points to the broad scope of advantages that an efficiently tapped wildlife biodiversity unleashes.

The importance of a Wildlife Economy is immense in its scope; thus, its conservation becomes an even more pressing concern.

THE WILDLIFE POLICY IN INDIA

Wildlife Conservation has been a prevalent practice in India for thousands of years. In ancient times, wildlife management was an intrinsic part of religious and cultural practices. Though wildlife conservation practices were not as finely structured as in modern times, some ancient Indian rulers took measures to protect certain species. Ashoka, "the Great," introduced early forms of environmental protection by issuing edicts that prohibited the killing of animals in sacred forests. Ashoka's efforts are considered one of the earliest recorded attempts at wildlife protection in India. However, the first officially protected area in India was recognised about two thousand years later, during the British Colonial Rule in 1878. It was the Sundarbans Reserve. This was primarily aimed at making sure that species like the Tiger would continue to facilitate hunting and tourism.

Despite this, the British Government was unsuccessful in reducing the rampant exploitation of wildlife, which had caused many species to be driven nearly to extinction due to unchecked hunting and habitat loss. As the threats of extinction rose throughout the domestic and international communities, the British instituted limited wildlife conservation policies in India through reasonable (for the British) legislation regarding wildlife, including the Wild Birds Protection Act 1887 and the Wild Birds and Animals (Protection) Act 1912. The amendment of this Act in 1935 introduced the concept of a 'Sanctuary' for the first time in India.

After Independence in 1947, the Indian Government enacted provisions for preserving and conserving wildlife resources. The Constitution of India stated that forests and wildlife would be under the State list. Eventually, it was found that this was not realistic in practice. Therefore, the forests and wildlife were included in the Concurrent list thereafter, through the Constitution (42nd Amendment) Act, 1976.

In 1952, India made a landmark decision with the National Park system beginning with the Jim Corbett National Park in Uttarakhand, the first national park in modern history. These parks were designed as places to visit and enjoy, and also served as an early example of how to protect wildlife. The most popular and significant legislative changes brought to promote the long-term viability of wildlife in India were the Forest Conservation Act of 1980 and the supporting Wildlife Protection Act of 1972. While the WPA 1972 is the most well-known/recognisable Act, through the 1950s and 1960s, there were a multitude of smaller things that laid a platform for it to take place. The Wildlife Protection Act, 1972 standardised a legal framework for the country, banning hunting, regulating the trade of wildlife and wildlife products, and creating schedules of species to be

designated protected.

This Act framed the conception and establishment of National Parks, Wildlife Sanctuaries, Conservation Reserves, and Community Reserves, thus solidifying the modern phrase "Protected Area". The Act was amended in 1982, 1991, 2002, 2006, and 2022 to shore up the legal framework for protecting biodiversity, its inherent diversity, and the communities' role in conservation. The 1991 amendment especially addressed issues of banning hunting and protecting animal habitats. The amendment in 2002 brought in the concept of Conservation and Community Reserves in support of the local people working towards conserving biodiversity. The latest amendment in 2022 aimed to officially include the laws of CITES (Convention on International Trade in Endangered Species) into the Wildlife Protection Act, 1972. This was done to ensure sufficient control and regulation of wildlife trade, and legal recognition of more endangered species for protection. Various flagship programs like the Project Tiger and Project Elephant have been launched by India to provide protection to endangered species and to support conservation. These projects have helped foster connectivity in habitats. The National Biodiversity Act (2002) and Forest Rights Act (2006) have not only moved towards integrating ecological protection and people's livelihoods, but also recognised communities as vital and important in using resources sustainably and in decision-making. There were, therefore, several institutions set up to ensure compliance and implementation of conservation actions.

The wildlife economy encompasses various sectors, including wildlife tourism, eco-tourism, and wildlife sanctuaries, among others. However, from a broader perspective, it comprises two main aspects: economic growth and ecological conservation. On the one hand, it aims to boost economic growth by promoting wildlife and eco-tourism, but it also seeks to conserve the wildlife on the other hand. It promotes economic development through sectors like wildlife viewing or eco-tourism, which significantly boost GDP growth and provide employment opportunities as it provides jobs to tour guides, hotels (hotels employ the hotel staff), and overall boosts the economy in the area where wildlife viewing is prevalent, thereby supporting the locals and supporting sustainable development. However, because most of the wildlife tourism is handled by the private sector, they may try to exploit the wildlife for profit or may ignore the state the animals are kept in, as it does not directly impact their profits. For instance, excessive tourism activity in popular tiger reserves such as Corbett and Ranthambore National Parks has sometimes led to habitat disturbance, noise pollution, and stress among wildlife. Wildlife economics aims to stop this exploitation of wildlife and seeks to balance out economic growth and wildlife conservation.

There are some challenges to wildlife economies in India. India has always had a traditionalist approach towards conservation and has always prioritised it before economic

growth. This led to conflicts between humans and the wildlife, more specifically in rural areas where poverty is prevalent. This is because when poverty is prevalent, people might resort to activities like hunting/poaching to increase their revenue, and such activities are illegal. This may lead to conflicts. The problem with these traditionalist strategies is that they leave few employment and growth opportunities. For example, as activities like hunting are heavily regulated in India, leaving only a few opportunities for economic growth, the most impactful one is wildlife tourism, which leads to another problem - The ones that make most of the profit aren't local communities, but people like hotel owners, or travel agencies, etc. These issues call for a change in policy and public perception of wildlife economies as a whole. Moreover, corruption is prevalent in every part of India, and wildlife is no exception. Corruption is a crucial threat to the successful implementation of wildlife economies in India.

Despite all these challenges, India also has great potential to build a vibrant wildlife economy. India is a mega-diverse country, holding 7-8% of the world's recorded species within its 2.4% land area, and is home to four of the world's 34 biodiversity hotspots: the Himalayas, Indo-Burma, Western Ghats, and Sundaland. This gives India a massive edge over most countries in terms of wildlife economies due to its rich flora and fauna. The rich and diverse flora provides the necessary habitat for the animals to survive, which also leads to a diversified fauna. In order to overcome the above challenges, India should change its policy and be slightly more liberal with its protection policies. An example of this is to allow hunting in a highly controlled manner. This, although it may seem contradictory at first, would actually reduce the human-wildlife conflicts as it would improve economic welfare and raise employment. But such a policy should be implemented with utmost care. It should also focus on diversifying its wildlife and eco tourism sector, as it could massively increase revenue while minimising its ecological footprint.

There were, therefore, several institutions set up to ensure compliance and implementation of conservation actions. The apex central government authority is the Ministry of Environment, Forest and Climate Change (MoEFCC), and it deals with the policy, legal, and financial aspects for the conservation of wildlife in the Country. This Division also provides financial support to the State and UT Governments for the preservation of wildlife. Next comes the National Board for Wildlife (NBWL), which was constituted under Section 5A of WLPA. It is chaired by the Prime Minister. It serves as an advisory body to the Central Government on all wildlife-related matters. It promotes the conservation and development of wildlife and forests, controls poaching and illegal trade of wildlife and makes recommendations on the setting up of and management of national parks, sanctuaries and other protected areas and on matters relating to restriction of activities in those areas. Along with that, it carries out an impact assessment of various projects and activities on wildlife or its habitat, reviews the

progress in the field of wildlife conservation in the country, and suggests measures for improvement and prepares and publishes a status report. Central Zoo Authority (CZA) is a statutory body established under Section 38A of WLPA. This Authority sets the minimum standards for housing, upkeep, and veterinary care of the animals kept in a zoo and evaluates and assesses the functioning of zoos according to the standards. Apart from that, it grants or withdraws recognition to zoos, identifies endangered species of wild animals for the purpose of captive breeding and coordinates the acquisition, exchange and loaning of animals for breeding purposes. It also promotes research, training, and education for scientific zoo management and development. Another significant central body is the Wildlife Crime Control Bureau (WCCB), established under Section 38Y of WLPA. It performs some very important duties such as collecting and collating intelligence related to organised wildlife crime activities and coordinating the actions by various officers, State Governments and other authorities in connection with the enforcement of the provisions of the Act. It is also responsible for the implementation of obligations under various International Conventions and facilitates coordination and universal action for wildlife crime control by providing assistance to concerned authorities in foreign countries. At the state level, the Forest Departments play a crucial role in the conservation of wildlife. Their primary duty is the protection and conservation of forest resources throughout the country. It is their responsibility to maintain the health and biodiversity of forests, prevent deforestation, and combat any kind of illegal activities such as encroachment, poaching and timber trading. In the forest departments, the forest officials have the important duty to patrol the forest areas and enforce the various laws. Another function of theirs is to frame policies and plans for sustainable forest management. They also play an active role in raising awareness about forest conservation by hosting various kinds of workshops, and they also collaborate with different research institutions. States also establish their State Board for Wildlife (SBWL), which is typically chaired by the Chief Minister. It advises the State Government on selecting and managing protected areas, formulating policy for the protection and conservation of wildlife, in any matter relating to the amendment of any schedule and also for harmonising the needs of the tribals with the protection and conservation of wildlife. Together, the central and state authorities work with the goal of wildlife protection in India.

Thus, the wildlife economy is very important and cannot be ignored. It is not just about saving animals. It is about bringing together people, rules, and ways of living that let both nature and communities grow. We need to keep a balance so that development and conservation happen together.

WILDLIFE AND THE INDIAN ECONOMY

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COMPARATIVE ANALYSIS OF NATIONAL PARKS

India has seen multiple events signifying both turmoil and development in its wildlife scene. This describes a rather tumultuous relationship between local communities, their livelihoods, and the aspect of conservation. Conserving wildlife often entails cutting down on established livelihood sources, such as those associated with timber and hunting. However, conserving biodiversity can transfer these job avenues to newer ones in the form of employment opportunities in National Parks that promote tourism and boost the local income of the communities associated with their operation. One of the major goals of these establishments is to boost biodiversity conservation and to provide a protected environment for endangered species.

Figure 2.1: Rhino at Kaziranga National Park

KAZIRANGA NATIONAL PARK

The Kaziranga National Park and Tiger Reserve in Assam is an epitome of nature's true reflection. Spanning the grasslands of elephant grass in the flood plains of the Brahmaputra Valley, the park serves as a natural sanctuary to the highest number of one-horned rhinoceros in the world. Established in the year 1974, the park is an extensive extension with an area of 430 sq. km, which houses many exotic plants and animals such as elephants, wild buffaloes, and the famous hoolock gibbons. What makes the park unique is that it serves as a natural habitat to many endangered species of the world. In addition, the park has one of the highest ratios of tigers per unit of land area in India.

The Kaziranga National Park is a UNESCO World Heritage Site and has recorded a more than 35% increase in the overall tourist volume throughout the decade, making it the third most visited tourist destination amongst national parks of India, falling only behind the Periyar National Park of Kerala and the Ranthambhore National Park of Rajasthan. The National Park registered around 443,636 visitors from October 2024 to May 2025, making it the third most visited wildlife

destination in India.

The park was able to generate the maximum revenue in 2023 since its initiation. Registered statistics have showcased a positive trend in the revenue generation data of the park. According to officially published data by the Ministry of Tourism, India, the Kaziranga National Park was able to generate an impressive ₹10.9 crores in revenue. This number saw an increase from the initial amount of ₹8 crores in revenue generated. (Press Release, Govt. of India, 2023-24). This signified the largest volume of income that the park generated in the last five decades. This major boost was seen after the park recorded more than 13,900 foreign tourists in 2023; foreign tourists now contribute about 4.5% of the total tourists received by the park. (The Hindu, May 11, 2024).

The national park consists of many attractions and activities that contribute to its popularity amongst tourists within India and outside India as well. Visitors undertake a plethora of activities at the park, which include sightseeing and jungle safaris. Other activities include trekking along various popular trails, such as the famous Karbi-Anglong trail. These ranges offer tourists the chance to indulge in recreational activities whilst promoting local cuisine and culture. Bwisag-Na, a popular ethnic cuisine restaurant run by women of the local Bodo community, stands as a paradigm for the contribution of local communities and their culture in the national park's sustenance. (Press Release, Govt. of India, 2023-24).

The main feature of the national park lies in its having a tropical climate, caused by the Tropic of Cancer surrounding this particular place. It can be stated that the tropical climate means that the weather at the national park is rather hot and humid; therefore, the national park is most advisable to visit in winter and in summer. Most tourists and income are generated by the national park during the winter months of November through February. One of the main reasons that winter is the ideal season for tourists to visit the national park compared to any other season is that migratory birds visit the park in droves, including the bar-headed goose and ferruginous ducks. Nevertheless, the least favourable season for tourists to visit the national park is the monsoon season due to the danger it poses. Due to the fact that there is much rainfall (more than 85 inches or 2,000 mm) and the whole western part of the national park gets flooded, it becomes almost impossible to move through it.

The management and operation of the national park requires collective responsibility and coordination between authorities and local communities equally. The threat of illicit hunting and poaching still runs large; in order to ensure proper implementation of the provisions of The Wildlife Protection Act, 1972, the local authorities have employed about 500 guards to patrol the entire area, along with armed guards from the Assam Forest Protection Force. Moreover, the park has also created more than 150 new security posts to prevent poaching. (Kumar, H. 2013, April 11, New York Times). The administration and management of the park

has been divided into three divisions, namely, the Eastern Assam Wildlife Division, the Bishwanath Wildlife Division, and the Nagaon Wildlife Division. The management of the national park and reserve has focused on decentralising the administrative work by creating various micro-plans. To ensure that these micro-plans are implemented in an efficient manner, various Environmental Development Committees (EDCs) have been created. The executive body of each EDC comprises a Member Secretary, General Members, and a President. The key focus of each EDC is to ensure cooperation and collaboration between the local communities and the wildlife tourism industry. This will not only ensure that the conservation plans of the government are met, but also that the local community benefits from these action plans as well.

SUNDERBAN NATIONAL PARK

The Sundarbans is the largest area of mangrove forest in the world and the only one that is inhabited by the tiger. Some 78 species of mangroves have been recorded in the area, making it the richest mangrove forest in the world. The total area of the Indian part of the Sunderban forest is about 4,262 sq km, of which 2,125 sq km is occupied by mangrove forest across 56 islands, and the balance is underwater (Information About Sunderban National Park, 2020). 2585 sq. kms of the Indian Sundarban forms the largest Tiger Reserve and National Park in India. It provides shelter for 84 species of flora, including 26 mangrove species, 453 species of fauna, 120 species of fish, 290 species of birds, 42 species of mammals, 35 reptiles and eight amphibian species (Sundarbans, n.d.).

The Sundarbans earns its revenue from many sources. It offers a boat safari to the visitors and charges a fee for the same. It offers various holiday packages like the Sundarban Weekend Tour, which is of 2 nights and 3 days and the Royal Bengal Tigers package, which is of 10 nights and 11 days and consists of various places like Kolkata, Sundarban, Agra and more. It also gets its revenue from the accommodation services provided by them, like the Sunderban Mangrove Retreat, the Sunderban Tiger Camp and many more. Online booking systems further increase bookings, boosting the revenue.

The park is primarily managed by the Government of India, with the Principal Chief Conservator of Forests (PCCF) being the senior-most executive officer looking over the administration of the park. The Indian Forest Act, 1927, with its amendments, Forest Conservation Act 1980, Wildlife Protection Act, 1972 and Environment Protection Act 1986, are being effectively implemented, with rules and regulations regarding

Figure 2.2: Tiger at Sundarban National Park

environmental pollution strictly enforced. The existing laws are sufficiently strict in respect to the protection and conservation of the property (UNESCO World Heritage Centre, n.d.). Thus, the main focus of the management of the forest is providing memorable tourism services while conserving the wildlife and the environment.

The forest is climatically vulnerable and has a highly volatile climate, with the average minimum temperature being 20°C and average maximum being 48°C, making the area prone to disasters like cyclones and because of this, the sea level there rises by twice the amount of sea level rise in an average coastal area.

Some major threats to the park, which challenge the very objective of the park, i.e. wildlife and environmental conservation, are oil drilling, logging, wood harvesting and air-borne pollutants in the park. Other threats include the exploitation of molluscan shells for lime manufacture. It prevents calcium recycling into the system and hence disturbs the ecological balance. Additionally, uncontrolled collection of shrimps and prawns could also be a threat to the Sunderban ecosystem. This is because prawn collection, due to the low barrier to entry and their high demand both domestically and in foreign countries, is an attractive economic activity for unemployed people. However, during this process, they can end up destroying the seeds of many other fish species, damaging the fauna of the Sunderban ecosystem. Over-tourism is also a potential threat to the condition of the wildlife of the forest. The reason is that it is possible for over-tourism to result in noise and other types of disturbance for the wildlife, thus, their quality of life is negatively impacted.

While the main focus of the park is wildlife and environmental conservation, it has, in fact, also gone a long way in taking steps against illegal activities that can either harm the environment or the wildlife. The forest department ensures strict patrolling on a periodic basis in the park, consisting of forest guards, watchtowers, patrolling boats, and many other such measures. Activities which harm wildlife, like poaching, are strictly banned, and strict action will be taken against anyone caught doing so. Additionally, it has a set of rules and guidelines to be followed by all visitors and staff members, and failure to comply with such can lead to strict action being taken against the offender.

The park has greatly benefited the local people of the area. For starters, tourism creates employment for the local people as tour guides, boat operators, petrol agents, and many other such jobs. Visitors to the park often purchase handicraft items as mementoes of their trip, thus local artisans are provided with job opportunities. In addition to that, the money flowing into the local economy from the whole tourism activities, paves the way for improved infrastructure and services, upgrading the living standards of the people. Moreover, the implementation of such projects is an excellent strategy of women's empowerment, whereby they are raised to a high level of

self-reliance and enabled to improve their social status through income generation
.
As of October, 2025, Sunderban National Park has a 4.5/5 star rating on the app "TripAdvisor" and has 77 reviews from visitors, in most of the reviews, the visitors are expressing how flabbergasted they were by experiencing the utter beauty of nature which can be seen from the park and seeing the tiger, which has become a rare sight due to excessive poaching.

GIR NATIONAL PARK

Gir National Park, the single most prominent wildlife sanctuary of the Asiatic Lions, is located in the Indian state of Gujarat. Established in 1965, the area covered in total is about 1412 sq. km. In 1975, out of 1412 sq. km total area, the 259 sq km of the core region was declared a national park. It is made up of a dry deciduous forest with teak trees. Combined together, it makes up for a scrubland with hills in a dry environment. Seven perennial rivers cross through this park, creating four dams and hence forming four reservoirs.

Amongst all the species living in the Gir forest, a total of 38 species are mammals. As expected, the top predators in this national park are Asiatic lions and Indian leopards, along with jungle cats, hyenas, desert cats, honey badgers, and mongooses. The park made most of its revenue by charging permit fees for eco-tourism safaris.

In 2019-20, the park managed to earn around 10.78 crore rupees through 5.23 lakh visitors who visited the park for lion safari. In 2023, the revenue increased to 8.77 crore rupees following the recovery in the post-pandemic era. This much revenue earned by the park mostly goes to conservation activities. (Kateshiya, 2023)

The Gujarat Forest Department primarily handles Gir National Park. The GLCS is in charge of the park's daily management. The state releases a specific Gir management plan, which states zoning, anti-poaching, habitat management and eco-development plans. The Gujarat Government released over ₹277 crore for lion conservation during the past two years (2022–2024) to intensify manpower, forest vigilance, and habitat extension measures (Pti., 2024, February 13). The lion sanctuary at the Gir is the absolute main point of interest of the entire National Park. Along with the Asiatic lions, the jeep safari is one of the most popular tourist attractions at Gir. In addition to this, there is the Devalia Safari Park, also referred to as the Gir Interpretation Zone, which offers the same experience on a smaller enclosed space and has a crocodile breeding centre where one can safely view wildlife at close

Figure 2.3: Lions at Gir National Park

range.

There is also a dam within the park by the name of the Kamleshwar Dam. It is a spot suitable for picnics and relaxing. The climate of Gir National Park is semi-arid, which is suitable for its dry deciduous forest. The summer season, which lasts from March to June, is very hot and humid, and the highest temperature can reach 43 °C. The winter months from November to February are cold and dry, and the temperature can drop to about 10 °C at night and go up to about 22 °C during the day. The monsoon season comes in mid-June and stays till September. The rains are the heaviest in July and August. November and early March are the best months to visit the place as the weather is cold and dry at these times. The greatest threat to the Gir is that the Asiatic lion population is isolated to one particular area and, therefore, is highly susceptible to outbreaks of epidemics, as seen in the past. There was a Canine Distemper Virus (CDV) outbreak in 2018 that claimed more than 20 lions and brought to the fore the disease transmission risk in this narrow gene pool. This virus causes a highly contagious disease in a wide range of carnivores. The disease often manifests as respiratory and gastrointestinal signs that progress to neurologic disease. Wildfires and continued human encroachment have similar implications. As lions begin moving out of the park, they occasionally attack livestock, causing conflicts with humans. This may lead to humans attacking lions in revenge or lions getting hurt or killed while being hit by vehicles. There is also the risk of overgrazing by llivestock belonging to Maldhari settlements. Also, more stringent measures are taken against illicit activities. The park places significance on preventing poaching and conserving wildlife by means of the "Vanya Prani Mitra" project, where local residents and forest guards are engaged in daily monitoring. Recently, more than 150 officials have undergone training in handling arms and laws so that they can handle wildlife crimes more effectively and impose stricter penalties on the offenders. In addition, illegal hotels run by people in the vicinity of the park have been closed after court orders. As far as the contribution and participation of local communities are concerned, there are almost 14 Maldhari tribal hamlets within the sanctuary area, living among these lions. A large number of Maldhari households have been resettled from the central zone to the periphery on a voluntary basis, which has enhanced the quality of habitat. In the past few years, the Gujarat government has launched several schemes to improve the standard of living of tribal people. It is also promoting ecotourism to facilitate them in earning their livelihood without damaging the environment of the Gir Forest. The Gir Eco-development Project, funded by the Ministry of Environment and Forests, and the Biodiversity Conservation and Rural Livelihood Improvement Project, funded by the World Bank, have played major roles in improving the standard of living of neighbouring villages, forest dwellings and tribes. These projects have their focus on activities such as pasture and soil conservation, livestock vaccination, the use of renewable energy, and environmentally

friendly employment. Now, lastly addressing the visitors' feedback, there is commendable lion spotting in reviews on sites such as TripAdvisor. There is positive feedback in terms of well-organised safaris, knowledgeable staff, clean facilities, and a clear rural atmosphere compared to other Indian reserves. However, others complain about inadequate and hardly accessible public transport and the scorching heat of summer, which impacts comfort.

RANTHAMBORE NATIONAL PARK

The Ranthambore National Park is the largest national park in India, and it has also become a tourist spot. The Ranthambore National Park lies at the meeting point of the Aravali and Vindhya mountain ranges and is located at a distance of 13.5 km from the city of Sawai Madhopur in Rajasthan, India.

The Ranthambore National Park is the largest national park in India. The Ranthambore National Park lies at the intersection of the Aravali and Vindhya mountain ranges and is located at a distance of 13.5 km from the city of Sawai Madhopur in Rajasthan, India. The tigers are the most significant attractions that lure tourists to visit the Ranthambore National Park. The Ranthambore National Park received massive attention in the year 2024-25 because a total number of 727,268 tourists visited the Ranthambore National Park; out of which, 197,146 were foreigners, and 529,693 were locals.

Income generation comes mainly from entry charges and charges for jungle safaris. There are a number of reasons behind this, including Tatkaal (jungle safari), the sudden increase in the number of baby tigers, and so forth. One of the important reasons for its popularity among tourists is the large number of sightings of tigers, where most people see 10 tigers on the Single Safari. As for the facilities provided to tourists, there are numerous types of safaris like Jeep Safari, Canter Safari, Chambal Boat Safari, and many more activities like bird watching, walks to the villages, and fort visits.

The climate within the park symbolises that of an arid zone in India, with maximum temperatures reaching 48 degrees centigrade during summer and a minimum of 2 degrees centigrade during winter. Annual rainfall received by the park is estimated at 800 millimetres, which takes place during the months of monsoons, between July and September. During the period of heavy rains, the park remains closed.

The Park faces various possible threats, such as the potential increase in territorial conflicts among tigers due to the rising population. Another threat is a weed called Cassia Tora,

Figure 2.4: Ranthambhore Tiger Reserve

which destroys the grassland. This is problematic for the herbivores, who migrate to search for food elsewhere. This reduces the prey base for the tigers and increases the likelihood of human attacks. A major issue is that the location of one-third of the tigers remains unknown. Although monitoring is done through camera trapping and GPS tagging, it might be inadequate due to gaps in resource allocation. The wildlife of the park is an isolated population; thus, there is the danger of inbreeding. This may lead to genetic deformities and threaten the future of the population in the long run. The outbreaks of diseases due to interaction with the domestic population further add to this threat. There are various weaknesses, such as the presence of shrines, which attract a huge number of pilgrims. This disturbs the wildlife and leads to a huge amount of waste being generated.

Despite the existence of such challenges, there are various positive aspects of the management at the Park. The water distribution systems are 100% solar powered, leading to sustainable development and growth of renewable energy. Another positive aspect is the network of patrolling roads, which assists in effective monitoring by covering almost all vulnerable areas of the Park. The Park is managed by the Rajasthan Forest Department and the Ministry of Environment, Forest and Climate Change of India. The park has also been subjected to various special regulations implemented by the National Tiger Conservation Authority (NTCA), which include the development of core and buffer zones, laws against poaching, and protection regulations. Several steps have been taken to control illegal acts like poaching, including increasing patrols. These patrols are mostly conducted in the areas with the potential of having these activities happen. In order to stop the occurrence of these illegal activities, the government has decided to increase the penalty imposed (fines) and tighten the laws against poaching. The Supreme Court has also asked the Rajasthan Government to form a committee to end mining practices. Drones are also being considered for surveillance of these areas. It has been found that there are 12 possible locations for watchtowers to be constructed. It has also been decided that thermal cameras will be installed in these locations. Moreover, a new software called "M-STrIPES" is used to modernise the existing monitoring system (National Tiger Conservation Authority, n.d.).

There is a symbiotic relationship between the wildlife sanctuary and its surrounding population because both parties derive benefits from one another. More than 2000 people residing in 13 neighbouring villages have been informed about the significance of environmental conservation. The local communities, in turn, contribute to conservation efforts by engaging in vermicomposting, medicinal plant conservation, etc. They also assist in the management of the park by setting up camera traps and informing the forest department of wildlife presence and movement in corridor areas. This has significantly reduced the incidence of poaching. Moreover, they assist researchers

in fieldwork and help in locating endangered animals. The locals are also employed as guides or in other tourism-related fields, hence they get the opportunity to earn a livelihood. Other ways to involve the community include Public-Private Partnerships (such as the Ranthambore Tiger Reserve Sustainability Project by the Indian Hotels Company (IHCL) in collaboration with the Rajasthan Forest Department), and NGOs such as Tiger Watch.

Nevertheless, the park's impact on residents has not been entirely beneficial. The Forest Act and the Wildlife Protection Act have reduced local access to forest resources. Greater attention is given to foreign tourists, and as a result, many communities feel alienated. Incidents of financial losses arise as wild animals continue to destroy crops and cattle. Development has been restricted, as Ranthambore Forest is protected, and new infrastructure cannot be built.

The visitor experiences at the park have been mixed. It has a 4.2 rating on TripAdvisor; the majority have a positive experience and recommend it highly. This is primarily due to the large number of tigers seen during safaris. However, a few of them are dissatisfied and claim that the park is not well organised. According to them, the guides seem uninterested, and the canter used for safaris is overcrowded.

JIM CORBETT NATIONAL PARK

The Jim Corbett National Park is the first National Park in India. At the time of its formation in 1936, it was known as the Hailey National Park, but later in 1957, it was renamed to Jim Corbett National Park in honour of the renowned hunter and conservationist, Sir Edward Jim Corbett. It covers an area of over 1318.54 square km, out of which 520 square km is the core area. This area falls under the Nainital district of Uttarakhand, and the Ramganga River flows through it. This park holds a significant value in terms of Indian conservation. It has a constitution with 9 various zones, which include Dhikala, Bijrani, Jhirna, Durgadevi, Sonanadi, Garjiya, Phanto, Sitabani and Dhela zones. These areas are filled with big forests, rocky riverbeds, grasses, hills, etc, that give the areas one of the most beautiful sceneries. The park is home to a wide variety of flora and fauna. The wildlife (fauna) consists of Royal Bengal Tigers, elephants, leopards, sloth bears and several species of birds.

The park and its surrounding areas usually have a moderate climate with annual temperatures ranging from 5°C to 40°C. During the monsoon period, the area receives rainfall in abundance. Tourism is the main source of revenue for the park, as about 70,000 tourists visit the park every season. In FY 2024-25, the Jim Corbett National Park made a record ₹30 crore in revenue, which was its highest ever annual collection; a significant 28 per cent rise compared to FY 2023-24. The annual footfall is more than 4,00,000, out of which about 11,300 are foreign tourists. Owing to the increasing popularity of the park, the local businesses have experienced significant growth and

employment opportunities have increased. Jim Corbett has consistently remained one of the best ecotourism sites in India and has continued to captivate nature lovers and adventure tourists, solidifying Uttarakhand's position among the best wildlife tourism centres.

The key sources of revenue for the park include entry permits, safari fees, accommodations, associated costs, and other activities. The entry fee, safari permits, and applied accommodation constitute one direct revenue. The park provides a safari with jeeps, elephants, and camels, ranging from ₹500 to ₹7500.

The eco-tourism zones at Jim Corbett National Park promote adventure safaris through gypsy cars. These zones are sources of livelihood and income for the region. The region is surrounded by 400 resorts, 560 nature guides and 1500 registered drivers according to data. The Jim Corbett forest vicinity provides a good market opportunity for setting up hospitality services such as hotels and resorts, which encourage ecotourism and associated activities. The landscaping plays a vital role in the tourism industry and provides a platform for conscious and sustainable tourism practices through partnerships with local people, hence enabling economic growth of the region. The government of Uttarakhand has established a centre for eco tourism and sustainable livelihood near the national park, which provides support to local communities.

The management of the Corbett National Park is governed by the Corbett Tiger Reserve (CTR) under the Project Tiger of the National Tiger Conservation Authority (NTCA) for a ten-year plan, i.e., 2021-2031. It incorporates the following elements:

- Core Buffer and Wildlife Corridor Management: Establishment of core and buffer areas leading to the creation of a wildlife corridor that connects the fragmented habitats, thus ensuring animal movement, genetic diversity conservation, and balancing conservation with human needs.
- Habitat Management: Rehabilitation of habitat through fire prevention, weed eradication, and water resource maintenance.
- Prey Base Enhancement: Primarily focusing on increasing the population of prey animals that will support the ecosystem by sustaining the predator populations.
- Protection and anti-poaching: Patrolling, surveillance, and drone monitoring. Eco Development Committees (EDCs) are the formation of community-based groups, resulting in the involvement of local people in the conservation and protection of forest areas and wildlife.
- Resolving the Human, Wildlife Conflict: Stopping activities such as crop raiding, livestock predation, or any that may cause injury or death for both people and animals.
- Research and Monitoring: Use of Camera traps and the M-STRIPES application.

The Honourable Supreme Court of India has permitted only 20% of the park area for tourism. The government previously restricted the conversion of commercial land within a 5km radius around Corbett. The villages inside the national park have been relocated and developed as grasslands. The management makes use of an online booking system for Indians and foreigners to book 45 days and 90 days in advance, respectively.

Management Strengths: The management has been actively engaging with the committees around the reserves. More than 40 Eco Development Committees (EDCs) are reducing their dependence on the park for resources. The management has been taking conscious efforts to maintain the grasslands (Chaurs). They make use of an electronic Eye for surveillance and monitor any illegal entry with High-Tech cameras. They receive funding from NTCA, the State government and Compensatory Afforestation Fund Management and Planning Authority (CAMPA) for infrastructure and patrolling vehicles.

The State and Central governments have been framing guidelines and strategic measures for the management of wildlife zones, yet the implementation needs to be rechecked time and again. The efforts of the authorities, in conjunction with the local communities, can work towards better results and balance. With respect to the ecological sensitivity of the park, the problems of unwarranted tourist activities, land use, encroachment, poaching, biotic pressure, etc, need to be dealt with. The IFSR 2024 report denotes the loss of 22 square km of forest cover in the state of Uttarakhand, which includes the Corbett National Park, between 2021 and 2023. (Azad, 2024.) There has been an increasing human-animal conflict in the region, with the increase in loss of habitat. The absence of an Economic Sensitive Zone notification has given rise to illegal constructions, as cases of remodelling private resorts have been reported. The roads and highways still need to be restricted as eco-sensitive zones according to the guidelines.

The northern periphery of the park has been reported to have poaching activities and seizures, along with vacancies of range officers in the region. This suggests that the vigil and efforts are still complacent. While grazing activities are not allowed in the core area, there are still families living in the buffer zones that depend on the forest for livestock. Despite the NTCA's directions, the management has not phased out tourism in the Dhikala range (core area). This has led to a behavioural change in the tigers towards their surroundings.

Figure 2.5: Elephant at Jim Corbett

ZONES	ENTRY GATE	VISIT TIME	PERMIT (INDIAN)	PERMIT (FOREIGNE	VEHICLE CHARGE	GUIDE CHARGE
Jhima	Dhela	Throughout the year	₹3380	₹6680	₹3000	₹900
Dhela	Dhela	Throughout the year	₹3380	₹6680	₹3000	₹900
Bijrani	Amdanda	15 Oct - 30 June	₹3380	₹6680	₹2700	₹900
Garjiya	Garjiya	15 Oct - 30 June	₹3380	₹6680	₹3000	₹900
Durgadevi	Durgadevi	15 Nov - 15 June	₹3380	₹6680	₹3000	₹900
Sonanadi	Vatanvasa	15 Nov - 15 June	₹3380	₹6680	₹2800	₹900
Pakhro	Pakhro	15 Nov - 15 June	₹3380	₹6680	₹2800-4500	₹900

Table 2.1: Day Safari Prices at Jim Corbett National Park (Zone-wise)
(Pricing | Corbett National Park. (n.d.).) https://corbettgov.org/pricing

ZONES	ENTRY GATE	VISIT TIME	1 ROOM (INDIAN)	1 ROOM (FOREIGNER)	VEHICLE + DRIVER	GUIDE CHARGE
Jhima	Dhela	15 Nov - 14 June	₹3500-5050	₹10450	₹5750	₹900
Dhela	Dhela	15 Nov - 14 June	₹3500-5050	₹10450	₹5750	₹900
Bijrani	Amdanda	15 Nov - 14 June	₹3500-5050	₹10450	₹5750	₹900
Sonanadi	Vatanvasa	15 Nov - 14 June	₹3500-5050	₹10450	₹6200	₹900
Dhikala	Dhangarhi	15 Nov - 14 June	₹3500-5050	₹10450	₹7250	₹900
Pakhro	Pakhro	15 Nov - 15 June	₹3500-5050	₹10450	₹6200	₹900
Mailani	Amdanda	15 Nov - 14 June	₹3500-5050	₹10450	₹6750	₹900
Sarpduli	Dhangarhi	15 Nov - 14 June	₹3500-5050	₹10450	₹7750	₹900

Table 2.2: Night Safari Prices at Jim Corbett National Park (Zone-wise)
(Pricing | Corbett National Park. (n.d.).) https://corbettgov.org/pricing

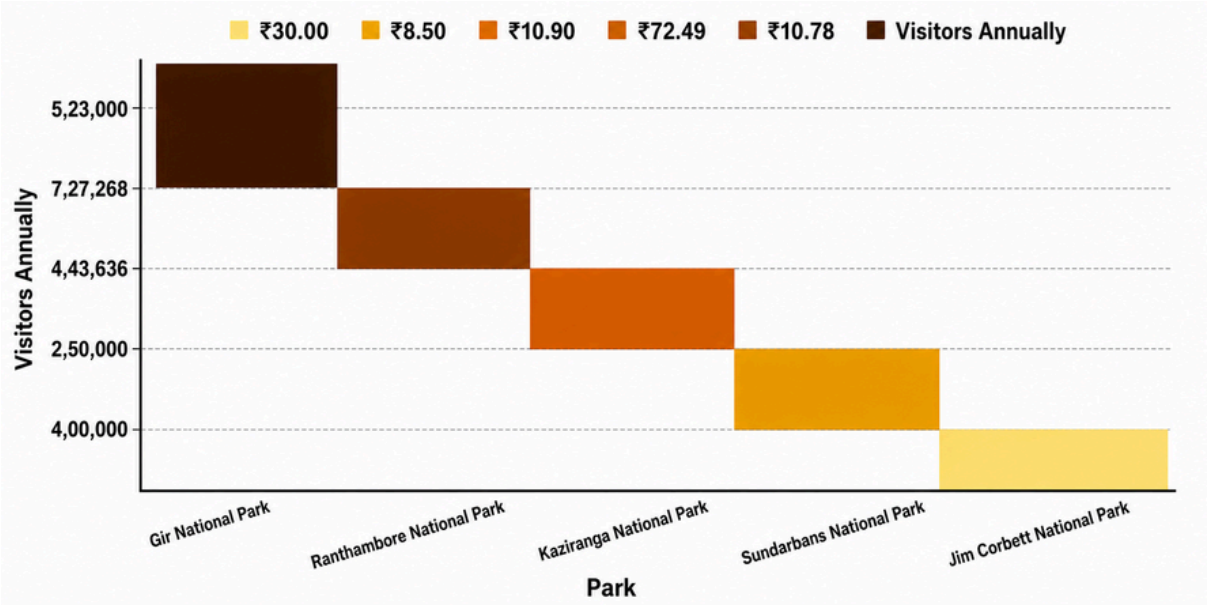

Figure 2.1: Revenue Range Relating to Annual Visitors

The infographic depicts a stepwise decline, indicating how revenue contributions vary across parks, directly dependent on the number of annual visitors. The highest share comes from Gir National Park and gradually decreases across others.

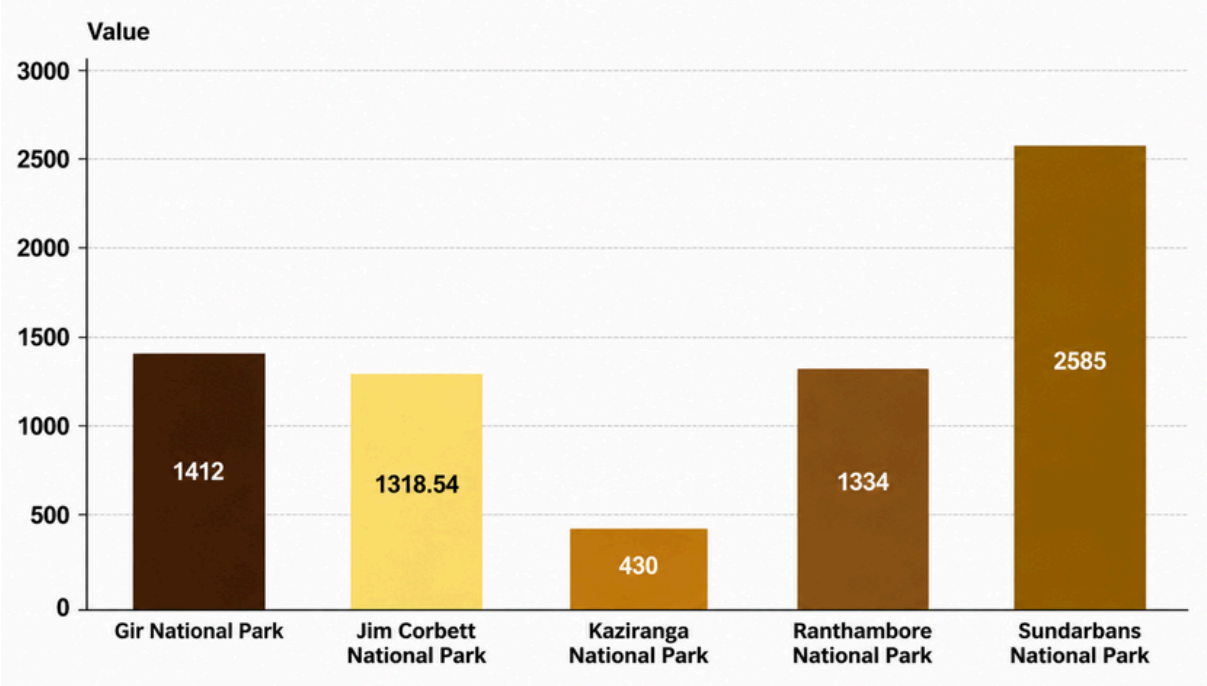

Figure 2.2: Area Covered by Each National Park (in sq. km)

The infographic depicts an area-wise comparison between national parks, with Sunderbans National Park standing out with the largest coverage, while Kaziranga National Park remains the smallest in geographical coverage.

IMPACT ON HABITATS AND MARINE BIODIVERSITY

IMPACT ON HABITATS AND MARINE BIODIVERSITY

Climate change, for long, has been considered the worst adversary for natural habitats, be it national parks or unmarked forest areas. Climatic alterations affect the wonted alignments of wildlife with their natural habitats, and they disrupt the established conventional consonance between the flora and fauna of a certain natural habitat. According to the United Nations, Climate change refers to "long-term shifts in temperature and weather patterns, primarily after the 1800s, caused by human interference and impingement" (International Fund for Animal Welfare, 2022). The greatest ramification of climate change is the rise in average temperature levels across the globe. It has been recorded that the present average temperature, as compared to pre-industrial levels, has risen by more than 1.2°C, worsening due to the added strain of increased greenhouse gas emissions in the atmosphere. This paints a rather grim picture of the existing conditions in nature's equilibrium, especially in terms of habitat loss and change in breeding patterns.

The rising average temperatures have caused more severe, frequent, and longer-lasting incidents of drought and wildfires in particularly dry regions. Higher climatic temperatures mean lower volume of rainfall in the already dry regions. A drought usually occurs due to a continuously decreasing rate of precipitation being recorded in a certain area. India is highly dependent on agriculture as a means of livelihood and also sustains itself on many water-intensive crops, such as paddy, as a food source for millions. Moreover, the textile industry is dominated by cotton, which requires huge volumes of water for harvesting. Thus, water scarcity in India does not paint a positive prognosis for both its producers and consumers. It is predicted that droughts will happen twice as often and lead to much higher losses in agricultural revenue, especially in the Mediterranean and Atlantic regions (Consequences of Climate Change, European Commission). Moreover, areas previously unaffected by forest fires are now more prone to forest fires with greater severity and length. Another drastic impact of Global warming is the rise in global average sea levels due to the melting of glaciers.

The recorded global average sea levels have risen by 3.99 inches in contrast to the levels pertaining to the 1990s (*Climate Change: Global Sea Level*, 2023). The thermal expansion of sea levels, along with the melting of the Antarctic glacier sheets, has increased the risk of flooding and erosion along coastal areas. Tropical cyclones along

the Bay of Bengal and the Arabian Sea are the major repercussions of climate change in India, causing multiple cases of coastal flooding and "flash floods". The major wreckage occurs in the areas of Gujarat, Kerala, Kolkata, and Odisha. There are many recent incidents of coastal flooding across various risk zones in India. In the year 2021, the West Coast of Kerala was flooded, which led to "Cyclone Tauktae." The natural prognosis of rising sea levels insinuates a decrease in available freshwater sources across the country. The conglomeration of rivers with saltwater bodies reduces the seepage of freshwater to the groundwater tables. This heterogeneity in the water sources poses a series of grave issues for the marine biodiversity being supported by freshwater bodies, mainly due to the fact that any mix between salt compounds in freshwater bodies reduces the rate at which oxygen can be dissolved in water. Many freshwater fish face the risk of becoming endangered due to habitat loss. For instance, the Kerala Nilgiri Mystus, a species of freshwater fish, is now critically endangered due to the invasion of local saltwater bodies into their natural marine habitats, which alters their breeding cycles and growth drastically. The unfortunate loss of habitat in India is not just limited to marine biodiversity, but also extends to many other terrestrial species of animals. As per IUCN's official "Red List" of endangered species, the maximum number of endangered genera is that of amphibians, with more than 41% of critically endangered animal species being amphibians (The IUCN Red List of Threatened Species, n.d). Many terrestrial mammals, such as the famous snow leopard and the white elephant, are part of the "Critically Endangered", particularly due to climate change-induced habitat loss.

Out of the many adverse impacts of climate change on wildlife, the one that specifically stands out is "Phenological Alterations." Climate change alters the growth period of many plant species, mainly due to the recorded shifts in weather patterns, which often delay the breeding period in plants, or worse, shorten it to levels that lead to hazardously low levels of emerging plant saplings. The IUCN (International Union for Conservation of Nature) has released a new list of endangered species of both plants and animals globally. The list now includes more than 2000 new additions, making the total number of endangered plant and animal species a whopping 48,600 in total (The IUCN Red List of Threatened Species,n.d).

The official "Red List" released by IUCN contains around 132 species of "Critically Endangered" biodiversity from India; out of this, 61 species of plants are recorded to be endangered to the point of extinction (Sudhi, 2012, The Hindu). This clearly goes on to show that plants are the most unfortunate victims of climate adversities. The resulting effects of bioclimatic changes that alter the leaf growth patterns in plants have highly reduced chlorophyll production on the outer leaf surface, and climate change has delayed leaf unfolding by -3.0 days/decade since 1985; moreover, precipitation rates in high elevation areas have -43.6 mm/decade (Meier et al., 2021). The reduced surface area of leaves disrupts transpiration rates

(evaporation of water from the plant surface), which is crucial for global hydrological cycles and crop yield. "Transpiration" is most prominent in areas with high leaf surface area in terms of leaf index, such as rainforests, where the density of foliage is the maximum, making them the greatest contributors to transpiration to the water cycle and subsequent rainfall. However, climate change has diminished transpiration rates by 18.9%-31.8%, the range varying as per weather conditions (Yang et al., 2023). Reduced precipitation, partnered with shortened breeding cycles in plants, creates a vicious cycle of loss in plant species, which further worsens the hydrological cycles and photosynthesis rates. Plants are the largest identified autotrophs on Earth, which support food cycles for all the other species of animals. All species of animals are either directly or indirectly dependent on plants for their nutrition.

CASE STUDY: THE DECLINING POPULACE OF THE YELLOW COLCHICUM PLANT IN INDIA

Colchicum Luteum, or commonly known as the Yellow Colchicum, is a small flowering plant found in high elevation points (1800-3000 m) of the Western Himalayas and Kashmir in India. Known for its extensive use in Ayurvedic science due to its medicinal properties of pain relief and alleviation, the Colchium plant blooms in early spring and requires specific climatic and soil conditions to aid its growth. It requires a cool temperature marked with relatively low humidity in the environment, along with Alpine soil. However, Global Warming has altered the weather patterns drastically, inducing the Springs to become warmer and more humid, causing an early onset of the Summers even in high altitude areas. This has caused a shift in the plant's flowering phenology, reducing the time period in which the flower can bloom. This creates a discordance between the plant and its pollinators, implying lower rates of pollination and thus lower seed transmissions. The increased summer patterns reduce the moisture content required at later stages for the plant's growth, thus causing the flowers to wilt at much earlier stages than normal. All these factors have contributed to endangerment of the Colchicum on a large scale, to the point that this has started to negatively impact other species of fauna dependent on the plant. The natural pollinators of the plant, which include flies and bees, now face survival risks, as they are mainly dependent on the Cochicum flower nectar and pollen as a sole means of nutrition in the frigid zones of the Himalayas. The Yellow Cochicum is a species endemic and aboriginal to specific areas of Kashmir and the Himalayas only; its presence is niche and now stands at risk of being forced out of its indigenous habitat. Many invasive species, such as Prosopis juliflora, have found a foothold in these niche habitats due to climate change, causing the native plant species to share the already scarce soil nutrients with them.

Thus, it becomes quite relevant that the race of modernisation and industrialisation is the key promoter of climate change in today's

day and age. It is clear that the opportunity cost of what we consider "growth" is a number too high. A country like India, which is home to a variety of flora and fauna, cannot afford to lose one of its biggest assets in the quest for materialistic returns. India's natural resources sustain the livelihoods of many of its inhabitants, be it humans or animals. Abundant in both land and water resources, a country like India should focus on conserving nature's bounty and concentrate its efforts on recognising that sustainability is harmony.

MARINE BIODIVERSITY

India has a coastline exceeding 7,500 km, spanning nine states and four union territories (including two island UTs), with 12 major and 200 minor ports. The country's blue economy facilitates 95% of national trade via transportation and is estimated to contribute around 4% to the Gross Domestic Product (GDP). India also ranks as the third largest producer of fish and the second largest in aquaculture fish production globally (NFDB 2020a). Consequently, all areas within the blue economy can involve a significant workforce and have been doing so for many decades, particularly in sectors like fishing, aquaculture, fish processing, marine tourism, shipping, and port operations. Currently, involvement in emerging sectors like offshore wind, marine biology, biotechnology, and other endeavours, such as shipbuilding and shipbreaking, is also increasing significantly. The fisheries sector alone supports around 16 million fishers and fish farmers at the primary level, with nearly double that number participating in the value chain. The government sees this sector as having great potential to significantly increase the incomes of fisherfolk and fish farmers.

The shipping industry serves as a vital source of income in the blue economy, with India possessing one of the largest merchant fleets in developing nations and holding the 17th position globally. In 2018, the count of Indian seafarers working on both Indian and foreign-flagged ships surpassed two lakh, reflecting a remarkable rise of 35% compared to the prior year. Seaports also serve as a significant source of job opportunities. In contrast to India's large ports, employment at smaller ports has risen from 1,933 in 2003 to 19,102 in 2017 (Blue Economy Working Group Report 4- Blue economy: An ocean of livelihood opportunities in India). In the past five years, smaller ports have outpaced larger ports in cargo volume increase. This results from their positioning in more strategic areas, boasting modern infrastructure and enhanced operations.

Coming to the fishing sector, it provides direct employment to over 4 million marine fishers, primarily from marginalised coastal communities. Overall, it sustains 28 million livelihoods in a variety of sectors (NITI Aayog, PMF IAS). For example, the fishing community of Chilika Lake in Odisha depends majorly on estuarine fisheries for livelihood. According to the Ministry of Fisheries, Animal Husbandry and Dairying (2023), the marine fish production in India has stabilised to about 3.7 million tons per

annum. It contributes 1.1% of the country's GDP and over 7.3% of agricultural GDP (MoF, 2024–25). The fisheries-based microeconomies of the coastal states of Kerala, Andhra Pradesh, and Gujarat engage in extensive local employment and trade. Fisheries infrastructure boosts regional GDP and livelihoods. Since the existing blue economy structure consists of employment opportunities mainly in the traditional sectors like fishing, marine tourism, shipping and offshore exploration, most of these sectors, especially fishing and marine tourism, depend on pre-existing skill sets. However, these skillsets would not be able to meet the growing demand for fish due to various climatic and environmental changes in the marine ecosystem. Also, gradually, fishing as a sector is now moving from subsistence farming to commercial farming through farming practices such as aquaculture, and this requires technical skills at every level of the value chain. The Agriculture Skill Council of India (ASCI), in consultation with industry and institutions, has identified the various job roles in the aquaculture industry, but developing skilling programmes in line with these roles is still a work in progress. Similarly, shipping and ports require skilled manpower, but to meet the growing and changing demands in this sector would require re-skilling and up-skilling in the future. Recently, the Ministry of Shipping entered into a pact with the Ministry of Skill Development and Entrepreneurship (MSDE) in order to both reap the benefit of vast employment opportunities in the maritime sector and also to certify the sector's skill sets. The Aichi Biodiversity Targets were established at the COP10 meeting of the Convention on Biological Diversity in Nagoya, Japan, in 2010. They represent the core of the Strategic Plan for Biodiversity 20112020. The plan includes 20 targets assigned to the five strategic outcomes. Marine biodiversity and fisheries-based livelihoods are addressed in targets six, eleven, and fourteen. Target 6 illustrates the sustainable harvesting of all fish and aquatic resources as one of the components, through an ecosystem-based management approach that does not overfish and cause degradation. Target 11 is committed to the conservation of at least 10% of the coastal and marine areas through management that is effective, representative in ecological terms, and ensures the connection of marine protected areas. Target 14 intends to maintain the natural ecosystems that are the main providers of the essential services, especially food and livelihood, to the people who need them the most (Secretariat of the Convention on Biological Diversity. (n.d.). Aichi Biodiversity targets.

Aichi's targets were adopted at COP10, tied to an international deal hammered out in Nagoya in 2010. Those aims then shaped the decade-long game plan from 2011 onward, aiming to shield species within natural systems. Spread over five broad aims, there are twenty specific markers. Among them, numbers six, eleven, and fourteen touch ocean diversity along with fishing-dependent ways of living. Goal six includes smart take levels from water sources using whole-system methods - keeping stocks safe while steering clear of excessive catch or

habitat harm. Target 11 wants to save a tenth of ocean and shoreline spots through better oversight, fair spread across habitats, along with linked-up safe zones for sea life. Target 14 hopes to shield natural systems supporting key benefits - particularly meals and jobs - for communities relying on them heavily (Secretariat of the Convention on Biological Diversity, n.d.). Aichi Biodiversity targets. Taken together, these goals show very clearly that the conservation of biodiversity is an economic and social goal and not only an environmental goal. Global Biodiversity Outlook 5 (CBD, 2020) shows that during 2020, because of poor integration of biodiversity values into national development and the continued unsustainable exploitation of marine resources, most of the Aichi Targets could be partially achieved by the year 2020. India's National Biodiversity Action Plan and National Biodiversity Targets include these targets. They promote sustainable fishing, conservation of coastal ecosystems, and participation of local communities in conservation efforts, among others. The Aichi framework provides an excellent base for policies and actions that associate marine biodiversity conservation with fisheries-based livelihoods and bring out the imperative to manage aquatic resources sustainably for the well-being of ecosystems and humans.

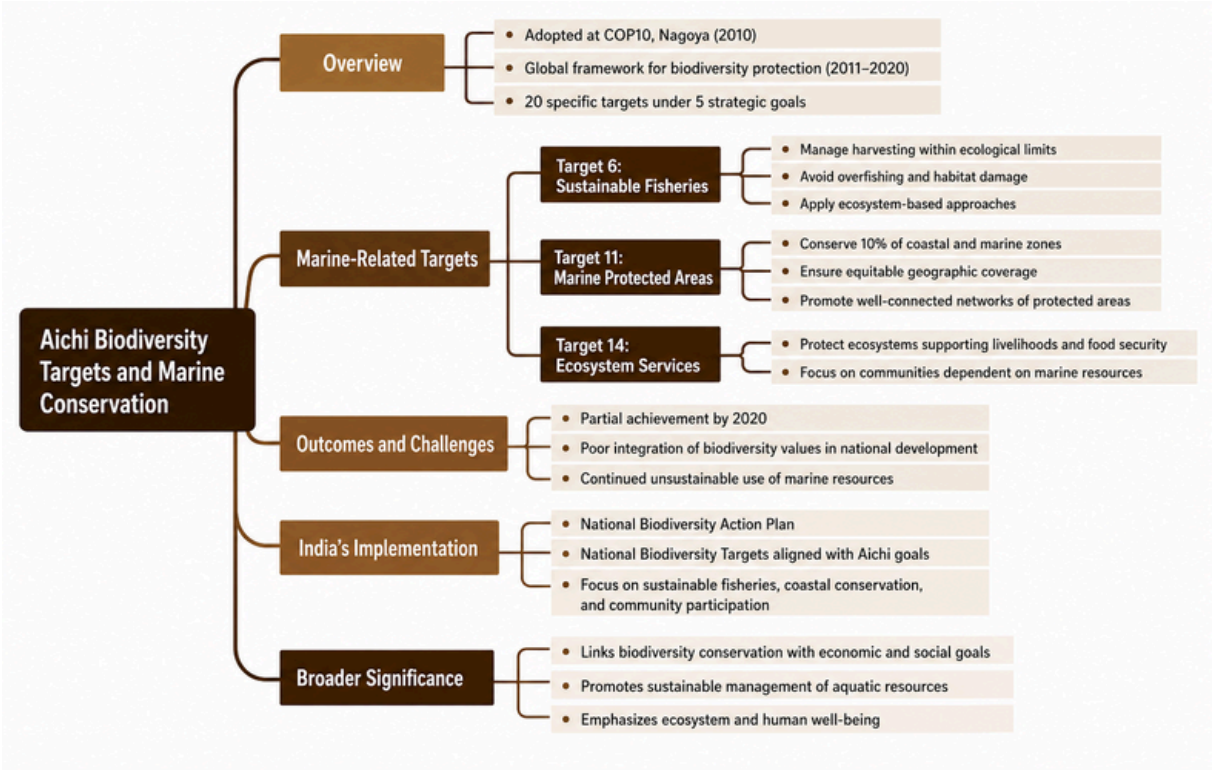

Table 3.1: Aichi Biodiversity Targets and Marine Conservation

CORAL REEFS

The coral reefs make some of the most vibrant ecosystems in the whole world. The coral reefs serve as the home of over 4,000 types of fish, corals, and marine creatures; however, the reefs only cover 1 per cent of the earth's water bodies. Nevertheless, it has been established that almost 25 per cent of all the fish species on the earth exist in the coral reefs (NOAA National Ocean Service Education: Corals Tutorial, n.d.). Many species of the reef are yet to be discovered. In order to gain insight into the subject matter, it is necessary to learn about the definition of the term "coral reef". Coral can be defined as a combination of thousands of animals known as polyps. The polyps choose to settle at one spot, especially on a hard substrate, where they begin to construct their skeletons. This occurs as the polyps secrete calcium carbonate, which exists freely in abundance in the water. The polyps push themselves up by depositing the calcium carbonate beneath them to create a hollow structure. They use this depression to store their stomach while they allow their tentacles to protrude out and collect microscopic food floating around in the water. However, as the polyps are tiny in size and their skeletons are rooted in one place, individual polyps are highly vulnerable, and if the spot chosen by them is not good enough, it's very likely that they will die. To prevent this situation, groups of polyps can link their bodies to neighbouring polyps through a tissue called the Senior's Arc. In case any polyp requires nutrients, the other polyps within the colony offer it the necessary nutrients in order to make sure that all of them live together. Most corals which build reefs usually have algae known as zooxanthellae living within their body. Zooxanthellae are dinoflagellates (an important group of phytoplankton that produce oxygen in marine and freshwater environments) that have taken up residence inside a coral polyp's cells. They have a mutualistic relationship with the coral, using photosynthesis to convert the energy from sunlight into nutrients that the coral can use. In exchange, the coral provides protection for the zooxanthellae (Padilla-Gamiño et al, 2012).

Figure 3.1: Corals

These zooxanthellae provide corals with 90% of their nutrition and vibrant colouration. As such, when the zooxanthellae are stripped away from the corals, the coral's white skeleton is exposed. This phenomenon is termed 'coral bleaching'. The significance of coral bleaching lies in the fact that under conditions where the environment does not favour the symbiotic growth of algae within the body of the coral, the coral expels these algae because of the production of lethal reactive oxygen produced by the algae that kills the coral and the algae. However, the process of coral bleaching does not cause the instant death of the coral but rather induces greater levels of stress since the coral lacks 90% of its energy source. The return of the

algae to the coral takes time until the environmental conditions are suitable again. If the conditions do not return to being suitable, the corals will die.

Coral bleaching, on a broad scale, is caused mostly as a result of the warming of sea water resulting from climate change. It is most common in localities in which there are frequent unusual temperature differences or deviations from the average temperature (McClanahan et al., 2020). Other environmental factors, like light intensity, nutrient concentrations, zooplankton availability, and water-flow rates, are key factors responsible for exacerbating the coral bleaching process. Experimental studies under high temperatures indicated that there is a reduction in coral bleaching when the light levels are low (Lesser & Farrell, 2004; Takahashi et al., 2004). Coral bleaching has been a frequent phenomenon in the most popular reef system, the Great Barrier Reef, in Australia. There has been an increase in the recorded number of incidents involving bleaching of major coral reefs.

The Great Barrier Reef is the largest coral reef system in the world, made up of over 2,900 individual reefs and over 900 islands, spanning more than 2,300km of coastline, and over an area of approximately 344,400 km^2. However, coral bleaching has also caused many problems.

The following is an overview of those:

1998: Mild bleaching was observed in late January and intensified in February and March. Most reefs recovered fully, with less than 5% of inshore reefs suffering high coral mortality; however, the most severely affected reefs in the Palm Island area saw up to 70% of corals die.

2002: Across the 641 reefs observed, 54% bleached in the summer of 2001-2002. This mass bleaching event was slightly more severe than the 1997-1998 event; however reef recovery was generally good, with fewer than 5% of reefs suffering high mortality.

2006: A bleaching event largely confined to the southern part of the Reef, particularly around the Keppel Islands, took place in January and February 2006. The degree of bleaching was worse than that in previous years, with up to 98% of corals bleached on some reefs.

2016: In 2016, the Far Northern management area between Cape York and Port Douglas experienced widespread and severe bleaching due to record ocean temperatures. This led to record widespread coral bleaching on the Reef, with overall coral mortality at 22%. Bleaching in the southern parts of the Reef was less severe.

2017: The Reef underwent remarkable bleaching in consecutive years (2016 and 2017), affecting about two-thirds of the Great Barrier Reef. In early 2017, the central third was particularly affected by both unusually warm sea surface temperature and accumulated heat stress; the southern sector of the Reef was spared in both years.

2020: In many locations of the Great Barrier Reef, serious bleaching was registered; from reefs investigated throughout the survey, 60% of the air-surveyed reefs were confirmed as having moderate or serious bleaching. Unfortunately, on-water monitoring efforts were limited by the COVID-19 pandemic, and only limited data on the resulting coral mortality were compiled.

2024: In March 2024, the fifth bleaching incident at the Great Barrier Reef took place. This was the fourth incident in a series of global bleaching incidents that started in 2023. The bleaching process took place in an El Niño year. This year was the year after the hottest year in history.

2025: This was the sixth mass bleaching phase in the Great Barrier Reef since 2016, and was also the second time that bleaching occurred in two successive years at the reef (2016-2017 and 2024-2025). However, this time, the bleaching was not similar to that in the previous years, and it was also the first time that it took place simultaneously in both of Australia's World Heritage-listed reefs, the Great Barrier Reef and Ningaloo.

TIME

THE CORAL REEF BLEACH

1998

First major mass bleaching; mild impact overall but reached 70% mortality in the Palm Island area.

2002

54% of reefs bleached across the system; recovery was generally good with low total mortality.

2006

Severe southern bleaching; Keppel Islands saw up to 98% of corals bleached on specific reefs.

2016

Record ocean temperatures caused 22% overall mortality, devastating the Far Northern management area.

LINE

2017

First consecutive-year bleaching; heat stress affected two-thirds of the reef system in just 24 months.

2024

Part of a global bleaching crisis following the hottest year on record; occurred during an El Niño.

ING CRISIS EXPLAINED

2020

A rare and concerning mass bleaching during a "cool" La Niña summer, spanning the reef's entire length.

2025

Simultaneous bleaching of the Great Barrier and Ningaloo reefs for the first time; second consecutive-year event.

DEEP-SEA MINING

Minerals are the basic building blocks that are used in every industry in the world, both directly and indirectly. Their importance, therefore, cannot be overstressed. Mining for minerals on land has been well established and has been going on for a long time. However, there has been a sudden surge in demand for these minerals due to rapid industrialisation, economic growth, and the recent green transition, and the minerals that are available on land are not sufficient to meet this surge. Thus, some have started looking for viable alternatives for land mining to be able to meet this surge in demand and are now looking to tap the seafloor for metal ores. Deep-sea mining aims to retrieve valuable mineral deposits found on the ocean's floor, hundreds or even thousands of meters below its surface. Alongside a diverse array of marine life at these depths are significant reserves of copper, cobalt, nickel, zinc, silver, gold and rare earth elements (Ashford, n.d.). It is also a very attractive proposition for investors since the minerals in the deep sea have turned out to be purer than those on the earth, and a lot of rare earth elements have been found in the deep sea, which are a very important component of new technologies.

To meet investor demand, the ISA (International Seabed Authority) has been more generous in issuing permits for deep-sea mining. It has been indicated that more than 1.5 million km2 of the Pacific Ocean floor has been the subject of exploration license grants alone. Deep-sea mining has been initiated on a small scale, but it has not yet been done on a large scale commercially.

POTENTIAL BENEFITS OF DEEP SEA MINING

The following are some of the many benefits of Deep Sea Mining:

1. Advocates of Deep Sea Mining argue that Deep Sea Mining can be a solution for the future demand for critical minerals, since, in the years to come, the demand for critical minerals will only increase.
2. Although some suggest that Deep Sea Mining can replace traditional mining by lowering the environmental damage done by mining on land and solving problems such as deforestation and pollution of water caused by traditional mining, others have argued that setting up the infrastructure required for Deep Sea Mining requires obtaining land, which could affect the local population in the process.
3. The other benefit of Deep Sea Mining over traditional mining lies in the fact that Deep Sea Mining can ensure that exploitation of workers does not take place at these mines. This is due to the fact that the process of deep-sea mining cannot easily be accessed.

The global deep-sea mining market recorded a valuation of US$3.92 billion in 2024 and is projected to reach US$40.79 billion by 2032. As a revenue model, there would be many revenue streams and costs that come with deep-sea mining.

One of its revenue streams would be in the form of resource extraction and sales. This is the revenue stream for the private companies that actively engage in deep-sea mining activities. Additionally, the Government will also earn revenue from deep-sea mining in the form of giving licenses and permits to private companies for deep-sea mining. Similarly, there would also be many costs to be incurred to be able to establish deep-sea mining sites and start the process of deep-sea mining. The highest cost would be the construction of infrastructure for deep-sea mining sites, as it would require land acquisition and construction on a massive scale. Other costs would also include the cost of deep-sea mining vessels/vehicles, salaries and wages of employed staff and storage, transportation and processing costs of minerals obtained.

Despite all the above benefits, there are also multiple drawbacks and risks associated with deep-sea mining. The biggest risk with deep-sea mining is due to the ocean's mysterious nature. Our current knowledge of the ocean barely scratches the surface, leaving much of its vast depths and mysteries unknown, making deep-sea mining a risky proposition.
The following are some of the risks/drawbacks associated with deep-sea mining:

1. There is a high chance that marine life will be negatively impacted due to deep-sea mining projects. For eg, Small and less mobile organisms may be killed due to contact with the mining vehicles/vessels.
2. Deep-sea ecosystems are already under a lot of stress due to human activities and human-led stresses like climate change, etc. Introduction of deep-sea mining on a large scale will add significantly to these stresses and may disrupt the functioning of the deep-sea ecosystem entirely.
3. Deep-sea mining will not only impose a risk to the seabed, but also to the surface. This is because the scrap and unnecessary rocks collected while mining will be discharged back into the ocean, which could impose a threat to the living organisms near the surface, and would also contaminate the water bodies.
4. The ocean is a significant absorber of carbon dioxide, absorbing about 25% of carbon emissions. Microscopic organisms in the ocean are responsible for the same. Deep-sea mining could potentially harm these organisms, which would hinder the process of carbon absorption, thus negatively affecting the environment and raising global warming.

"Blue Carbon" is the term coined for carbon dioxide (CO2) stored in the world's coastal and marine ecosystems, such as mangroves, salt marshes, and seagrasses *(guide, 2023).* Due to climate change, such ecosystems are gaining importance. In this context, Blue Carbon Credits become vital. These work much like other carbon credits, the only difference being that they focus more on the carbon in the ocean and coastal ecosystems. (What Are Blue Carbon Credits, and How Do They Work?, 2023). When a corporate or individual entity funds a certified blue carbon project, it is given credits equal to the

quantified reduction of emissions. These credits can be used to offset emissions that are unavoidable. The capacity of the ocean to absorb carbon thus becomes a quantifiable and tradeable instrument that merges ecological restoration with market-based climate solutions.

The World Bank estimates the value of global blue carbon absorption to be $190 billion per year, which points to both its economic importance and its indispensable role for the environment. Blue carbon credits are gaining prominence in the financial sector, which is evident by the fact that they have reached a record high, with Platts' DBC-1 benchmark hitting $29.30/mt$CO_2$e in late August 2025 (Illuminem briefings, 2025). This is due to various factors, such as:

1. Governmental support: Countries in Southeast Asia and Africa are implementing coastal restoration projects. This increases the demand for blue carbon credits.
2. Technological features: Technologies such as the Blue Carbon Finance Toolbox permit the digital recording of the results of the project, along with the instant verification of the captured carbon. Such openness aligns blue carbon with the growing demand for data-backed sustainable finance instruments.
3. Low supply: The annual issuance of credits amounts to less than 10 million tons; therefore, it assumes even greater value.
4. Investor confidence: Financial institutions are entering early, motivated by premium returns and long-term credit appreciation.
5. Regulatory alignment: Thanks to Article 6 of the Paris Agreement, blue carbon credits may be allowed in compliance markets soon, thereby increasing their legitimacy and liquidity, improving in investor confidence.

The limited availability of these credits, combined with their verified positive impact, makes blue carbon credits "impact-dense" financial instruments, attractive to investors who are looking to maximise their financial returns while achieving measurable environmental outcomes.

Blue carbon credits are a prime example of the coupling of ecological science with financial innovation. In effect, they change the ocean's natural carbon-storage capacity into a unit of value that can be exchanged or invested in. Therefore, once methods have become more stable and market trust has strengthened, blue carbon will be able to sustain the position of a core instrument of the finance of the environment, alongside renewables and terrestrial offsets.

Blue carbon changes financial systems, as it acknowledges nature as a real and productive asset. Blue carbon could create a balance between environmental responsibility and economic opportunity, if supported by appropriate policies and inclusive finance. Ocean restoration projects have become an essential way to help reverse marine and coastal ecological degradation. A broad spectrum of organisations and foundations provides support through grants, in the first place, intended to promote ocean conservation initiatives. Funding comes from

from both public and private channels. These include The Ocean Foundation, NFWF(National Fish and Wildlife Foundation), and the United Nations Development Programme (UNDP) – Small Grants Programme.

The funding of ocean restoration programs can be better understood through a case study on the reconstruction of the Sundarbans mangrove.

1. Contributions are made by community-led initiatives, such as the ones supported by SESDO(Social and Environmental Sustainable Development Organisation) and the 'One Tree Planted' organisation.
2. Various funds, such as the Livelihoods Carbon Fund and the Blue Mangrove Fund, fuel projects with conservation objectives.
3. Government plans such as MISHTI(Mangrove Initiative for Shoreline Habitats & Tangible Incomes) and CAMPA (Compensatory Afforestation Fund Management and Planning Authority) provide publicly funded eco-restoration programmes in the Sundarbans area.
4. Institutions such as the West Bengal Forest Department provide funds for a selection of projects. International donor funding is also facilitated through The Nature Conservancy, which plans to restore 100 hectares.

Thus, restoration projects involve funding from a plethora of programmes, including community-based initiatives, corporate grants, government schemes, and international collaborations.

NATIONAL FRAMEWORKS

NATIONAL FRAMEWORKS

India's concern and commitment towards environmental conservation were reinforced in 1976 by the 42nd Amendment of the Constitution of India. Article 48A under the Directive Principles of State Policy and Article 51A (g) of the Fundamental Duties in the Constitution that 'the State shall endeavour to protect and improve the environment and to safeguard forests and wildlife in the country', and 'to protect and improve the natural environment, including forests, lakes, rivers and wildlife, and to have compassion for the living creatures.

Earlier, these articles were not a part of the Indian Constitution when it was enacted in 1950. However, in 1976, they were brought into existence through the 42nd Constitution Amendment Act. During that period, environmental concerns were being raised, both domestically and internationally, and this Amendment was India's response to these concerns. The Constitution of India, in terms of Article 48A, mandates that the State is under a Constitutional obligation to protect and improve the environment and to safeguard the forest and wildlife in the country. The major objective of the judiciary was to develop a sense of duty and responsibility among the citizens through the provisions of Article 42. Article 51(A) lists basic responsibilities for the citizens of the country. It is not rigid in nature as it can be modified according to the ongoing needs of a nation. Over the years, rules on safeguarding nature have been brought into law through several amendments. As per Article 51(A), clause (g), all citizens share the mutual responsibility to improve the conditions of natural resources, including rivers, lakes, and forests. Various subsidiary laws under the Air (Prevention and Control of Pollution) Act, 1972, the Forest (Conservation) Act, 1980, the Indian Forest Act, 1927, and the Biological Diversity Act, 2002. These laws, among other laws, were enacted with the main aim of expanding the boundary of the laws dealing with environmental protection and enhancement. The Constitutional Part II, I, which deals with Fundamental Rights, does not directly contain an Article on the protection of the environment. Nevertheless, with the development of the law and the decisions made by the Supreme Court of India, Article 21 has expanded, and now even the right to a clean and healthy living location is also present.

The main objectives that this act aims to fulfil are:

- To ensure that the State organises actions for afforestation, wildlife protection, and pollution prevention.
- To create a culture of responsibility via administrative policies and statutory frameworks.
- To ensure a sound balance between economic development and ecological protection while promoting sustainable resource use.
- DPSPs guide policymaking, as they function (though not justiciable) as a calculus for the pursuit of governance compatible with environmental ethics.

Illicit wildlife trade has proved to be highly profitable, with aggregate estimates of US$6.2 billion in annual revenue earnings, with high-value commodities like ivory from elephants, skin and meat from pangolins, various endangered plant species such *as Boswellia,* rosewood, and blackwood for timber extraction *(Pearl, M. C.,2004, Wildlife Trade: Threat to Global Health).* As per a 2008 US Congressional Research Service Report, the illicit wildlife trade has been closely correlated to organised crime and drug trafficking, and has been assessed to be the third most lucrative illegal commercial domain operating behind the underground drugs and arms trade market. When humans covet threatened and endangered species or their parts, it puts tremendous pressure on ecosystems and their inhabitants.

The current international trade scenario is heavily dependent on biodiversity to support the global markets. The rising trend of trading in wildlife allied products is due to the increasing consumerism across international markets. Wildlife Trade, in simpler terms, refers to the exchange of goods and services derived from non-domesticated wildlife extracted from their natural habitats or under controlled conditions. The legal wildlife trade usually involves the buying of Nature and the selling of skin, bones, and meat products, which come under the purview of licensing and trade restrictions within the World Trade Organisation.

To ensure that international trade does not entail any illicit exchanges involving illegal capturing, bartering, or trading of protected species, as per the International Union for Conservation of Nature (IUCN), for purposes of food, clothing, medicines, or any other substantive use. As per IUCN, the most impacted segment of animals due to illicit trading is vertebrates, since calcium-based products are assimilated and extracted at a high commercial rate to trade internationally. The aggregate value of the international trade dealing with wildlife extracted products (mainly calcium-based products such as dry blowfish extract, seashells, and coral reefs) is more than $220 billion annually (Annual Market Size of Wildlife, CITES). The possible threat of extinction to various species of biodiversity poses a major risk factor to international trade and calls for controlled supervision on global exchange routes dealing with wildlife trade.

The legal wildlife trade is regulated by the United Nations Convention on International Trade in Endangered Species (CITES), which was signed by 184 countries on March 3, 1973, and was implemented in the year 1975.

India became one of the signatory members in the year 1976, signifying its agreement to the primary appendices and fundamental principles of the Convention. The CITES agreement entails primarily three appendices, which include the list of species restricted from being traded internationally. Each appendix consists of categorically divided wildlife species that no country whatsoever should indulge in trade with, wherein each category has been accorded different levels of protection from over-exploitation based on their degree of endangerment.

Appendix 1 (Article II, Paragraph I, CITES) of the convention specifies the list of the species most threatened with endangerment, these include species of snow leopards, Asian elephants, and one-horned rhinoceros, amongst many others. These species are not to be traded in any form, including, but not limited to, powdered bones, calcified skin, and ligaments. The import-export of such species has been restricted in commercialised segments of trade; however, countries are free to trade. The second appendix of the CITES agreement (Article II, Paragraph II) regulates the trade of species that are not yet "Critically Endangered", but might be on the verge of being endangered if their trade is not placed under controlled supervision. These species include red pandas, giraffes, and hippopotamuses as part of the second appendix. Trading in these is partially restricted, i.e., countries will require an import-export permit from the UN specifying the exact reason, quantity, and form of the commodity to be traded. (CITES Secretariat et al., 2022)

Whereas, Appendix 3 *(Article II, Paragraph I)* of CITES deals with species that are endangered and protected in one country, and are required to be a part of preventive trade agreements among nations involved. This agreement allows a country to unilaterally impose restrictions on animal species on the verge of extinction in their jurisdiction for the purpose of avoiding overutilisation and utilisation incompatible with their survival. An additional supplementary section has recently been made a part of the CITES official document, often titled as the Appendix 4, which includes the format for permits and licences to be issued and followed for trading in species strictly under exceptional provisions of the CITES. In case a country fails to follow these provisions, the CITES Secretariat or any other presiding diplomat representing the UN or the WTO in that country may sign a formal warning demanding compliance, and in case of further non-compliance, the country can be suspended from any trade agreements or contracts with other nations. *(CITES Secretariat et al., 2022)*

In retrospect, conventions such as that of CITES shift the supply curve and impact the global supply chains with lower conditioning towards market demands, as illicit wildlife products usually have a relatively inelastic demand in the market. Even if the penalties and restrictions rise, market demand does not fall enough to bring out the expected results. Ironically, such restrictions give rise to black markets and alter the cost structures prevalent in the economy. The success of CITES depends on various enforcement risk perceptions and even the availability of

lab-grown substitutes to rare commodities such as ivory. The CITES system is largely based on scientific advice and information, with authorisations or refusals to export or import specimens based on scientific advice. (Venkateswarlu et al., 2025). This often creates the risk of misalignment in terms of labels and categorisation of wildlife commodities.

The biggest loophole recognised with respect to the Convention is its inability to lucidly specify "Captive-bred" species of endangered animals. This lack of definition and scope has created a major subterfuge in the illicit trading of species listed in Appendix 1. Many times, endangered species are illegally introduced into controlled captivity and breeding facilities and are then labelled as "captive-bred." The policies of various nation-states are different in scope when it comes to dealing with "captive-bred" species, i.e, the penalties and fines are often weaker or not in place across many countries. Seeing this leeway, many traders use this to create a way via which they can "legally" escape the provisions of the CITES. Despite its many loopholes, the convention is still considered one of the most important international legal regulations governing wildlife conservation. India, being one of the major signatories to international trade agreements and conventions such as CITES, has to implement the intent of such policies pragmatically and feasibly to ensure its alignment with international trade standards. Following the idealistic approach that the global wildlife trade has put forth, India has created multiple regulatory laws to protect endangered species from being traded illegally. A major step towards this direction was taken with the introduction of the Environment (Protection) Act. The Environment (Protection) Act was implemented in 1986 with the view of conserving, protecting and improving the environment. This act primarily empowers the central and state governments to tackle environmental degradation by granting them the necessary powers. This Act was enacted in Article 253 of the Indian Constitution. The roots of the Act lie in the United Nations Conference on the Human Environment, held at Stockholm in June 1972. It is also known as the Stockholm Conference, and India also participated in it. The Environment (Protection) Act implements the decisions made in this conference. This Act enables the central government to plan and execute a nationwide programme to help reduce environmental degradation, lay down standards for the quality of the environment and for emission and discharge of environmental pollutants from various sources, and also empowers the Central Government to restrict industries, etc, from being set up in certain areas. This act is thus the reason why residential and industrial areas are separated, as otherwise the private firms would have set up factories in residential areas or areas which would have damaged the wildlife if they had maximised their profits. Additionally, the Act also empowers the central government to appoint officers to ensure that environmental conservation efforts are flowing smoothly and effortlessly, and to eliminate any obstacles that may come on the way. It is also empowered to establish environmental

laboratories and carry out all necessary actions for the smooth and seamless functioning of these laboratories. It is also empowered to hire government analysts who are specialised in analysing the quality of soil, air, water, etc, sent to the laboratory for testing. To achieve the profit maximisation goal, most people ignore the impact their actions may have on the environment. To protect the environment from these human activities, various restrictions have to be placed on individuals and firms in order to protect the environment from their actions. This Act places various such restrictions on their activities. It also empowers the central government to take the necessary action against violators of these restrictions. Some of these restrictions are:

1. **Restriction of Pollutant Discharge -** There is a prescribed limit of pollutant discharge for both individuals and organisations, and no individual or organisation is allowed to go beyond this permissible limit.
2. **Protection from Hazardous Substances -** No untrained individual is allowed to carry hazardous substances like dangerous chemicals, which could cause harm to others or themselves if not handled properly.
3. **Control over entities -** Any individual appointed by the central government and given enough power by the government can order the inspection of any industrial equipment, plant, etc and is also authorised to seize the equipment if it does not conform to the safety standards.

The Government of India, in 1991, issued a major notification under the Environment Protection Act, 1986, framing rules for the regulation of various coastal zone activities. These rules are called the Coastal Regulation Zone (CRZ) rules.

Under these Rules, the entire coastal stretch from the lowest low tide to the highest high tide line and the coastal land within 500 m from the high tide line on the landward side is termed as CRZ. The latter is classified into four categories (CRZ-I to CRZ-IV) depending on the sensitivity of the zones. Prohibited and regulated activities have been listed for each zone. The following activities are declared as prohibited within the CRZ, namely: New industries other than the permitted like IT; disposal of hazardous substances; new fish processing units; new effluent/waste treatment plants; disposal of untreated waste and effluents; dumping of city or town waste or ash from thermal plants; land reclamation; mining of sands, rocks or corals (except rare minerals not available outside CRZ areas; harvesting or extraction of ground water other than manual wells for domestic purpose or traditional activities construction other than permitted ones, etc. The Ministry of Environment and Forests and the Government of the State and Union Territory, and such other authorities at the State or Union Territory levels, shall be responsible for monitoring and enforcement of the provisions of this notification within their respective jurisdictions.

These zones are classified as:

CRZ-1: These areas are ecologically sensitive and also essential in maintaining the

ecosystem of the coast. They lie between low and high tide lines.

CRZ-2: These areas are urban areas located in the coastal areas. Under the Coastal Regulation Zone (CRZ) Notification 2018, the floor space index norms have been unfrozen.

CRZ-3: Rural and urban localities which fall outside the 1 and 2. Only certain activities related to agriculture and even some public facilities are allowed in this zone.

CRZ-4: This lies in the aquatic area up to territorial limits. Fishing and allied activities are permitted in this zone. No Solid waste should be let off in this zone. In 2011, a change was made in this zone from the 1991 notification, as the islands of Andaman & Nicobar and Lakshadweep were excluded from the list.

The latest notification of the CRZs was the Coastal Regulation Zone Notification 2019, which was issued to replace the 2011 notification and develop the coastal region of the country in a sustainable manner on scientific principles, keeping in view the current global problem of climate change and sea level rise. The earlier notification of 2011 had frozen the floor space index or floor space area, which was unfrozen in the latest notification. One of the important developments was the division of CRZ-III areas(rural areas) into two categories, namely CRZ-IIIA and CRZ-IIIB. CRZ-IIIA refers to an area with a population density of more than 2161 persons per square km, while CRZ-IIIB refers to rural areas with a population density of less than 2161 persons per square km. As per the 2019 notification, the CRZ-IIIA areas will have no development zone (NDZ) of 50 metres from the high tide line (HTL). This was mentioned as 200 metres in the notification of 2011. The CRZ-IIIB areas, however, will have a no-development zone of 200 metres from the HTL. The population density of the respective areas will be measured on the basis of the Census 2011.

DRAWBACKS OF THE POLICY

Just like any other Act/policy, the Environmental (Protection) Act, 1986, also has some drawbacks. The primary drawback of it is that it is centralised, i.e. most of the powers reside only with the central government, and a smaller portion of the powers are given to the state governments. Additionally, it does not focus on participation from the public; it does place restrictions on them and gives government officials the powers to take action against the rule-breakers, but it doesn't encourage the people to partake in activities which help conserve the environment, for eg, awareness schemes, workshops, etc. The Act is limited only to the empowerment of the Central Government and setting in place rules and regulations to avoid further environmental degradation. Additionally, as the Act was introduced in 1986, it does not address the modern pollutants directly, like radiation waves from mobile phones, air pollution due to the amount of vehicles skyrocketing, etc.

The Government of India enacted the Biological Diversity Act (BDA), 2002, in order to conserve biodiversity and promote sustainable use of resources. This is done through a 3-Tier Framework:

1. The National Biodiversity Authority

(NBA)-Central level.
2. The State Boards-State level.
3. Biodiversity Management Committees

Thus, the National Biodiversity Authority (NBA) was established in 2003 under this Act. The NBA has various regulatory, advisory, and promotional functions aimed at the protection of the biological resources of India. It regulates access to biological materials in order to ensure that their usage will benefit local communities and will not disrupt the ecological balance. Foreign nationals and organisations must obtain prior approval from the NBA if they are to access biological resources or related knowledge in India. Indian researchers are also required to get permission if they want to transfer their research results to foreign entities. These rules aim at the prevention of biopiracy and the provision of fair Access and Benefit Sharing (ABS) mechanisms.

The NBA also plays a proactive role in protecting India's traditional knowledge systems by intervening in cases where patents or intellectual property rights are sought abroad based on resources or knowledge originating from India. Additionally, the agency facilitates the documentation of local biodiversity through People's Biodiversity Registers (PBRs), which are prepared by community institutions. It also facilitates campaigns and workshops to generate awareness among multiple stakeholders to ensure the sustainable use of bioresources. It advises both the Central Government and the State Government. The Central Government provides guidance on conservation issues, sustainable use of biological resources, and the sharing of benefits in an equitable manner. For State Governments, it assists in the identification and management of Biodiversity Heritage Sites.

The NBA has taken a significant step towards biodiversity management through its partnership with the United Nations Development Programme. This partnership aims to strengthen institutional capacities in Madhya Pradesh and Jharkhand. The authority has considerably institutionalised governance relating to biodiversity in India. However, challenges such as inadequate resources and variations in the implementation of the Act across different states are still being faced.

The National Biodiversity Authority is the foundation of the environmental governance system in India. It has, through its numerous functions, implemented the Biological Diversity Act, 2002, in such a way that the goals of conservation are combined with the welfare of the locals and the sharing of benefits. Persistent strengthening of the institution, cooperation among different government levels, and involvement of local people are required to turn the Act's aim of sustainable and inclusive biodiversity management into reality.

POLICY INSTRUMENTS AND FLAGSHIP PROJECTS

POLICY INSTRUMENTS AND FLAGSHIP PROJECTS

NATIONAL ACTION PLAN ON CLIMATE CHANGE (NAPCC)

India's National Action Plan on Climate Change (NAPCC) is a landmark in the country's path to sustainable development. The plan concentrates on energy efficiency and resource conservation to support future policy decisions. The plan, which runs until the year 2025–26, is aimed at equipping India with measures to cope with the adverse effects of climate change. It represents a change in the direction of India's growth by shifting from a conventional model to a sustainable one. It is a Central Sector Scheme, the coordination of which is done by the Prime Minister's Council on Climate Change, whereas execution is under the authority of the ministries.

The NAPCC's guiding philosophy is based on these two principles:

- Technological innovation: The plan aims to use cutting-edge technologies and collaborations among various sectors.
- Inclusiveness: It refers to protecting the vulnerable groups of society through climate-sensitive policies.

With its objectives and policy framework, NAPCC intends to guide India's development trajectory to be environmentally friendly while still ensuring that economic progress is made.

GREEN INDIA MISSION (GIM)

National Green India Mission (GIM) is administered by the Ministry of Environment, Forest and Climate Change (MoEFCC) and marks a significant moment in India's response to climate change issues. The Green India Mission is concerned with the environment in a very comprehensive way. The focus is not only on afforestation, but also on conserving the natural ecosystems and their services, such as flora and fauna, water, biomass, etc.

It intends to bring about a five-million-hectare increase in forest and tree cover in India. In addition, the plan aims to enhance the quality of forest cover on another five million hectares of both forest and non-forest lands. It also aims to revive severely degraded forests, which have been damaged by open lands and polluted ecosystems (Ministry of Environment, Forest and Climate Change,n.d). These measures are aimed at raising India's carbon dioxide sequestration level by 50 to 60 million tonnes, at the same time enabling nearly three million forest-dependent households to have a sustainable

source of income (National Mission for a Green India, n.d.).

The mission is mainly committed to forest communities' proper adaptation to climate change through ecosystem resilience and income diversification. It aims to double the area for afforestation, boost the removal of greenhouse gases by forests, and restore ecosystems with the help of the community. One of the most outstanding features of GIM is the integrated cross-sectoral approach that coordinates public and private land management, local governance, and civil society for engagement in planning, implementation, and monitoring.

The Green India Mission is put into effect through the collaboration of a multi-level structure:

At the national level, oversight is undertaken by the Ministry of Environment, Forest and Climate Change. At the state level, implementation and supervision are carried out by State Forest Development Agencies, which further coordinate the functioning of Forest Development Agencies at the district level. At the community level, monitoring and local execution are entrusted to Gram Sabhas and village committees. In urban areas, responsibilities related to environmental maintenance and greening initiatives are shared among municipal authorities and Residents' Welfare Associations, thereby ensuring civic participation in environmental management.

Green India Mission is distinctive among the NAPCC missions because of its one-year preparatory phase before the start of the main project, a feature that no other missions have. In 2011–12, ₹50 crore was allocated from the National Clean Energy Fund towards preparatory activities for the same period. It covered 21 states and 71 landscapes with 708 villages. The activities under it include micro-planning, awareness generation, nursery development, and entry-point activities.

GIM is working closely with various major national programmes such as MGNREGA (Mahatma Gandhi National Rural Employment Guarantee Act), CAMPA (Compensatory Afforestation Fund Management and Planning Authority) and NAP (National Adaptation Plan on climate change) to ensure efficient use of resources.

India has planted an estimated 11.22 million hectares of land through GIM and related initiatives between 2015–16 and 2020–21, thus contributing to the gradual increase of the total forest cover. However, difficulties such as a lack of funds and the inadequate protection of old-growth forests have prevented the mission from achieving its full potential. It is important to enhance the

Figure 5.1: Mission Green India

implementation of GIM in order to attain India's national target of 33 per cent forest cover. Thus, the National Mission for a Green India is a prominent element of India's climate strategy, which integrates ecological restoration with social empowerment.

NATIONAL MISSION FOR SUSTAINING THE HIMALAYAN ECOSYSTEM

For a long time, the Himalayan ecosystem has been the source of a huge variety of plant and animal life. However, it has been in danger for the last few decades because of climate change and unsustainable developmental practices. Acknowledging these problems, the NMSHE intends to set up a community-involved framework. The main areas of this mission include institutional capacities and continuous self-learning systems to be able to balance human activity with natural processes. It deals with the melting of Himalayan glaciers and the resulting changes in the water cycle, conservation of biodiversity and wildlife (National Mission for Sustaining Himalayan Ecosystem).

Objectives:

1. Developing the capacity of the existing and new institutions in the Himalayan region
2. Locating and networking national knowledge centres; and creating state-of-the-art methods for monitoring ecosystem health, with special reference to glaciers.
3. The mission also wants to measure the factors behind the climate-related changes, create possible weather patterns for the future, and suggest policy interventions based on solid evidence.

Moreover, the NMSHE has given importance to aspects like the linkage of traditional knowledge systems of local and indigenous communities with formal scientific methods in order to facilitate the implementation of sustainable development practices.

The mission is made up of several specially designed programmes and initiatives such as Thematic Task Forces, State Climate Change Centres in Himalayan States and Union Territories, Centres of Excellence, and State Network Programmes throughout the Indian Himalayan Region (IHR).

In order to provide efficient involvement of people, the mission stimulates submission of proposals via the Project Appraisal Management System (ePMS), thus projects that are in line with the mission's strategic objectives are being invited. At the core of the National Mission for Sustaining the Himalayan Ecosystem, India's pledge to protect one of the most fragile and essential ecological zones in the world is represented.

OTHER MISSIONS UNDER THE NATIONAL ACTION PLAN ON CLIMATE CHANGE

NATIONAL MISSION ON STRATEGIC KNOWLEDGE FOR CLIMATE CHANGE

The consequences of climate change on social systems are expected to vary in

different regions of the world on account of several regional and other local factors. Therefore, different modelling studies, adaptation strategies and technology systems would be required in differing geographical and social contexts. To overcome the uncertainties in disaggregating the effects of global warming on different agro-climatic regions, developing a strong capability in basic and applied research in climate science was required, by strengthening observational and modelling tools and systems. There are a number of constraints that limit, at present, the ability of the national knowledge system to deliver the required and expected outcomes for effective response. Addressing these constraints through strategic actions that include the development of appropriate institutional and human resource capacity for this purpose will form the main goal of the National Mission on Strategic Knowledge for Climate Change. Accordingly, the following objectives have been identified for the Mission:

- Formation of knowledge networks among the existing knowledge institutions engaged in research and development relating to climate science, and facilitate data sharing and exchange through a suitable policy framework and institutional support.
- Establishment of global technology watch groups with institutional capacities to carry out research on risk-minimised technology selection for developmental choices

Development of national capacity for modelling the regional impact of climate change on different ecological zones within the country for different seasons and living standards.

- Establishing research networks and encouraging research in the areas of climate change impacts on important socio-economic sectors like agriculture, health, natural ecosystems, biodiversity, coastal zones, etc.
- Providing an improved understanding and awareness of the key climate processes and the resultant climate risks and associated consequences.
- Building alliances and partnerships through global collaboration in research & technology development on climate change under International and bilateral S&T cooperation arrangements.

NATIONAL SOLAR MISSION (NSM)

The NSM was launched in January 2010 to establish India as a global leader in solar energy by creating the policy conditions for solar technology diffusion across the country as quickly as possible. The initial target of NSM was to install 20 GW of solar power by 2022.

This was upscaled to 100 GW in early 2015. (Ministry of Information and Broadcasting, Government of India, 2021). Numerous facilitative programmes and schemes under the Mission have driven the grid-connected solar power installed capacity from 25 MW in 2010-11 to about 36.32 GW on 31st October 2020. An additional 58.31 GW solar power capacity is currently under installation/tendering process.

NATIONAL MISSION FOR ENHANCED ENERGY EFFICIENCY (NMEEE)

NMEEE aims to strengthen the market for energy efficiency by creating a conducive regulatory and policy regime and has envisaged fostering innovative and sustainable business models in the energy efficiency sector. The Mission has been implemented since 2011. NMEEE consists of four initiatives to enhance energy efficiency in energy-intensive industries.

The Government of India has introduced several initiatives to promote energy efficiency and sustainable economic development.

The Perform, Achieve and Trade (PAT) scheme sets energy consumption reduction targets for energy-intensive industries and allows the trading of efficiency certificates to encourage compliance. The Market Transformation for Energy Efficiency (MTEE) programme seeks to accelerate the adoption of efficient technologies by shaping favourable market conditions through policy support and financial incentives. The Energy Efficiency Financing Platform (EEFP) aims to mobilise investments in energy efficiency projects by linking financial institutions with project developers and reducing financial risks.

Complementing these initiatives, the Framework for Energy Efficient Economic Development (FEEED) integrates regulatory and financial instruments to promote long-term energy efficiency across sectors of the economy.

NATIONAL MISSION ON SUSTAINABLE HABITAT

The Prime Minister's Council for Climate Change approved the mission in June 2010. The key deliverables of the Mission include:

- Development of sustainable habitat standards that lead to robust development strategies while simultaneously addressing climate change-related concerns.
- Preparation of city development plans that comprehensively address adaptation and mitigation concerns.
- Preparation of comprehensive mobility plans that enable cities to undertake long-term, energy-efficient and cost-effective transport planning.

NATIONAL WATER MISSION

The National Water Mission will ensure integrated water resource management, helping to conserve water, minimise wastage and ensure more equitable distribution both across and within states. The Mission will take into account the provisions of the National Water Policy and develop a framework to optimise water use by increasing water use efficiency by 20 per cent through regulatory mechanisms with differential entitlements and pricing. (National Water Mission, n.d.)It will seek to ensure that a considerable share of the water needs of urban areas are met through recycling of wastewater, and ensure that the water requirements of coastal cities with inadequate alternative sources of water are met through the adoption of new and appropriate technologies, such as low-

temperature desalination technologies that allow for the use of ocean water.

NWM has identified five goals, which are mentioned below:

- Comprehensive water database in the public domain and assessment of the impact of climate change on water resources.
- Promotion of citizen and state actions for water conservation, augmentation and preservation.
- Focused attention to vulnerable areas, including over-exploited areas
- Increasing water use efficiency by 20 per cent.
- Promotion of basin-level integrated water resources management.

NATIONAL MISSION FOR SUSTAINABLE AGRICULTURE

In the 2014-15 financial year, the National Mission for Sustainable Agriculture (NMSA) was launched. The objective of the scheme is to maximise productivity, sustainability, remuneration and climate resilience of agriculture. To this end, location-specific integrated and composite farming systems, soil and moisture conservation, soil health management, water management, and rain-fed technologies will be efficiently and comprehensively worked upon. In order to guarantee better water use, one of the elements introduced under NMSA in the 2014-15 period was Farm Water Management (FWM). This would help in technological interventions, such as the drip and sprinkler technologies, an effective water application and distribution system, secondary storage, etc. Later, it would be combined under the Per Drop More Crop (PDMC) scheme of the Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) during the 2015-16 period.

Soil Health Management (SHM) is one of the factors of the National Mission on Sustainable Agriculture (NMSA). The SHM is also brought up to facilitate Integrated Nutrient Management (INM), which would ensure the effective use of the traditional chemical fertilisers, which have micronutrients, organic manures and bio-fertilisers to improve the soil health and productivity. It also seeks to enhance soil/fertiliser testing and advice in enhancing soil test-based recommendations to farmers to improve soil fertility. In the country, the scheme was introduced as the Soil Health Card Scheme in February 2015, with the mission of issuing Soil Health Cards to all farmers in the country. The Soil Health Cards will contain details on the nutrient composition of their soils and policies on the optimal quantity of nutrients to be incorporated in order to enhance soil health and fertility. (Press Information Bureau, 2021).

WILDLIFE PROTECTION ACT, 1972

The Wildlife Protection Act of 1972 provides a legal framework for the protection of various species of wild animals and plants, management of their habitats, regulation, and control of trade in wild animals, plants,

and products made from them. This act lays down schedules of plants and animals on the basis of the amount of protection given to them. Before the Amendment Act of 2022, this act had 6 schedules. Schedule 1 covers the endangered species, such as the Black Buck, Snow Leopard, etc. Species under this schedule are strictly off-limits for hunters, unless they prove to be a threat to human life, for eg, being attacked by one of these species while roaming in a forest. Violation of this rule can lead to strict punishment and harsh penalties for the violator. Schedule 2 covers animals which aren't endangered, like the ones in Schedule 1, which are also highly protected under the act, and any form of their trading is strictly prohibited, with strict action against violators of this rule. Some of the animals under this schedule include Assamese Macaque, Himalayan Black Bear, and Indian Cobra. Schedules 3 and 4 are similar, as they both cover species which are not endangered or under any such threat. However, this does not mean these species are not protected; they are, but the punishment/penalty for violation of this rule is not as strict and harsh as the ones in Schedules 1 and 2. Some animals in Schedule 3 are Chital, Bharal, and Hyenas, while some animals in Schedule 4 include Flamingo, Hares, Falcons, Kingfishers, etc. Schedule 5 covers animals that are considered "vermin", which are small animals that can carry diseases and destroy plants and food. These are allowed to be hunted by the people without any punishment. Some examples of these are crows, rats, and mice. Finally, Schedule 6 provides the regulations for the cultivation of specific plants under the act. Additionally, it also restricts the sale and transportation of these plants. Some plants protected under this Schedule are Blue Vanda, Red Vanda, Pitcher plant, etc.

There are multiple bodies constituted under this act, like the NBWL (National Board for Wildlife), SBWL (State Board for Wildlife), Central Zoo Authority, NTCA (National Tiger Conservation Authority), and the WCCB (Wildlife Crime Control Bureau).

Since the introduction of the act, there have been 4 main amendments to the act. The same are listed below:

Wildlife (Protection) Amendment Act of 1991:

This amendment increased the size of penalties and fines to be imposed on people who violate the rules under the act and commit wildlife-related offences.

Wildlife (Protection) Amendment Act of 2002:

This amendment introduced the concept of community reserves and conservation reserves as protected areas.

Wildlife (Protection) Amendment Act of 2006:

This amendment dealt with the issue of human-wildlife conflict due to a lack of management systems. Thus, this led to the creation of NTCA (National Tiger Conservation Authority) to manage and protect tiger reserves. It also led to the creation of a Tiger and Other Endangered Species Crime Control Bureau to deal with wildlife-related crimes.

Wildlife (Protection) Amendment Act, 2022: This is the biggest amendment made to the Wildlife Protection Act, 1972, even since its introduction. This amendment increased the species that come under the act, and it implemented CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora).

The biggest change made under this amendment is that the number of schedules has been reduced from 6 to 4. Now the schedules are as follows:

1. **Schedule 1** - Contains endangered species requiring and enjoying the highest amount of protection.
2. **Schedule 2** - Contains animals enjoying a slightly lesser degree of protection.
3. **Schedule 3** - Contains protected plant species.
4. **Schedule 4** - Contains specimens under CITES.

Additionally, the penalties for violation of the rules and wildlife damage have also increased in this amendment. The State Action Plans on Climate Change (SAPCCs) are a clear indication of how India recognises that an effective climate change response must be grounded in the realities of the country's different regions and ecosystems.

The SAPCCs are the result of a top-down approach, where in 2009, the Prime Minister requested all state administrations to prepare their plans. It was decided that the states should draft detailed blueprints that would be in harmony with national priorities. At the same time, they would consider state-specific problems and opportunities. This way, the states would become the focus of climate governance in India. The majority of the states made their plans in 2010 and 2011, with consultant support from development agencies. The SAPCCs serve as a gateway for the redirection of the development planning process to climate resilience. In fact, 34 states and UTs have finalised their SAPCCs so far.

The SAPCCs are each a different colour but follow a similar pattern. Each state's unique vulnerabilities due to climate change are outlined, as well as the government's way of dealing with climate change, both now and in the future. Most of the states have not done detailed climate-specific vulnerability assessments. They have mostly depended on national and sector-specific studies. As per the instructions of the central government, the emphasis in most SAPCCs is on adaptation, and little is said about mitigation. The plans describe measures that will be implemented in sectors such as agriculture, water, transport, energy, industries, urban development, and forestry.

Nearly all the states have established climate change cells or specialised departments for execution. The organisation also includes State Climate Change Committees that are led by senior officials, technical working groups for main sectors, and nodal agencies, which are in charge of the daily coordination.

Yet, a number of obstacles are impeding the implementation of the plans. The absence of leadership and political will, because of the top-down nature of SAPCCs and already existing climate strategies, continues to be a major challenge. Most of the plans fail to define clear and specific actions that would lead to the implementation of the stated objectives. There is also a lack of resources.

In reaction to these problems, a number of future strategies have been proposed. As a matter of fact, international climate finance could help to cover the additional costs of adaptation. The appointment of nodal officers in the main departments may help to solve institutional bottlenecks issues by giving out clear points of responsibility. Besides, states will be able to further their climate action by preparing thorough project reports of their work and by constantly updating their plans so as to always be in line with climate risks and policy priorities.

A key characteristic of a large number of SAPCCs is that they concentrate on the identification of the actions that produce co-benefits across the different sectors. These co-benefits are economic(like green job creation and increased agricultural productivity), health improvements(caused by cleaner air and reduced heat-related illnesses) and environmental (such as biodiversity conservation and pollution reduction). By featuring these co-benefits, SAPCCs pave the way for a wider political and public endorsement of climate action.

FLAGSHIP PROJECTS

Conservation efforts often require laws to be formulated in a manner that includes policy frameworks with adequate budgetary allocations to reduce the issues of under-investment that wildlife conservation faces. Various concentrated efforts are often made by authorities to promote "Carbon Sequestration", the process of accumulating carbon dioxide emissions to reduce greenhouse gas emissions. These efforts might prove to be redundant if the result of such acts does not reduce the marginal private benefit to a level lower than or at the equilibrium of the marginal social benefit of wildlife conservation policies aimed to bring "wildlife" as a categorised public good. The focal point behind these policies and projects is to balance out long-run positive externalities, which can help reduce future fiscal burden that the economy might have to face to support the scarcity. Wildlife biodiversity is a typical public good, i.e., it is non-rivalrous and non-excludable. Biodiversity is not explicitly traded in the market, so it is seemingly difficult to estimate its actual market price. To counter this issue, economists analyse the price of wildlife and its losses in terms of the opportunity costs that the economy faces while calculating the costs that society incurs. Conservation is represented as a choice between using limited and fixed inputs like land for either production or for wildlife habitats. Analysing opportunity costs over time requires the use of opportunity cost which rises over time, as the environmental damage starts to become irreversible. Another method of evaluation is

CRITERIA	CHANDIGARH	TAMIL NADU	UTTRAKHAND
Main Focus	Chandigarh's SAPCC focuses strongly on water conservation and energy efficiency.	Protection of fragile coastal ecosystems. It emphasises sustainable agriculture and biodiversity preservation.	Focuses on protecting Himalayan ecosystems and improving disaster management.
Institutional Framework	Operates through a Climate Change Advisory Committee and relies heavily on institutions like CREST to coordinate energy-related initiatives.	Tamil Nadu Climate Change Mission (TNCCM), along with departmental climate cells, regulate this.	Headed by the State Climate Change Centre (SCCC), which works with the Forest Department.
Budget and Funding	Requires over ₹17,000 crore across five decades. Funding is done through budget allocations, schemes like AMRUT and JJM, and external technical partnerships.	Requires ₹68,000 crore of investment. Funding is done through central schemes and partnerships.	Requires an investment of ₹8,832 crores. Funding is done through state and central schemes, along with organisations such as CDKN (Climate and Development Knowledge Report)
Status & Implementation	Chandigarh's SAPCC 2.0 (2020–2030) has been approved, and the UT has already made visible progress through solar rooftop penetration, EV infrastructure, etc.	The state has already implemented significant actions across renewables, coastal management, and climate-smart villages.	Uttarakhand implemented its 2014 SAPCC. Implementation focuses on watershed development and community-based disaster risk management.
Climate Innovations	Solar rooftop model.	Mangrove restoration programs.	Micro-hydro models
Challenges	Rising urban heat, everyday water stress, and vehicular emissions.	Climate threats such as cyclones and ecosystem degradation.	Frequent disasters like landslides and floods.
Future Targets	Chandigarh aspires to be a Model Solar City by 2030.	Tamil Nadu aims to meet 50% of its power demand through renewable energy by 2030, and targets net-zero emissions before India's 2070 deadline.	Focuses on climate resilience and carbon-neutral development. No explicit targets.

Table 5.1: SAPCC in various states/UTs

the application of shadow costs to the analysis in order to understand the implicit costs of biodiversity losses. In the case of many flagship projects, biodiversity is not just a product per se, but rather it is a constrained or restrictive resource, which consequently implies that these shadow costs can be assumed to be equal to the marginal opportunity cost of opting for production over conservation. In essence, it simply states the cost incurred implicitly in social terms when an additional unit of fixed natural resources is preferentially put to uses other than conservation.

Various flagship projects, such as "The Project Elephant" and "The Project Tiger," try to minimise these shadow costs by creating controlled environments with limited and fixed resources (especially land), to promote the growth and welfare of endangered species such as the Asiatic elephant and the Royal Bengal tiger in India. As per the official data of the Press Information Bureau of India, for the fiscal year 2025-26, the government of India has allocated approximately ₹290 crores for both Project Tiger and Project Elephant. The budget allocations will end up covering more than 90% of the non-recurring expenses, such as immunisation drives and forest infrastructure development programmes, such as building bridges and fire lines. Whereas the centre funds more than half of the recurring expenses that the project requires, such as the cost of employing patrolling staff, providing salt licks, and water facilities. The government has approved the allocation for the Centrally Sponsored Scheme of Integrated Development of Wildlife Habitats for the 15th Finance Commission cycle for an overall outlay of Rs. 2602.98 crores.

The Project Elephant was started in the year 1992 to protect the species of the Asiatic elephant, which is mainly found in India. The project was started in the milieu of conserving the species of Elephas maximus, the largest terrestrial mammal, which is the support system for many tropical wildlife species due to its heterogeneous habitat. The Project was focused on conserving the elephant species in the North-Eastern border alongside Nepal and in the Eastern parts of Bengal, to the parts of the lower Brahmaputra plains extending to Assam, Tripura, and Barak Valley.

The project has declared about 24 reserves across 12 states to protect the highly fragmented population of elephants in India. The scheme is fully sponsored by the state, which has often focused on the infrastructural developments in the protected sites by creating culverts and bridges to promote eco-tourism and to prevent illicit poaching. The scheme also includes in its broad purview the creation of ecological corridors and migration routes for elephants. Other than that, much investment has been made to set up squads that prevent elephant attacks in local communities caused by sudden depredation. Recent efforts have been made to include many non-conventional sources of energy in the forest communities to sustain local livelihoods as well. The policy framework under the project is not just limited to elephant species but is also extended to

immunisation programmes of many other large tropical mammals, such as the wild buffalo and cattle. Moreover, it has been recognised recently that necessary fund allocations are to be made to prevent the outgrowth of invasive species in elephant habitat continuity.

Another crucial wildlife conservation project was the "Project Tiger", initiated in the year 1973 by the Ministry of Environment, Climate and Forest Change to protect the endangered species of Bengal Tiger in India. The tiger population surged from about 1,400 in 2006 to about 3,682 in the year 2022 due to the efficient implementation of Project Tiger (Akaashwani India, All India Radio). More than 50 years have gone by since the project was initiated, and it has seen multiple amendments to include the digitisation of tiger reserves, signifying the collaborative efforts of the National Tiger Conservation Association, along with the Project Tiger Directorate, an autonomous operational body within NTCA overseeing the Project Tiger in India. The Project has been successfully implemented, and at present there are 28 Tiger Reserves in 17 states, covering an area of 37761 sq. km (National Tiger Conservation Authority et al.).

National conservation projects like these are often a paradigm example of how conservation in a nation-state is incomplete without legislative as well as central backing. At the international level, the United Nations stands as a pioneering governing body of the statute to oversee wildlife conservation efforts. Many international projects have been implemented at a large scale to conserve natural resources. One such initiative is the UN Great Green Wall as a flagship project of the UN Decade on Ecosystem Restoration. The project has focused on restoring the degraded soil and savannah terrains in the Sahel region of Africa. The purview of the project also includes consolidating methods of renewable energy development in the region and paving the way for sustainable development.

INTERNATIONAL INTERVENTIONS AND BEST PRACTICES

INTERNATIONAL INTERVENTIONS AND BEST PRACTICES

COMMUNITY FOREST PROGRAMME IN BHUTAN

To enhance community involvement in the management of national forests, the first community forest was initiated at Dozam, Drametse Geog, Mongar Dzongkhag, in 1993. Currently, 4% of the total government reserve forest, i.e., 108,879 hectares, has been donated to 34,169 rural households, i.e. 25% of the total rural households in the country as Community Forests (CFs) (Tshering & Yoezer, 2023). During the past decade, various projects such as the Third Forestry Development Project, the Wang Watershed Management Project, and, since 2002, the Participatory Forest Management Project had been tried by CF (Social Forestry Division, 2010). Agriculture in Bhutan is predominantly subsistence-oriented and seasonal, so timber and firewood from CF can generate income and potentially improve the livelihoods of local people. For example, in Zhasela CF, the community forest user groups (CFUGs) were involved in constructing furniture from CF timber, which was then traded to generate income for the community fund (Tshering, 2010). According to Meijboom et al. (2008), farmers of Bjoka village earned almost 70% of their annual income by selling handicrafts prepared from canes and bamboo. Similarly, CFUGs also supported the rehabilitation of degraded forests and protected wildlife and water sources, thus the environment was preserved. For example, Shambhaya CF, Dechen Kinga Choeling CF, and Ziptangzur CF have been established to conserve water sources (Dorji, 2011).

The Community Forest Programme contributed to decreasing poverty through the development of enterprises and by selling timber and non-timber forest products. For instance, from the lemon grass distillation fees, Drametse CF has earned Nu. 53,841 (about US$1,200) for the community. According to Roder et al. (2003), leaf litter was picked for cattle bedding and fertilising agricultural farms, fodder species for cattle feeding, mushrooms are collected as vegetables (Namgyel, 1996), and fuelwood for cooking and heating (Dick & Yonten, 1995). For fencing and scaffolding, and religious flag poles, timber products such as beams, planks, and poles are used (Moktan, 2010). Community funds were collected through membership fees, penalties, timber sales, and donations from community forests. These funds can be provided as loans to the user group at low interest to mitigate risks and improve their living conditions, as well as

to support their children's education. To build local governance capacity and to extend forest management responsibilities, the community forest program played a vital role (Dorji, 2011). Similarly, to conserve watersheds and to supply water downstream, various payments for environmental service schemes were established at Community Forests. Incidents of forest fires in fire-prone areas have also been reduced with the aid of CF. Communities also characterised the maintenance of fresh air, carbon sequestration, and neutralisation of soil erosion by the presence of live trees in the forest (Wangchuk, 2021). It is reported that after establishing CF, Forest conditions have been improved along with the increase in vegetation cover (Temphel et al., 2005).

COMMUNITY-BASED NATURAL RESOURCE MANAGEMENT (CBNRM) IN BOTSWANA

Community-based natural resource management (CBNRM) has been a staple of the southern African conservation landscape for the last 25–30 years (Dressler et al., 2010). The motivation for the advent of local-level conservation and development programs in the region was a growing realisation that the exclusion of rural communities in the establishment of exclusionary protected areas, along with the state control of resources, primarily wildlife, was causing hostility and resistance in the local community (Ndumeya, 2019; Nelson, 2010; Spinage, 1996).

CBM Community-Based Natural Resource Management (CBNRM) in Botswana started in the early 1990s and is aimed at combining conservation with rural development. By this system, community-based organisations (CBOs) or trusts in the form of local communities become the users of the natural resources, particularly the wildlife, and therefore have the direct benefit of controlled hunting and tourism. The first project that is frequently mentioned as the pilot one within this model is the Chobe Enclave Conservation Trust, which was established in 1993.

By the year 2012, approximately 45 community trusts comprising 123 communities and approximately 283,000 individuals were engaged in CBNRM. (Mbaiwa, 2013) Communities have government land on lease, and in some instances, they have the land on sub-lease to the safari companies or tourism operators, through joint ventures and make money to develop their communities. CBNRM has provided ecologically and socio-economically significant results: by means of hunting and photo tourism, local communities get revenue, game meat, working places, and social services. This is the case in Sankuyo village, where over 65 per cent of CBNRM revenues have been reinvested in local infrastructure such as piped water, housing and pensions to the elderly people residing there. However, outcomes are mixed. The research indicates that not every trust is equally effective, as some do not have the business skills, are improperly managed, or do not invest the revenues of the tourism industry. Household-based surveys show that there is a lot of idle labour in certain areas, but no adequate financial returns.

Nevertheless, CBNRM in Botswana continues to be a bright example of connecting conservation of wildlife with community empowerment, and the backgrounds of the possible and the traps of the devolved resource management.

INTERNATIONAL INTERVENTIONS

CONVENTION ON BIOLOGICAL DIVERSITY: NAGOYA PROTOCOL

The Convention on Biological Diversity (CBD) is a revolutionary international treaty. This treaty was introduced in the year 1993. It is designed to provide a mechanism for international cooperation in the fields of conservation, sustainable use, and benefit sharing of genetic resources. The CBD dedicates its near-universal membership to make national plans on the basis of these aims with its indigenous people, science, and equitable allocation of resources.

To render the CBD goal of benefit sharing effective, the Nagoya Protocol was accepted in 2010 and started working in 2014. It establishes a transparent legal framework as far as access to genetic resources is concerned and necessitates the distribution of benefits (monetary or non-monetary) equitably with nations or communities that present the resources. The recognition of the traditional knowledge of Indigenous peoples is of particular importance. Access to that knowledge is based on free, prior and informed consent and mutually agreed terms of access and use.

An Ecosystem Services Payment is a financial program that rewards individuals for protecting or restoring nature. The Government purchases the ecological services such as clean water, carbon sequestration, or biodiversity protection. An example is the national Pago por Servicios Ambientales (PSA) program created in Costa Rica in the late 1990s. In this program, the government pays landowners for not cutting down their forests. The program, which has been funded by a fuel tax and later topped up by water tariffs, has secured the conservation of millions of hectares and avoided millions of tons of carbon emissions.

In short, the Protocol provides countries with an economic incentive to protect biodiversity for the sake of sustainability and equitable development.

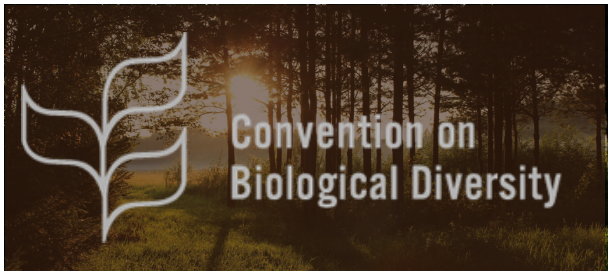

Figure 6.1: Convention on Biological Diversity

PAYMENT FOR ECOSYSTEM SERVICES

PES schemes act as an intermediary between conservation and development: PES payments level the incentives of individuals with societal environmental advantages. The challenges that critics observe include assuring additionality (payments make a difference in new conservation), effectiveness monitoring, and equitable targeting, particularly among marginalised

communities. Yet, properly designed, PES also serves as an effective instrument to finance sustainable biodiversity to provide livelihoods and to take care of the entire world ecosystem.

HUMAN-WILDLIFE CONFLICT:

The basal anomalies surrounding wildlife disruption are the positively increasing population trends, along with the capitalist tendencies of humans in their consumption patterns, which, in turn, have induced humans to privatise land and other common resources to their benefit. The unbridled encroachment of finite resources like land to convert it to productive and industrial resources has ultimately led to an array of dysfunctionalities in the environmental setup. The rapid transformations have led to 70% of the remaining forest being within 1 km of the forest's edge, impacted by the rising land fragmentation (Haddad et al., 2015). The continuous stretch of natural wildlife is no longer uninterrupted, with human-marked land transformations interspersing between the habitats. This is primarily quantified in the loss of vegetation cover, the increase in the isolation of land area, and increased human use and settlement along the fragment edges, which have initiated long-term changes to the land pattern. Human settlements should not be exposed to wildlife habitats beyond an acceptable range. However, due to rapidly expanding human settlements, the threat of exposure to wildlife has increased multifold. This unlikely contact between humans and wildlife has reduced the forest coverage, where most of the global forest cover lies within just half a mile of their boundaries.

Almost 20 per cent of forested land has just 100 meters of area unexposed to human markers such as roads, highways, and factories. Major forest cover has been turned into agricultural farmland, the direct consequence of which is habitat fragmentation in forests. Approximately 37% of grasslands are now considered highly fragmented with agricultural avenues replacing wildlife areas *(Bryce, 2024)*. These disjoint patches of wildlife are often embedded in a matrix consisting of various habitat structures. This creates intermingling amongst habitats, and the species inhabiting a specific area tend to encroach on adjacent habitats. However, this statement has seen various affirmations and refutations alike from economists. Economists like Faulkner, Hulme, and Wilson are of the view that multiple identical factors, like the size, quality, and geography of the fragmented wildlife patches, impact the ecology of landscapes and, in turn, the ability of various species to successfully disperse or fail to disperse between adjoining or closely associated habitats. Habitat biologists, including the Blaustein and Templeton laboratories, have found multiple species coexisting in habitats not particularly their own *(Templeton, 2025)*.

Multiple species have the dispersion ability defined by their genetic shaping. However, species coexisting in fragmented areas have this ability reduced to much lower levels, thus impacting functional connectivity and extinction risk. Various examples include plant species such as the Water Hyacinth,

Lantana Camara, and Prosopis juliflora. These plant species are densely found across the tropical parts of India and various other Southeast Asian countries. Multiple animals, such as the Papaya mealybug and the Sailfin catfish, are also included as invasive species in the Indian subcontinent. Species like the Lantana Camara found in nearly all of India's tropical and subtropical zones (specifically in the Shivalik hills and Himachal Pradesh) are invasive in nature to the presiding species, such as that of the Royal Bengal Tiger. The plant species creates a dense thicket, which impacts the growth patterns of plants required as a nutritional base for prey. Thus, the invasion of such alien species indirectly affects the mode of nutrition in tiger species, primarily in Central India. For such species with excellent dispersion abilities, habitat fragmentation becomes a possibility even without population fragmentation, i.e., their population can exist in multiple habitat surroundings. This is objectively a severe issue, coupled with the encroachment of land area for agricultural purposes. Cultivating the land excessively proves to be a detriment to the soil quality of the forest area. This destroys the capacity of the soil in the forest regions to be able to sustain wildlife fauna. This creates a widespread conflict of interest between forest communities, local communities, the state and private individuals. Conserving forest land would mean an added strain and losses to the private stakeholders.

Over the years, the government has been creating multiple protected areas for the wildlife and especially endangered species. This global network of protected areas covers around 13% of the Earth's surface, and the wildlife is kept safe and out of danger in these areas. However, outside of these areas, where animals are unprotected, and humans and wildlife coexist, these animals often enter into conflicts with the local people, especially in rural and tribal areas. Some of the direct and obvious losses from these conflicts are the loss of human life and wildlife, damage to crops in rural areas, etc. These damages are indeed significant, but these are not all. There are multiple indirect costs which occur due to these conflicts. The main cause of this is due to human activities like deforestation or the acquisition of forest lands, which leads to the loss of habitat for the wild animals. This can lead to devastating losses for the farmers. For eg, if a farmer has taken debt from a moneylender to be able to grow crops in a field and is relying solely on the crops to pay off the debt and support his family, it will lead to major losses for him if wild animals destroy his crops, and the real issue is that these types of people are, in fact, the most prone to these attacks. This is because, first of all, their farms are usually situated in slums or extremely rural and backward areas, making the wild animals more likely to reach these places.

Secondly, since they are already living hand-to-mouth and are financially unstable, most probably they will not be able to afford preventive measures against these attacks, such as building fences around the farm, growing buffer crops, installing digitally empowered alarm systems, and so on. The gap between the rich and poor, therefore,

also gets wider, as it is mainly the poor who suffer from these conflicts. Hence, human-wildlife conflicts can cause huge losses to farmers' incomes, which is what farmers are left with. In addition, large animals such as elephants, if they go wild, can inflict serious damage on the infrastructure, as they are capable of demolishing houses and other buildings, especially in rural areas, where buildings are relatively less strong than those in urban areas. Another impact of these conflicts, one that is often overlooked, is that these conflicts create negative perceptions of wildlife conservation among the people and leave a bad taste in their mouths. This reduces local support for wildlife conservation activities, and in extreme cases, may even lead the locals to retaliate and start killing wild animals due to fear, anxiety and paranoia. Thus, the human-wildlife conflict has major impacts on the local people and even the wildlife conservation movement as a whole. Along with this, it even impacts the government to some extent.

The government takes various steps to mitigate the effects of these conflicts and also to reduce the frequency of these conflicts. It takes various measures, like issuing SOPs (Standard Operating Procedures) to the people in case they encounter a wild animal, developing habitats for the animals so they don't wander off to human-inhabited areas, providing compensation in case of loss of life, crop damage, etc, conduct public awareness programmes to educate the public on how to mitigate these effects, building early-warning systems and many more such measures. Needless to say, these measures deal a massive blow to the government's finances. It takes a massive toll on the government's resources, i.e. time, money and manpower. The same resources that could have been used for wildlife conservation efforts are being forced to be used to mitigate the effects of human-wildlife conflicts. Thus, it is clear that human-wildlife conflicts cannot be overlooked; they need close attention and must be dealt with on a priority basis, requiring long-term systematic planning from the government.

Given the significant economic and social effects of these conflicts, compensation for damages has become essential. Various policies revolve around these compensations. The most significant ones are the Wildlife (Protection) Act, 1972, the National Wildlife Action Plan (2017–31), and the MoEFCC's 2018 guidelines. These assist in standardising response protocols, advocating for early-warning systems and uniform ex gratia compensation norms. The ex gratia payments recommended by the Centre are ₹10 lakh for human death, up to ₹2 lakh for grievous injury, medical aid up to ₹25,000 for minor injuries, and different payments for crop and livestock losses. (Ministry of Environment, Forest and Climate Change, n.d.) However, the actual compensation varies from one state to another, depending on the level of the conflict and the local budget.

Karnataka has been widely acknowledged as a model state in India for the management of compensation cases following human-wildlife conflicts. This is largely attributed to its digital

e-Parihara platform, which facilitates the ex gratia claim processing in a user-friendly and transparent manner. The portal created under the Sakala initiative enables forest officials to document the conflict incidents along with geotagged pictures and detailed damage information. This not only helps in the creation of a reliable database but also enables faster, transparent, and workflow-based processing of compensation claims for crop damage, livestock loss, injuries, and deaths caused by wildlife. This digital device, which is merged with the official claims process of the Karnataka Forest Department, has brought about better documentation and traceability compared to the conventional paper-based systems. As a result, it has become easier to make quicker decisions and disbursements, as well as to inform conflict mapping and mitigation strategy deployment. While some delays and backlogs in clearing all pending cases still exist, the e-Parihara used by Karnataka is generally considered to be a progressive step towards efficient, transparent, and accountable compensation for wildlife-related losses. Most notably, it is in the areas of elephant conflict where incidents are the most frequent that the impact of the platform is being felt the most.

Maharashtra offers a compensation of up to ₹20 lakh in case of tiger or leopard-related deaths and has crop-wise compensation slabs, while Kerala and Tamil Nadu have online claim systems with species-specific rates. States like Gujarat, Assam, Odisha, and West Bengal offer higher payouts for a recurring lion or elephant conflict. Usually, the compensation application can be done through the following steps:

1. An immediate report to the forest staff.
2. An on-site inspection and damage assessment (panchnama).
3. Submission of documents such as land records and ID proofs.
4. Approval at the Range and Division level.
5. Direct Benefit Transfer into the claimant's bank account.

However, the ease and speed of the payment vary significantly from one district to another. Besides ex-gratia support, various insurance mechanisms, such as wildlife-linked livestock insurance schemes (supported by NGOs such as WWF-India and WTI), crop-damage insurance pilots, state-level schemes in Uttarakhand and Ladakh for leopard and snow leopard habitats, etc, are also present.

Despite these measures, various challenges exist. Compensation is often delayed or under-assessed, rapid response teams are not uniformly trained across states, and farmers have difficulties with paperwork and land titles. Retaliatory killings, community resentment, and inconsistent coordination between officials act as additional factors that contribute to the inefficiency of these schemes, thus making the long-term resolution of human–wildlife conflict a complicated governance challenge.

TOURISM, ECO-TOURISM, AND LOCAL ECONOMIES

TOURISM, ECO-TOURISM, AND LOCAL ECONOMIES

WILDLIFE TOURISM AS A REVENUE MODEL

Ecotourism has often been described as the intersection of environmental conservation, economic growth, and upliftment of local communities associated with wildlife avenues. Ecotourism is defined as responsible travel to natural areas that conserves the environment, sustains the well-being of the local people, and involves interpretation and education (TIES, 2015). (What Is Ecotourism - the International Ecotourism Society, 2019). The fundamentals of ecotourism are based on conservation of nature and upliftment of local communities.

Depicting tourism as a revenue model dependent on only a single strong and obvious parameter,i.e., the tourist footfall, would simplify the overall process of identifying an influential parameter. As a matter of fact, tourism revenue depends on multiple volatile variables such as operational costs, ticket fees, and seasonal dependencies alike. The model equations used for analysing such variables include production and input demand functions along with local market-clearing conditions, which determine prices of both tradable and non-tradable commodities with exogenous prices. Moreover, a reasonable assumption is taken for the short run, keeping households and business capital endowments of land fixed, as neither land nor capital can be freely transferred between households and private individuals due to government restrictions on protected areas such as national parks. Labour is tradable within the local economies with endogenous local wages. Thus, labour supply is relatively elastic in and around protected areas. All the said assumptions help us analyse how tourist footfall is a direct factor affecting revenue models when the negatively related factors like operational costs are also considered.

Multiple research studies were done by economists Anubhab Gupta and Heng Zu in the year 2023, in and around the protected areas of Zambia, Nepal, Brazil, and Fiji, to understand these factors and how an additional tourist would impact the revenue of the parks. This was done by running a simple Monte-Carlo simulation on these parks to provide an idea of the elasticities of revenue impacted by risk factors and iterations that tourism as a revenue model faces. In order to do the same, 500 iterations of the analysis were run at each protected area by making an equivalent number of random draws of all the model parameters (such as the cost of operations, labour, input demand, etc.). Initially, the team of economists (led by

economist Anubhab Gupta) studied the impact of an additional tourist (marginal effect) on the local economy, which was analysed in order to gauge the real-income multiplier of an additional dollar of tourists' spending (Table 1.1). The analysis of the same has also helped authorities gauge the aggregate estimated real income, which is simply the per tourist impact multiplied by the total number of tourists (A. Gupta et al., 2023).

In general, the revenue model of national parks involves direct contributions in the form of visitor spending on park fees, hotels, and lodging, which create employment and support for local businesses. Indirect benefits are accrued by the generation of profits and wages for both households, and the immediate effect of the same is the increased

Impacts (in US$) per additional tourist	Terrestrial Protected Areas			Marine Protected Areas	
	Zambia		Nepal	Brazil	Fiji
	Lower Zambezi	South Luangwa	Chitwan National Pk.	Abrolhos Marine Pk.	Mamanuca Islands
(Inflation-adjusted)	1,355 [1239,1471]	1,045 [944,1146]	169 [158,180]	357 [270,444]	2,400 [2270,2522]
One Tourist Spending	744	682	95	205	1,311
To household groups:					
Poor	737	913	21	61	544
Non-poor	618	132	148	296	1,652
Island	-	-	-	-	204
Production by sector:					
Crop	121	245	2	11	82
Livestock	80	67	2	18	139
Fish	-	-	-	11	99
Retail	228	614	75	197	1231
Services	414	288	42	130	701
Hotel	395	386	14	45	153

Figure 7.1: Impact of a Marginal Tourist in Protected Areas, Gupta et al., 2023, PMC, NCBI
Source: https://pmc.ncbi.nlm.nih.gov/articles/PMC10096494/)

About US$3 million per annum accrued to people involved in tourism activities. The balance amount of about US$2 million per annum was spent on non-local goods (food, handicrafts, restaurants) and services (public transport, national and international travel), which flowed as leakage to supplies and emand for households and businesses. Multiple consecutive rounds of increased household incomes and demand contributed heavily to local real income multipliers, defined as changes in total household real (inflation-adjusted) income per unit of income injected into the local economy by tourists.

Research reviews done by the World Bank in protected areas of India, Brazil, Namibia, and Nepal showcased that an additional dollar of tourist spending leads to a 1.5 times higher creation of real income at terrestrial

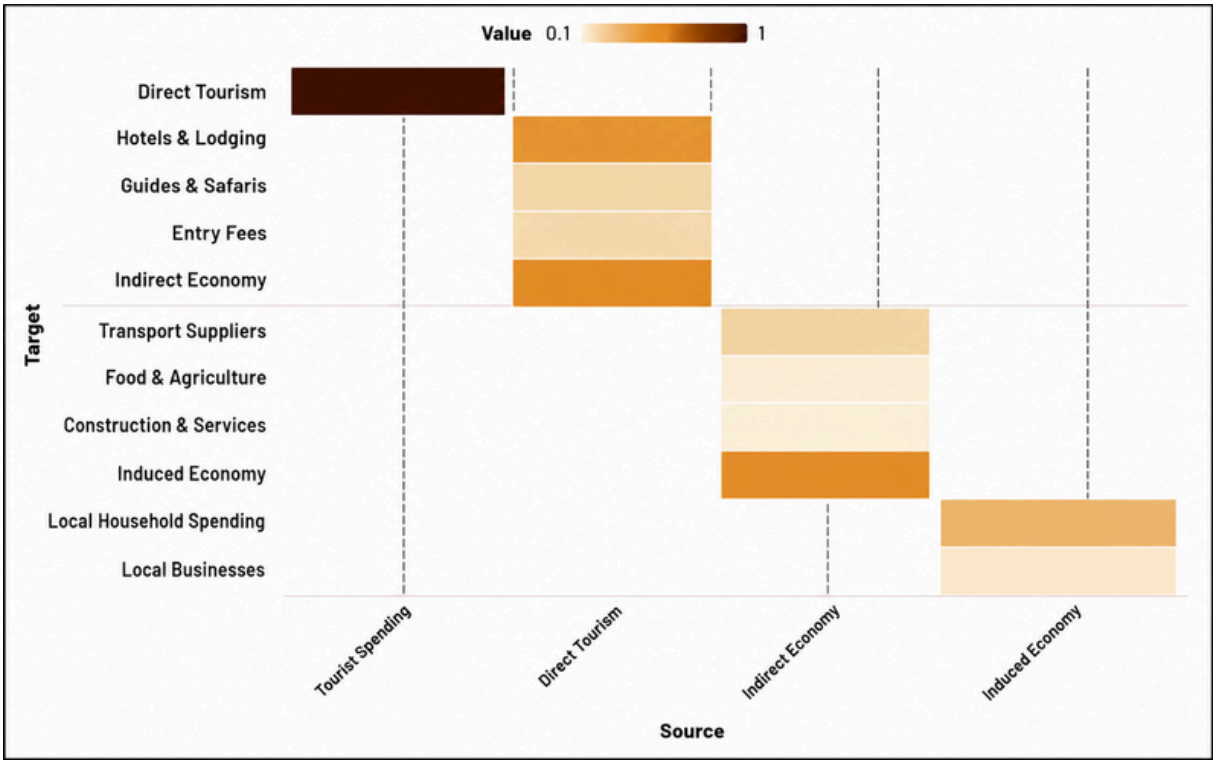

Figure 7.1: Multiplier Efficiency Indicating Revenue and Expenditure Targets and Sources

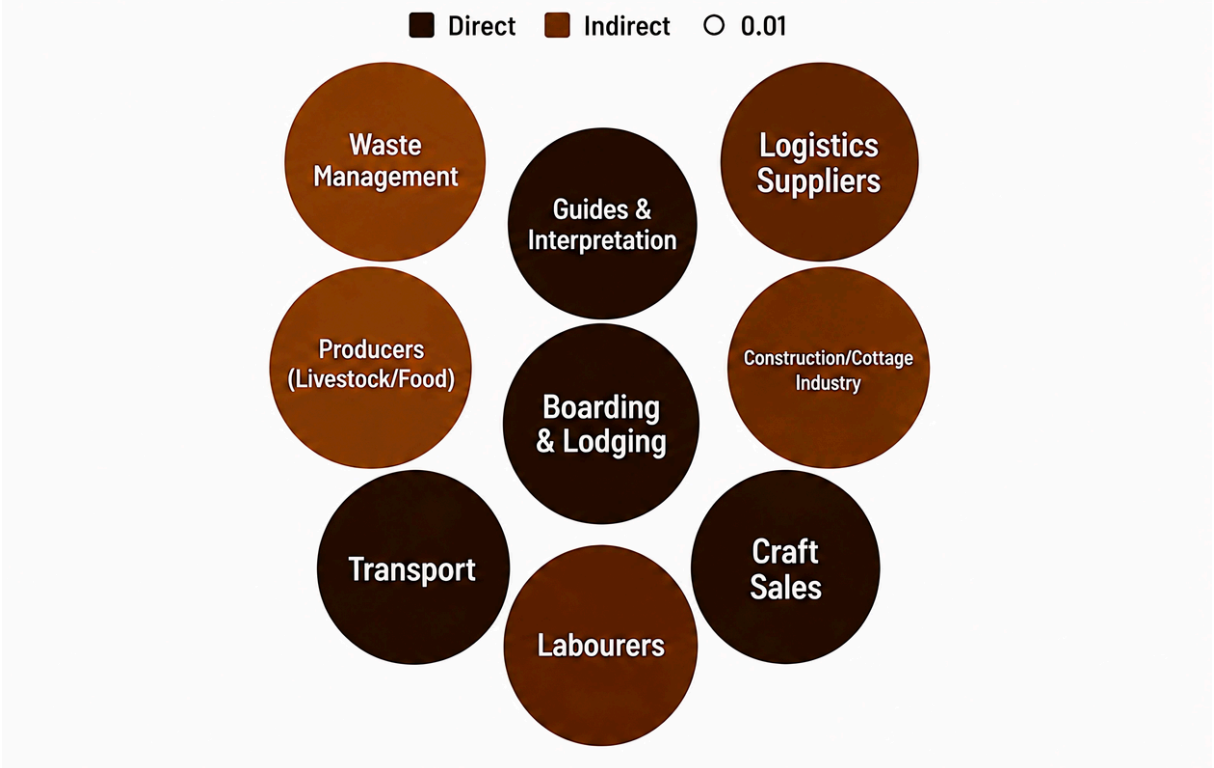

Figure 7.2: Direct and Indirect Revenue Streams

sites and a 1.74-1.83 times addition in real income at marine sites (Gupta et al., 2023).

The private sector revenue derived directly and indirectly from wildlife tourism and allied activities is primarily categorised into safari lodging, entry fees revenue, and partially shared incomes through concessionaires and licensing fees. Licensing permits for protected areas are widely traded and can prove to be a major source of revenue for private owners. Whereas, government revenue is mainly extracted through taxes on leisure, hospitality, penalties, and licensing fees.

STAKEHOLDERS	REVENUE ALLOCATION
Government (administration)	85-95% of gate fees
Community development projects	5-10% of gate fees
Private operators (direct earnings)	Tourist guides, hospitality
Local employment (indirect benefit)	Wages from private and public sector jobs

Table 7.1: Revenue Allocation, PMC, NCBI
Source: https://pmc.ncbi.nlm.nih.gov/articles/PMC10096494/

Multiple primary reconnaissance surveys have been conducted to analyse the population of service providers, including construction workers, those involved in lodging and boarding, and transportation. Those with direct contact with tourists have direct links to income and expenditure with tourism-related activities, such as transportation and craftwork. Another group of service providers is those with indirect contact with tourists, such as construction workers, farmers and cottage suppliers. Interpreters and hoteliers receive the highest per capita income from tourism, and artisans and farmers earn the least from tourism. A good representative of the result is one of the surveys taken at Kaziranga National Park, wherein similar data outcomes were recorded, US$1,233 per annum. Even though interpreters form the smallest proportion of the population, they have the highest income-to-population ratio. The lowest median income-population ratios recorded were 0.4 for artisans and farmers, primarily due to their larger population and unequal distribution of tourism revenue (Department of Natural Resource Sciences).

DIRECT	INDIRECT
Boarding and Lodging	Producers (livestock owners)
Transport	Logistic suppliers Labourers
Interpretation	Waste management (recyclers)
Craftwork (sale to tourists)	Cottage industry (for construction)

Table 7.2: Division of Income into Direct and Indirect Avenues, Department of Natural Resource Sciences
Source: https://pmc.ncbi.nlm.nih.gov/articles/PMC10096494/

GLOBAL COMPARISON

The United States is a remarkable contributor to tourism, with $2.36 trillion in revenue in 2024 (Lu & Neufeld, 2025). This is mostly because of the nation's first-rate tourism infrastructure and consistent demand from abroad. The world's largest destination region is Europe. Approximately 747 million foreign visitors visited the continent in 2024, more than half of all international travel (Adams & Hayes, 2025). In addition, a number of Asian travel destinations have grown in popularity in recent years, including Malaysia, the Philippines, and the Hong Kong Special Administrative Region. India has really performed remarkably well in this field, primarily because of the expansion of domestic travel and government initiatives like Dekho Apna Desh and Swadesh Darshan.

RANK	COUNTRY	ECONOMIC CONTRIBUTION (USD BILLION)
1	United States	2360
2	China	1300
3	Germany	487.6
4	Japan	297
5	United Kingdom	295.2
6	France	264.7
7	Mexico	261.6
8	India	231.6
9	Italy	231.3
10	Spain	227.9

Table 7.3: Economic Contributions of countries
Source: (WTTC Economic Impact Research (EIR) 2024)

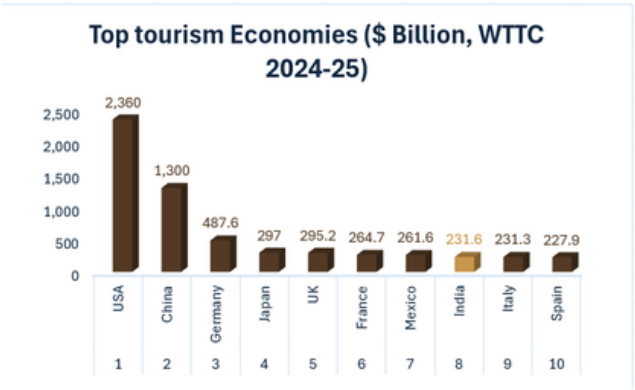

Figure 7.3: Top Tourism Economies

FEATURES OF WILDLIFE TOURIST DESTINATIONS

Wildlife tourist destinations are built around diverse natural resources. Thus, wildlife tourism is distinct from other forms of tourism that mostly rely on cultural or scenic attractions. Human support is vital to wildlife tourism. Trained guides, trackers, etc., who can help with the interpretation and ensure the safety of the tourists. Similarly, the local and indigenous communities' involvement is just as vital, as they usually participate through resource protection, conservation cooperatives, and homestays. Thus, supporting the livelihood capacity and increasing it manifold for a community.

These destinations are commonly found inside protected areas made up of national parks, wildlife sanctuaries and biosphere reserves. Wildlife tourist destinations are under the governance of very strict regulations and safety measures because of the erratic nature of wildlife. Thus, they have regulated access and clearly defined conservation measures.

Rules typically include prohibitions on feeding wildlife, bans on flash photography and vehicle distance requirements.

ASPECT OF SEASONALITY IN TOURISM

Seasonality in tourism is characterised by regular and rather predictable changes over time of tourism-related aggregates (arrivals and overnight stays in accommodation establishments, hotels' occupancy rates, traffic on highways and airports, lodging and transportation prices, etc.), which recur every year (Cantis & Ferrante, n.d). There are two major types of seasonality: natural and institutional. Natural seasonality results from environmental factors like sunlight, temperature, rain, or snow. The natural factors usually determine the kinds of tourism activities that can be carried out in certain periods. For instance, the beach requires warm weather, and skiing needs cold temperatures and snow. On the other hand, institutional seasonality is dominated by people's behaviours and social habits. Among such factors are school holidays, cultural and religious festivals, and even major sports competitions. The results of seasonality can be experienced in generating regions (where tourists live) or in destination regions (the areas they visit). Knowledge of seasonality helps tourism planners and businesses in controlling demand and lessening the burden of peak periods.

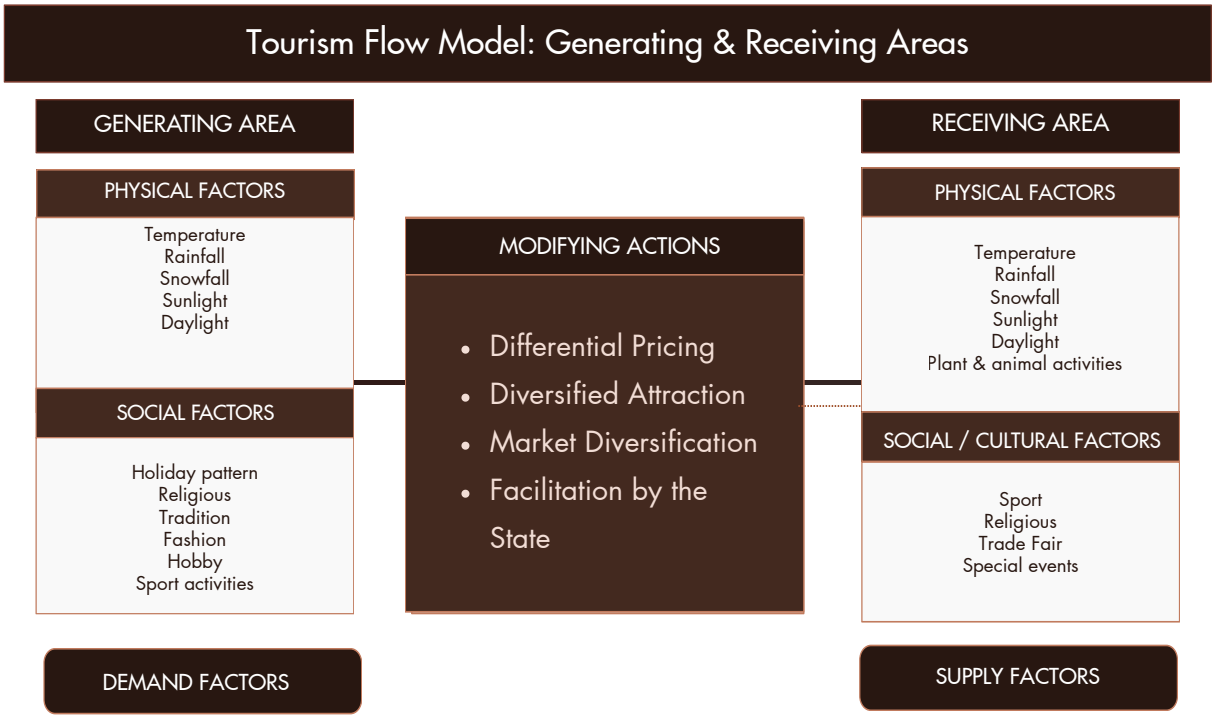

Figure 7.4: Factors of Seasonality in Tourism
Source: Lee et al., 2008.)
https://coastaltourismacademy.co.uk/uploads/CRC_Queensland_2008_Seasonality_in_the_tourism_industry_%282%29.pdf)

POST-COVID TOURISM RECOVERY

As countries removed quarantine rules and entry controls, people were able to travel again. Due to the previously unmet tourism demand, tourism grew rapidly once restrictions were lifted. Favourable government policies, such as domestic tourism incentives and international policies, also contributed to growth. Travellers, after the pandemic, seek to have eco-friendly and authentic experiences. This has led to a rise in wellness travel and ecotourism.

USE OF DIGITAL MARKETING AND DIGITAL TOURISM

Digital marketing and digital tourism became leading forces that helped the tourism industry recover post-COVID-19 crisis. Indonesia is a remarkable example of the same. It utilised online campaigns, engaging content on social media platforms, and virtual travel planning tools to ensure demand. Good digital communication was also used to eliminate the anxiety of visitors regarding health and safety.

Digital tourism mainly focuses on the use of digital solutions, which allow the continuation of the trip even when the traveller is not physically present or on-site, and acts as a substitute or a complement to traditional on-site activities. For example, virtual wildlife tours and immersive audio-visual experiences allow "travel" for people who are constrained by factors such as cost. These innovations lead to additional tourism income by inviting remote participants.

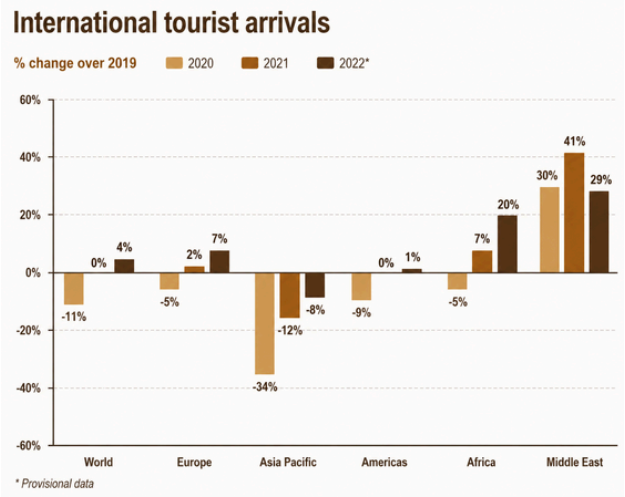

Figure 7.5: International tourism arrivals (Source: https://www.untourism.int/un-tourism-world-tourism-barometer-data; UN Tourism World Tourism Barometer | Global Tourism Statistics, n.d.)

ECOTOURISM MODELS

Ecotourism is responsible travel to natural areas that conserves the environment and improves the well-being of local people. The various ecotourism models are as follows:

1. Community-Conservancy Model:
The community-conservancy model refers to a model where different communities jointly lease or manage a piece of land for wildlife conservation. The money made from tourism is given to the local people to keep them motivated economically to conserve wildlife. This practice mitigates human-wildlife

conflict, as it provides compensation and improves livestock protection. Some of the best practices in this model are restricting the volume of visitors, use of lease agreements, and active community involvement. This model has led to the extension of protected habitats outside national parks, less poaching, better habitat connectivity, and socio-economic development.

2. High-Value, Low-Impact Tourism Model :
The purpose of this model is to attract a smaller number of high-paying tourists and to reduce the burden on the environment. Bhutan and Iceland have effectively adopted this model. This model is adopted through a visitor fee, the use of eco-lodges that run on renewable energy, enforcement of strict regulations regarding infrastructure and visitor conduct, and the implementation of sustainability certification programs. This has led to the use of clean energy.

3. Conservation Revenue Reinvestment:
This is a model where revenues from tourism are invested in conservation programs such as biodiversity monitoring, habitat restoration, and community projects. This model has been adopted in Costa Rica. The best practices adopted under this model are transparent allocation of tourism revenues to conservation funds and partnerships between government, NGOs, and communities. This results in more resources being allocated for protected area management.

BENEFITS OF ECOTOURISM ON ENVIRONMENTAL CONSERVATION

Ecotourism generates money through entrance fees, guided tours, and donations. In addition to that, ecotourism can make the area less attractive for poachers by providing alternative livelihoods and increasing risk due to greater tourist presence. It also educates both the visitors and the locals about problems in the field of conservation. It also leads to sustainable community development and reduces habitat loss.

CONNECTION OF ECOTOURISM AND SUSTAINABLE DEVELOPMENT GOALS (SDGS)

Ecotourism is a sustainable form of nature-oriented travel that emphasises intimate interaction with, and knowledge of, the natural world, including its ecosystems, flora, fauna, and landscapes, as well as the region's special cultural relics (Chaudhary et al., 2022; Elkaichi et al., 2023; Mendes et al., 2019; Sobhani et al., 2023).

It is increasingly identified with principles of sustainability due to its potential to generate income without harming the environment. Additionally, ecotourism represents an essential type of sustainable tourism as it encourages environmentally responsible practices in conserved natural regions by informing both visitors and residents, thereby enhancing their quality of life and wellbeing while also supporting the local economy (Çetinkaya et al., 2018; Gigović et al., 2016). Ecotourism is intricately linked to fulfilling the Sustainable Development Goals (SDGs) by 2030. It corresponds with the subsequent objectives:

SDG 13: Action on Climate:

Although tourism is one of the primary contributors to greenhouse gas emissions in the atmosphere, ecotourism can help alleviate climate change. The tourism industry is addressing climate change by implementing adaptation and mitigation strategies. Adjustment involves preparing for unavoidable situations and figuring out how to handle them. Mitigation seeks to reduce the impact of the tourism industry on environmental harm, as the emission of greenhouse gases into the atmosphere can be lowered by starting policy discussions, making personal commitments (like the Glasgow Declaration), and enhancing understanding of sustainable methods.

SDG 14: Life Below Water:

Through biodiversity preservation on the site and safe and secure rural and maritime systems, waste management, conservation regulations and guidelines, restoration, and tourist development as a sustainable product, all assist in lessening the detrimental effects of tourism on the environment.

SDG 15: Life on Land:

The reliance of tourism on the natural heritage, including landscapes and biodiversity, is crucial. The conservation of the natural heritage can be achieved by managing the visitors, ensuring sustainable tourism practices by the visitors, and initiating measures to curb the degradation of biodiversity with an eye on the provisions made by the International Union for Conservation of Nature (IUCN) by their RedList of Endangered and Threatened Species, provision of financial assistance to conservation organisations, provision of sustainability certification of tour operators, management of sustainable protected areas, creation of policies and strategies aimed at conserving wildlife, encouraging conservation and promoting conservation, creation and promotion of sustainable uses of the land.

SDG 7: Clean and Affordable Energy:

The sector makes a major contribution towards the demand for green energy and energy efficiency in the course of its operation, introducing renewable energy into the local communities, and promoting the use of clean energy transportation or cooking. Tourism can further limit greenhouse gas (GHG) emissions, fight climate change, and be part of universal access to energy by promoting investments in clean energy and innovative solutions.

SDG 12: Responsible Consumption and Production:

Businesses concerned with sustainability are at the forefront in matters of quality and long-term capacity to practice tourism. This may be by way of signing global initiatives like the One Planet Sustainable Tourism Programme and Global Tourism Plastics Initiatives signatories, or inner sustainability schemes, surveillance frameworks, i.e. sustainability certificates like the Ecorating Certification, sustainable waste management, i.e. food waste and by acquiring products and services from socio-environmentally sound businesses. They will be able to undertake

capacity building, awarness creation, incentive programs such as awarding and involving the local community in such a way that they can be responsible for the consumption of tourism products and services.

SDG 2: Zero Hunger :

Hotels, restaurants, and resorts serve farm-to-table cuisine because sustainable tourism promotes the use of local food and agricultural products. By providing agrotourism products and services, such as local cuisine, and enabling small-holder farmers, the tourist sector can boost sustainable agricultural output by improving food producers' market access. Food security is enhanced, and dependency on foreign items is reduced.

SDG 3: Good Health and Well-being. :

Cultural travel and eco-friendly retreats are examples of wellness tourism that promote both physical and mental well-being. The rules or procedures of cleanliness and hygiene standards at tourist locations and facilities promote the health of staff, visitors, and local communities. Some companies engage in health-related CSR initiatives to ensure that the local populations have higher health standards. Additionally, sustainable tourist practices reduce pollution and the health concerns associated with noise, water, and air.

SDG 4: Quality Education:

Education can also be promoted through tourism indirectly by providing community-based projects, scholarships and training. Sustainable accommodations and responsible tour operators tend to invest in education for the locals and inform them about environmental care and hospitality, and empower them to control resources sustainably. Moreover, cultural tourism is also useful in preserving the indigenous knowledge and cross-cultural learning, and respect for diversity and heritage. In addition to this, tourism businesses and organisations have a great impact in training guests and local communities about their contribution towards the SDGs through training programs, awards, sponsoring schools to educate local children and through association.

SDG 5: Gender Equality:

Tourism, being one of the industries with the largest ratio of women working and owning businesses, can be an avenue through which women utilise their potential, enabling them to be fully involved and to be leaders. Sustainable tourism programs are usually concerned with women's empowerment in terms of training, leadership, and economic sustainability. Through encouraging women to participate in decision-making in the tourism business or community-based tourism planning, fostering equal opportunities for success as entrepreneurs, and providing training and career advancement for both women and men, equal opportunities are facilitated.

SDG 9: Industry, Innovation, and Infrastructure:

Sustainable tourism enables innovation through supporting technological innovations,

digital devices, and the implementation and integration of environmentally friendly infrastructure and procurement, including renewable energy sources, waste management, and green building designs and materials. The tourism industry may serve as a pilot for new practices that can be expanded to other industries to enhance green infrastructure, such as transport and construction. It may as well impact and promote financing, training, and development of business/industry.

SDG 10: Reduced Inequalities:
Sustainable tourism promotes economic development of the locals, introduces awareness and connectedness and avenue for the marginalised people so that they can have a voice in the leadership and management roles and spaces of making influential decisions. Tourism will be able to decrease the disparities among regions, income, and social groups by enhancing inclusivity. Responsible travel involves the involvement of Indigenous people and minority groups so that their voices are represented, and their cultures are not neglected and violated.

CHALLENGES

Despite all the benefits, eco-tourism comes with its own set of challenges. Although there are many tourist places, only a few manage to gain most of the public attention, leading to overcrowding in these areas. Overcrowding not only causes disturbance for the locals of the area, but also puts stress on the place/area's natural resources. This is because when the number of people in a particular place at a particular time increases, they require more resources like water, electricity, etc. In addition, not all of these people are aware of the importance of environmental conservation, or some might not comprehend it; thus, they would tend to engage in activities which may harm the environment or wildlife knowingly or unknowingly. Over-tourism also disturbs the wildlife to a certain extent. Scientists have noted changes in the behavioural patterns of local wildlife that appear to be linked to human activity. In many protected areas, the feeding and breeding behaviour of wild animals, such as birds, has been affected by tourists.

Another challenge faced in eco-tourism is the problem of excessive commercialisation. As we know, people respond to incentives. Thus, unless influenced to do otherwise, they would tend to engage in activities which would maximise their profits/leisure regardless of whether it harms the environment or wildlife or not. Thus, sometimes producers, for eg, tour guides or travel agents, may indulge in activities which may harm the wildlife or even put the tourists' lives at risk to gain extra profit. For eg, if a tourist wants to pet a tiger that is not trained for the same and offers a hefty amount, the tour guide may be tempted to let them do so, but this puts a major risk on the life of the tourist. Thus, individuals and firms usually do not consider the externalities or external effects of their actions while making decisions, at least not until they are influenced directly or indirectly to do so. Eco-

tourism is an extremely seasonal occupation. It may be jam-packed with tourists in the peak season, and some places may go days without a single visitor in the off-season.

This creates the problem of seasonal unemployment. People who rely solely on the tourism industry are thus forced to be practically unemployed during the off-season due to the number of tourists plummeting. This also impacts other businesses indirectly. For eg, the hospitality industry usually takes a major hit. When people visit a place for eco-tourism purposes, they usually stay in hotels, boosting the hospitality industry. But in the off-season, as the number of tourists plummets, so does the revenue and sales of the hospitality industry.

As mentioned earlier, in some cases, the tourists' lives can be in danger in eco-tourism. This can be due to, other than the example mentioned earlier, mismanagement and a lapse in training of the employees or the animals, which can lead to dangerous consequences, not only for the tourist and their families, but for the park as well, as they would lose a major chunk of their tourists and visitors, if such a case arises. As mentioned earlier, eco-tourism, especially excessive tourism, can cause a lot of disturbance to the local people living in the area, due to the excessive crowds, etc.

POACHING AND ILLEGAL WILDLIFE TRADE

POACHING AND ILLEGAL WILDLIFE TRADE

SCALE OF INCIDENTS

Wildlife trafficking has long been considered a global threat, mainly because of the dangers it poses to fragile ecosystems and vulnerable native species alongside the dependent local communities and economies. Illicit wildlife trade is considered the fourth most lucrative economic prospect, and has been estimated to be roughly $7- $23 billion in revenue earnings per annum. (*Community Impact of Wildlife Trafficking*)This multi-billion dollar trade is highly penetrated by organised crime networking, focusing on exploiting already vulnerable species in order to cater to the global market demand for exotic species and their use as traditional medicines or luxury goods as trophies. According to the latest data collected by the United Nations on widely trafficked species in the illicit global trade scene from 2015 to 2021 across 162 countries and territories, approximately 4,000 plant and animal species (as per *the UN Crime Agency)* are directly affected by illegal wildlife trade (*'Untold Harm to Nature' From Wildlife Trafficking, Warns UN Crime Agency, 2025)*. Out of these, more than 3,200 species are listed under *Annexure 1* of the CITES Agreement and are thus strictly prohibited from being traded, but still continue to be demanded in wide capacity (CITES Secretariat). Over this time frame, authorities confiscated more than 13 million items, including skin, bones, leather, and ivory commodities.

Wildlife tracking is hugely dependent on international organised crime networks exploiting sophisticated logistics and transnational routing loopholes. The levels of such activity include poachers, brokers, and various other intermediaries that help merge international networks of smuggling. Out of the various plants and animal species that are illicitly traded, African Elephants have been the worst affected, with approximately 90% of their species being decimated in the last century. Reportedly, around 10,000-15,000 elephants are hunted for their tusks in order to extract ivory for trade. Poaching of forest elephants in central Africa has led to populations in the region suffering a 60% decline in 10 years from 2002 to 2012. Elephant populations have a much higher estimated death rate than their birth rate, implying a steady population decline. The Indian counterparts of the African elephants, the Elephas maximus indicus, are also considered to be one of the most poached species of mammals globally due to the demand for ivory and its export to countries like Japan, Singapore, China, and Thailand,

under the disguise of "religious items". There are fewer than 1000 male Indian elephants with tusks in a total population of 25,000 elephants in total. Moreover, the risk gets aggravated due to the increased rate of poaching, to an average of 100 elephants a year (Whitley Fund for Nature, 2022). The ivory trade has been quite prevalent in the international markets for the last century. Earlier, ivory was used as an input to create piano keys and other decorative items due to the stark white shade it presents, due to the presence of dentine and calcium as its chemical foundation.

Many other tusked species of animals have been hunted primarily for ivory extraction. The African rhinoceros faces extreme pressure from poaching due to high demand for their horns for the purpose of traditional medicine formulation. Pangolins are widely hunted for their scales to be used in traditional medicines, especially in Eastern Asian regions. Over six subspecies of pangolins are now under the IUCN's red list for critically endangered animal species, and continue to be the most endangered species of mammals globally due to hunting and poaching.

Many animal species are traded for decorative purposes or for the purpose of being kept as domesticated pets. One of the many endangered animals in India is the Indian star tortoise (Geochelone elegans). These tortoises are found in the dry and arid regions of the Northwestern Indian states, such as Gujarat and Punjab, along with regions of Southern India, including Tamil Nadu and Kerala.

Various other critically endangered species of turtles, as well as tortoises, are also poached heavily. One such species is the Ganges softshell turtle, traded primarily for exotic meat consumption in Eastern Asian countries.

As many of these species are marked as 'endangered' by the government, and hunting or trading them is strictly prohibited with penalties being charged from offenders, illegal wildlife trading is still prominent. Illegal wildlife trading includes illegal trading of living animals and plants, animal parts, or plant products without proper permits, thus violating environmental conservation laws. Some reasons for illegal wildlife trading are:

- Demand for luxury goods: Goods such as tiger skin, rhinoceros horns, etc, are seen as 'status symbols' in some cultures, which increases their demand in the global and local marketplaces. This leads to them becoming endangered, and their trading is illegal, but due to the high demand and prices, hunters are incentivised to trade them despite the fact that it is illegal to do so.
- Use in traditional medicine: Some medicinal parts and products are crucial in traditional medicine. These are integral to systems like Ayurveda, utilising hundreds of herbs such as Ashwagandha, Turmeric, Neem, and Tulsi.
- Rare pets: Some people, especially wealthy and adventurous individuals, are keen on having rare and exotic pets, like tigers, leopards, ocelots, sloths, llamas, etc.

- High profit margins: Illegal wildlife trading is usually a very high-profit business model. This is because, due to their trading being banned, their supply in the marketplace falls, and both demand and price increase.
- Inadequate control systems: Some places might not have the required control systems in place, making it easy for perpetrators to engage in such activities.
- Lack of awareness: Due to the lack of awareness and education, some people might not even be aware of the depth of the consequences of their actions on the environment.

Anti-poaching and control systems need to be set up in order to avoid such activities. However, such systems and measures cost the government huge amounts of funds. Some of these costs are:

- Ranger teams and training - Training, equipping, and paying a ranger their salaries is one of the primary costs of anti-poaching measures. Despite this fact, they are an integral part of these measures, as they keep watch over the entire park and are entrusted with the responsibility of charging any perpetrators or lawbreakers.
- Surveillance technologies like drones or satellite communication also constitute a major chunk of the anti-poaching measures' costs. However, they are also an integral part of the effectiveness of these measures.
- There are also other costs involved, like the costs of vehicles and their maintenance, feeding of animals, and other such costs.

These costs, when added up, lead to a major chunk of the expenditure of the government. This sometimes raises concerns about whether this expenditure is even worth it or not. To highlight the reason why anti-poaching measures are necessary, the following are the impacts of illegal wildlife trade:

- Species decline - Illegal trading and poaching perpetrators often target endangered species, as they are usually the ones with the highest demand and fetch the highest prices, bringing them closer to extinction.
- Ecosystem disruption - The extinction of key animal and plant species in the ecosystem might disrupt the regular functioning of our entire ecosystem.
- Impact on the tourism industry - Loss of wildlife can lead to major losses for the tourism industry, as it might reduce the number of attractions people visit, thus reducing GDP growth and negatively impacting the locals who rely on it.
- Organised crime - Illegal wildlife trading is sometimes linked to more extreme forms of organised crime, like terrorist activities, etc, which have much more serious implications on the economy and the people.
- Spread of diseases - Illegal and unregulated trade of wildlife can lead to the spread of zoonotic diseases (diseases that are spread from animals to humans)

Thus, it can be concluded that even though these costs may be high for the government and expensive to bear, they are necessary costs that need to be borne, as reducing these costs and removing anti-poaching measures will have much more serious implications for the economy, wildlife and also humans. The African elephant is severely threatened by ivory poaching. All attempts to cut the trade to sustainable levels have been futile and hampered by a paucity of information on the trade. But the problems facing the elephant have no simple solution.

The Ivory Trade Review Group (ITRG) was formed in mid-1988 as a result of an initiative taken by Wildlife Conservation International (WCI). According to the preliminary findings and recommendations of the ITRG, the number of African elephants declined by at least 50% between 1979 and 1987. In 1979, there were estimated to be at least 1.3 million elephants in Africa; however, by 1987, the figure had dropped to 750,000. The number had reduced to 625,000 by 1989.

The pursuit of bull elephants for their ivory had been so intense in some areas that they comprised fewer than 5% of the adult elephant population in 1989. There was evidence that in places where bulls were scarce, a female was likely to come to oestrous without being detected by a male. Such missed mating opportunities depressed the reproductive rate of the population. With most of the bulls gone, the hunting pressure turned on the females and immatures, which were producing most of the tusks coming out of Africa. As the females were killed, their calves were left to die after them: deaths of orphans accounted for up to one in three of all elephant fatalities. Gradually, the laws became stricter, and ivory poaching reduced drastically as time passed by. Let us understand this with the example of Ghana.

IVORY POACHING IN GHANA

Ghanaians have a long history of ivory, both for export and for carving. From the 1970s to the early 1990s, however, most of Ghana's elephants were killed either by local farmers in retribution for human-elephant conflict or by poachers for the ivory trade. Ghanaian ivory craftsmen used the tusks primarily to make jewellery and figurines over this time. These curios were mostly sold in Accra, the capital, but due to a lack of market surveys, very little data is available.

In a survey on the retail outlets selling ivory in Accra, Ghana, conducted by Esmon Martin in 2010, out of the 186 souvenir shops and stalls visited, only five had actual ivory items. These five shops had a total of 85 ivory items. He also visited an art gallery which had only 10 ivory items on display. Ghana's legislation regarding elephants and the trade in their products dates back to 1901, when a minimum weight per tusk for domestic sale and export was introduced. The 1923 Wild Animals Preservation Ordinance increased the minimum weight to 25 pounds (11 kg) per tusk in order to reduce the killing of immature cows and calves. The 1961 Wild Animals.

The Preservation Act prohibited the killing of young elephants and all females with young; this Act also permitted the government to confiscate all elephant tusks weighing less than 25 pounds. By 1971, under the Wildlife Conservation Regulations, all hunting, capturing and destroying of elephants was prohibited, and a 'game trophy export permit' was required to export tusks. In 1983, the Wildlife Conservation (Amendment) Regulations made it an offence to acquire or have any ivory unless authorised in writing by the Chief Game and Wildlife Officer. In 1988, under the Wildlife Conservation (Amendment) Regulations, persons owning ivory would have to pay a fee of Ghanaian cedis (GHS)100 for jewellery, GHS 400 for worked ivory and GHS 400 for each piece of raw ivory. An export fee of 59% of the value of the ivory was also introduced that year (Republic of Ghana 2002; Kwarteng 2008).

Elephant poaching declined at the start of the 21st century thanks to improved law enforcement. In 2004, a new system was introduced that involves performance and adaptive management through the monitoring of patrol effort and observations by the field staff in the Wildlife Division. The combined effect of performance and adaptive management was that the number of effective days spent in the field by an average Wildlife Guard doubled, which dramatically lowered the number of elephants killed illegally. In addition, governance improved, and Ghanaians developed a great respect for the law, and as a result, there was less corruption, which in turn reduced elephant poaching and the sale of ivory objects. While improving anti-poaching exercises is more difficult in some African range States, the Ghanaian example of shop raids is easier to implement and has also worked in countries such as Cameroon and Ethiopia. Illegal poaching is a threat to global biodiversity and may lead to the extinction of certain species. As a result, various policies and technologies have been developed to deal with this issue.

ANTI-POACHING POLICIES AND TECHNOLOGY

The primary method of combating poaching is armed anti-poaching squads. These refer to a group of frontline wildlife protectors who are specially trained to intervene and eliminate any illegal hunting, capture, or killing of wildlife within protected areas like national parks and reserves. These squads are made up of trained rangers or wardens who patrol habitats that face the risk of poaching and are armed with various equipment such as firearms, communication devices, and vehicles. They assist in preventing, identifying, and arresting poachers. They do so by monitoring areas assigned to them, stopping illegal conduct, and collecting evidence for the court. This increases the risk faced by poachers and reduces poaching. These groups get paramilitary training to fight poachers, who have become sophisticated and well-armed. In addition, these units coordinate with locals to gather information and carry out activities that will lessen the occurrence of poaching. India has made a significant investment of more than ₹27 crores in anti-poaching

squads, in order to enhance patrolling in parks like Ranthambore and Kaziranga.

Technology has a major impact on the protection of wildlife and has been a great tool in lessening the burden of anti-poaching squads. Various innovative solutions in the field of surveillance, such as AI-powered real-time analytics and blockchain-secured evidence chains, have been developed. The use of Internet of Things (IoT) in biologging (attaching onto an animal an electronic device that will record in its memory physical and/or geochemical parameters as a function of time) on animals aids in real-time monitoring of their health and location. These sensors enable precise location tracking and data transmission in remote areas, supporting conservation efforts.

The use of Artificial Intelligence can be promising because it makes data handling more efficient to locate illegal human activities. One of the leading tools, PAWS (Protection Assistant for Wildlife Security), uses machine learning to identify high-risk poaching areas by analysing past poaching records and animal movement data. Increasing patrolling efforts in such areas improves efficiency.

Autonomous drones with thermal cameras patrol large areas at night, and are now able to patrol large areas, going to places where rangers cannot easily access by foot or vehicle. Blockchain technology ensures that the records of poaching incidents are safe and tamper-proof. Along with energy-harvesting mechanisms, these technologies can be continuously and freely operated in the most remote nature reserves and still provide a kind of protection that is available 24 hours a day.

Another method of stopping poaching is legal restrictions. These measures aim to prevent wildlife crime by creating fear of punishment. Under the Indian Wildlife Protection Act (WPA), Section 51 requires courts to impose jail terms of three to seven years and a fine of at least ₹25,000 for wildlife offences. The law also allows authorities to seize hunting tools and vehicles and cancel arms licenses. Repeat offenders are given a more severe punishment and are not allowed to apply for probation. Such sanctions demonstrate that illegal hunting is dealt with as a serious offence. Several states have enacted stricter laws that aid conservation efforts.

Since illegal wildlife trade is a global issue, international cooperation is essential. The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) supports this purpose. It does so by controlling cross-border wildlife trade by listing species under three different protection categories. These specify the protection level and trade restrictions of species to prevent overexploitation. A rigorous permitting system is at the core of enforcement to ensure sustainability. TRAFFIC (Trade Records Analysis of Flora and Fauna in Commerce), a wildlife trade monitoring network that works with CITES, offers comprehensive data concerning the illegal trade flows, engages in policy analysis, and

supports the agencies responsible for enforcement all over the world. Such a partnership generates harmonised standards, makes it easier to track wildlife products along trade routes, and fights wildlife trafficking through the coordination of law enforcement actions. In this way, CITES and TRAFFIC are significant components of the global anti-poaching system that not only tackle supply-side issues but also make supply chains more transparent.

INSTITUTIONAL AND FINANCIAL CHALLENGES

INSTITUTIONAL AND FINANCIAL CHALLENGES

The Indian wildlife conservation network is going through a turbulent phase marked by disparities, flaws in institutional laws, lack of money, understaffing, and division of authority and decision-making, especially in areas such as poaching and law enforcement in patrolling units.

CATEGORY	MAJOR ISSUES IDENTIFIED
Institutional Issues	Fragmented authority, inefficient law enforcement, lower conviction rates, weak inter-agency coordination, staffing shortages, lack of monetary incentives
Financial Issues	Low budgetary allocation, delays in fund distribution, inadequate recruitment, and a lack of training infrastructure

INSTITUTIONAL GAPS

Erroneous legislative implementation is the root cause of multiple administrative failures in wildlife conservation. This failure has been attributed to the fact that institutionalised incentives for conservation fall short of the profits earned due to collusion between stakeholders and poachers to promote illicit trade.

Low Conviction Rates and Inefficient Law Enforcement

One of the major consequences of this mismanagement is the piling up of habitat management activities due to long delays and duplication of efforts.
As per the study of trial court judgments conducted by WPSI (Wildlife Protection Society of India), the State of Maharashtra reports the success rate of wildlife prosecution cases as being only about 11.56%, thereby indicating the most alarming extent of the authorities' effort gap in the conduct of investigations. Besides, they recorded over 900 tiger-related cases in India, of which only around 60 have led to convictions, while the largest number of cases is still tagged as 'under due process' (UNTAC Wildlife Report, World Customs Organisation, EIA International).

Ineffacious Staff Management and Weak Inter-agency Coordination

Forest employees, mostly those in the lower-rank positions, experience situations of discomfort and hardship during forest patrolling. Even though the government has splurged crores of rupees on its forest conservation and management, the majority of Indian Forest Service (IFS) staff have been voicing their opinion that the management system is not right. The recruitment process is full of delays. Lack of sufficient human resources poses a great threat to forest departments, where vacancies result in overburdening of staff who have not been trained for patrols or anti-poaching excursions. In addition to this, staff training on wildlife crime detection, forensic skills, and community management is behind schedule, while an agency like the Wildlife Crime Control Bureau remains understaffed despite having a multi-agency mandate (Rana & Kumar, 2023). The poor coordination between Forest Departments, Police, and Customs results in unbridled activities of transnational poaching networks and enforcement of low bail, which hampers prosecutions.

Understaffing and Staff Shortages:

Staff shortages are a recurring problem in the country's wildlife sanctuaries, where the shortage is around 30-40% in states like Himachal Pradesh, Gujarat, and Rajasthan. Furthermore, the isolated location of the headquarters is once again a stumbling block in terms of maintaining strong and cordial communication with the villages, which, in the end, results in local conflicts between forest officials and villagers. Those staff members who reside at the headquarters have to cope with the water problem, lack of medical facilities, and electricity issues etc. Besides, the budgetary provisions for the Union Ministry of Environment, Forest, and Climate Change, which takes care of biodiversity conservation, have been significantly reduced.

FINANCIAL GAPS

Inadequate Budgetary Allocations:

Wildlife conservation efforts in India remain constrained by significant funding gaps, primarily due to the overall share of public expenditure dedicated to wildlife being extremely low. Insufficient budget allocation allows scarce capacity to meet the rising demands of habitat protection, species monitoring, anti-poaching operations, and community engagement. Sanctioning of funds sees delays in actual utilisation, caused by bureaucratic procedures, slow approvals, and weak financial management systems, creating further inefficiencies. Consequently, planned activities cannot commence on time, which results in project backlogs, compromised ecological outcomes, and the perpetual postponement of essential fieldwork.

These financial and administrative limitations lead to a certain complacency in scheme implementation. Departments that have

limited budgets and experience an inconsistent flow of funds may choose to invest in the routine functioning of their units instead of long-term conservation initiatives. The programmes that are essential for the restoration of habitats, the improvement of connectivity, or the strengthening of local participation are often under-implemented due to the absence of monitoring mechanisms and accountability structures. In such a situation, systemic weaknesses in understaffing are aggravated, as the low funding restricts the recruitment of frontline personnel such as forest guards, trackers, and ecological experts. Field teams are, thus, constantly stretched to their limits as they manage vast areas without the support of the latest technology and adequate training. This situation severely limits the ability of personnel to undertake effective patrolling, respond to emergencies, and collect reliable ecological data. The dearth of funds has also led to a situation where the adoption of new technologies is kept at bay in many protected areas. These areas continue to use old equipment and manual methods for surveillance, record-keeping, and wildlife census operations. There are very few reserves that can afford to have the tools which can greatly enhance conservation efforts, like drones, GPS-enabled monitoring systems, AI-based camera traps, or thermal imaging devices. The absence of such tools brings about the degradation of overall quality, precision, and speed of conservation activities and also serves as a hindrance to the transition towards data-driven ecosystem management. Due to inadequate governmenT funding, numerous national wildlife sanctuaries have become heavily reliant on tourism income to cover their financial deficits. Though tourism may bring in additional income, this dependence is quite unstable by nature. Tourist numbers vary as a result of changes in the economy, weather, and people's interests. What is more, the negative impact of many parks' ecological conditions on tourism is now quite severe, as many parks have been subject to habitat degradation, improper infrastructure, and less wildlife visibility. As the tourist revenue decreases, parks are not only financially disadvantaged but also face a shortage of staff, technology, and their ability to carry out operations deteriorates. This state of affairs engenders a negative feedback loop which becomes increasingly difficult to break. Lack of funding results in poor management and degraded ecological quality. Lower ecological quality results in less tourism interest, which in turn leads to further revenue reduction. Less revenue means less institutional capacity, more project delays, and further inefficiency across the system. Since each step feeds into the next, the entire conservation system becomes locked in a self-sustaining cycle of under-performance and delayed interventions. Breaking this cycle necessitates a fundamental transformation in the way.

ROLE OF PPPS:

Santhavasal Reserve Forest, which is a part of the Eastern Ghats landscape in northern Tamil Nadu, was heavily impacted due to fuelwood extraction, grazing and poor regeneration, resulting in low canopy cover and declining ecosystem services.

As a part of the Tamil Nadu Afforestation Project, the Forest Department started restoration work in collaboration with SST on a few hundred hectares or so, employing a combination of native species planting, soil and moisture conservation, and community protection measures. (Sreedharan, 2018).

At the policy level, national debates on forest sector reform have signalled the need for well-organised partnerships with private and civil society actors for the purpose of rehabilitating degraded forests, while also specifying that the state should retain ownership and that there should be strong provisions for community benefit-sharing. In this environment, the Santhavasal project can be seen as a very early, practical and field-tested example of such a PPP model.

The partnership includes three major actors:

- Tamil Nadu Forest Department: The legal custodian of the reserve forest is responsible for regulatory oversight, preparation of working plans and technical guidance on silviculture, fire protection and biodiversity conservation.
- Srinivasan Services Trust (SST): CSR institution of TVS Motor that offers financial resources, project management and capacity-building support, which is integrated with its wider village development programmes in the region.
- Local communities and Village Forest Committees (VFCs): Residents of villages located around the forest take part in planning, protection, planting and sustainable harvesting, and are organised into formal committees in accordance with participatory/Joint Forest Management principles.

The governance is based on a three-party agreement which spells out the roles, responsibilities and benefit-sharing. A joint committee comprising representatives from the Forest Department, SST and elected VFC members oversees annual planning, budgets and conflict resolution. Institutions at the village level are required to draw up micro-plans that not only identify protection zones but also controlled-use areas and livelihood activities that are in line with the state-level coastal/forest greening and afforestation frameworks.

Ecological Restoration of Degraded Land

Santhavasal's technical method is a close-to-nature regeneration model which mainly stresses on gradually replacing monoculture with mixed native species and giving preference to natural regeneration wherever feasible. Some of the major interventions taken up were:

- Soil and moisture conservation - contour trenches, bunds and small check dams are implemented to reduce runoff, arrest erosion and rejuvenate the groundwater, which in their case is the major cause of the dry deciduous systems.
- Assisted natural regeneration and planting- Protection of existing rootstock along with enrichment planting of native tree species like neem, rosewood,

peepal, amla and other regional species documented for Tamil Nadu's dry forest.

- Fire and grazing management- Creation of fire lines and community fire-watch arrangements coupled with negotiated grazing controls through VFC by-laws.

The monitoring reports are a testament to the large gains made in canopy density, understory growth and return of wildlife after the interventions, thus pointing to the ecological success of community-protected restoration.

Community-Based Sustainable Forest Management

The integration of local people into forest governance and benefit streams is one of the main features of the model. VFCs set up n villages surrounding Santhavasal are entrusted with:

- Participating in micro-plan preparation and annual activity planning, including zoning of strict protection and sustainable use areas.
- Implementing informal rules on fuelwood collection, grazing and NTFP harvest, which are backed by social sanctions and Forest Department oversight.
- Managing community funds generated through allowed activities, usually linked to self-help groups (SHGs) for savings, credit and small enterprises.

SST uses its wider CSR portfolio-health, education and livelihood projects in thousands of villages-to remove the socio-economic factors exerting pressure on forests by facilitating alternative sources of income and provision of basic services. Participation in forest management, as supported by evidence from the related literature, leads to improved regeneration, less illegal extraction, and better livelihood security, thus achieving ecological and social objectives simultaneously.

Financing Model and Economic Significance

The financial framework is generally a combination of CSR grants from SST to cover the cost of capital-intensive nursery and planting activities, soil conservation measures and community infrastructure, government funding through state afforestation programs, such as the Green Tamil Nadu Mission, focuses on large-scale tree plantation, community involvement, and livelihood support, and community investments in the form of labour (which is often considered an in-kind share) and local monitoring, as well as future returns from sustainable NTFP harvests and possible nature-based enterprises.

Worldwide studies on PPP in degraded forests point out that such models can attract private capital and use private sector management skills while maintaining public ownership and allowing local communities to share the benefits, thus solving the problem of a major part of India's forest area that is moderately to severely degraded.

In Santhavasal, the improved vegetation cover and water availability are said to have led to better agricultural performance in the villages around, thus pointing to the indirect economic benefits through ecosystem services.

Monitoring, Outcomes and Research Directions

The evaluation of PPCPs in forest restoration should reflect through biophysical, socio-economic and governance indicators. Relevant parameters in Santhavasal would be canopy cover, species richness, soil organic matter, wildlife presence, household income diversification, NTFP-based earnings, and the functioning of village forest committees (meetings, rule compliance, conflict resolution).

Partnership between the National Zoological Park and Vantara

In order to improve animal welfare and conservation efforts in public zoos, the National Zoological Park (NZP), Delhi, has signed a partnership agreement with Vantara in 2025, a private wildlife conservation centre located in Gujarat. It aims to modernise zoo operations via the exchange of knowledge and expertise in veterinary skills training.

The partner endeavour wants to confront issues that have been impediments for Indian zoos. These include the design of the enclosures, rehabilitation, and the training of professionals. Vantara will offer support to the Delhi Zoo through its Green Zoological Rescue and Research Centre (GZRRC), which is an institution dedicated to rescue-and-rehabilitation programmes and animal management systems. Thus, Delhi Zoo is to turn into an organisation that demonstrates the high standards of animal care in the wild under captivity.

One important sub-theme of the project is the strengthening of animal welfare protocols. Staff in the zoo will be trained in the new learn animal management methods. They will learn through interaction; in this case, they will learn the monitoring of animal health, behavioural enrichment, nutritional planning, and safety procedures. The main focus would be on large mammals and endangered species, and consist of measures of disease surveillance, preventive healthcare, and zoonotic risk management, in line with internationally recognised zoo standards.

Habitat renovation of the animals is also one of the key elements of the partnership. Vantara has made a promise to help not only in the construction but also in the design of the safe housing for the different biological species, which would not only serve the physical but also the psychological needs of the animals in captivity. The zoo will be turned into a centre of excellence for captive breeding and conservation research. Visitor engagement is also to be further improved through outreach programmes.

The implementation started in October 2025, when a six-member Vantara team began training workshops for Delhi Zoo staff from various departments. These sessions follow the so-called "Vantara Model," which revolves around scientific feeding regimes, structured habitat enrichment, and best practices in animal care. The deal provides for regular technical discussions, with joint workshops and coordinated long-term planning for endangered species management. Officials say that the early operational improvements were already

visible by September 2025, therefore providing confidence in the effectiveness of thepublic–private partnership framework.

Nevertheless, the project was met with political criticism at first. Among other things, the Congress party alleged that it was a case of privatisation. The government, however, after these accusations, clarified that the MoU is only advisory and collaborative, and there is no handing over of management or administrative control. Delhi Zoo Director Sanjeet Kumar and Vantara CEO Vivaan Karani assured that governance is still under the Ministry of Environment, Forest and Climate Change. They also confirmed that Vantara is only there to help in veterinary science, rehabilitation and zoo infrastructure design with the provision of specialist support.

The pact, in addition to enhancing zoo operations, aims to help meet broader national conservation goals through improved captive breeding and species recovery initiatives. Vantara's rescue skills will be a great support to public institutions' capacity to care for the wildlife that is injured, displaced, or endangered, more so amidst increasing threats of urbanisation and climate change. The measures taken are in line with broader environmental policies, which include biodiversity strategies under the State Action Plans on Climate Change (SAPCC).

The Delhi Zoo-Vantara collaboration is a forward-looking conservation model for India, as it combines private-sector innovation with public governance frameworks. This partnership is capable of establishing new standards for zoological management, thereby exhibiting the potential of cooperative partnerships in progressing animal welfare, along with retaining transparency and public accountability.

ETHICAL CHALLENGES IN WILDLIFE CONSERVATION

ETHICAL CHALLENGES IN WILDLIFE CONSERVATION

ANIMAL RIGHTS AND CONSERVATION ECONOMICS

The optimum level of conservation is possible at an efficient level of equilibrium between the government's fund allocation, tourism demand, and a sustainable valuation of biodiversity. As per the official press release by the Press Information Bureau, the Ministry of Environment, Forests and Climate Change allocated total funds nearing ₹3,412.82 crores in 2025-26 to wildlife conservation. Out of this monetary allocation, more than 64% of the funds were earmarked for flagship projects like Project Tiger and Project Elephant. The IUCN's Red List contains more than 900 species from India listed as "endangered" and in immediate need of concerted protection.

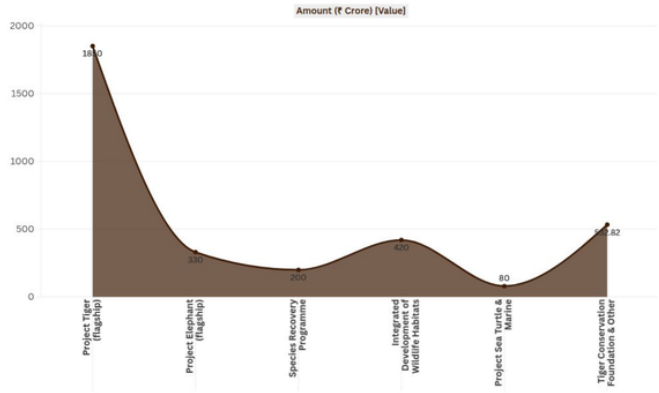

Figure 10.1: *Budgetary Allocation to Flagship and Non-Flagship Projects*

Even after registering such a high toll of various endangered species, it is clearly evident from funding gaps that the conservation efforts in India are skewed to a certain group of species only. As per general consensus, biodiversity is regarded as a "common resource", and its theory suggests that it should be protected irrespective of the market demand. However, the bias in the budget is contrary to what conservation economics preach. Popular tourist-favoured species, such as tigers and elephants, register higher "willingness to pay" per tourist. Thus, their marginal revenue is often much higher than that of other less favoured species such as amphibians and reptiles. A total of 9 species of mammals are considered Critically Endangered in India, including 7 species endemic to India itself. In comparison, 18 avian species, 26 species of reptiles, and more than 20 species of amphibians are critically endangered in India, to the point of extinction (Ministry of Environment, Forest and Climate Change, 2022). The data is lucid evidence that non-mammal species are at a greater threat (considering the absolute magnitude of critically endangered subspecies) than the species that dominate in fund transfers for conservation. Reptiles like the Fan-throated lizard, Shevaroy Gecko, Madras Spotted Skink, Shevaroy Hill's Earth

Snake, King Cobras, and the Indian Alligator (gharial) are endangered to the point of extinction in India. Yet, the least amount of monetary support goes to endangered reptiles in India. Recently, in March 2025, the Government of India announced the launch of a dedicated project for Indian alligators, called "Project Gharial". However, the on-ground implementation of this project is yet to be initiated in full force.

Despite classifying wildlife as a perfect common resource, India's eco-tourism model treats biodiversity as a semi-revenue-generating asset, especially in the case of favoured tourist species like tigers and elephants. In such a case, the worth of each component of wildlife is determined by the demand-side bias and the marginal willingness to pay that a tourist provides. This mechanism is far from being optimal because it ends up ignoring the positive externalities of "less-favoured" species. Amphibians, reptiles, insects and birds are crucial components of the natural food chain and pollination cycles. The disregard of these aspects denigrates the actual economic value that these species hold.

The ultimate implication of this is altered demand structures due to the fact that consumers now associate lower economic value with such fauna, and hence are willing to pay less for them. This drastically reduces their demand for tourism related to these animals. The supply-side facet also becomes inefficient, as suppliers do not account for the risks of habitat fragmentation and disruption of conventional wildlife habitats in their tourism fees. This ends up cutting down on the incentive for local communities and tourist service providers to invest in them. Thus, private incentives do not automatically translate to social welfare.

Revenue channels associated with wildlife include park fees, payments made for hospitality services, and ancillary employment. The purely monetary side of wildlife tourism creates distortionary incentives, where highly demanded fauna generate greater per-hectare revenue as compared to lesser-known animals. This resonates into a feedback loop mechanism, with higher tourism revenue adding more to tax multipliers in the economy. Furthermore, higher taxes encourage the government to invest more in the development of infrastructure and facilities for tourism. This increases the visibility of these species in the eyes of private investors, consumers, and foreign tourists, hence bringing in a flow of foreign exchange as well.

Another situation where conservation economics ends up being disproportionate in gains is when it provides unequal beneficial outcomes to local communities. The Protected Areas that generate large revenue pique the interest of private investors who view this as an opportunity to privatise the hospitality segment of tourism. Collusions between local administration and investors result in restrictions being placed upon local communities with regard to areas of the forests they can access for grazing, flocking or agriculture. Exorbitant rents are then placed on the communities to receive

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permission for any economic activity they might undertake. In some cases, the poorer sections are often displaced without sufficient compensation. This disrupts their social welfare and horizontal equity to an extent that it imposes localised costs and charges on the communities in the vicinity of the wildlife, but disperses benefits to those least concerned with the conservation of biodiversity.

ETHICAL DILEMMAS IN TROPHY HUNTING

Trophy Hunting

Trophy hunting is one of the most fiercely debated ethical issues in wildlife conservation. This refers to hunting individual animals with desirable characteristics to keep body parts (e.g. horns, heads, hides, antlers) as mementoes (Frontiers, 2005). Whereas the authorities of some countries allow trophy hunting under stringent regulatory frameworks, it is prohibited in India under the Wildlife Protection Act, 1972. This reflects a fundamentally different ethical orientation toward wildlife management.

From a utilitarian standpoint, the advocates of trophy hunting maintain that controlled hunting is a tool that can be used to raise money for conservation and provide incentives for habitat protection. Besides, it can support local communities economically by means of employment and improvement of social amenities. In some cases, it is alleged that the hunting licences' money goes to anti-poaching measures and the management of protected areas. Hence, the act is ethically defensible only if it leads to good conservation results.

However, there are many moral and environmental concerns that challenge this argument. If we look at it from an animal ethics point of view, killing animals for sport is considered a bad act because animals are believed to possess intrinsic value, i. e., their value doesn't depend on them being human resources only.

Environmental ethics also highlights the fact that humans have a moral obligation to animals. That is the reason why the important contributions of large-scale predatory species, being inseparably linked to their normal social and breeding behaviour, are taken into account in the case of their selective killing to allow for recreational hunting. Selective removal of the large or dominant individuals causes changes in social hierarchies, breeding patterns and a negative impact on long-term population stability.

Trophy hunting makes us reflect on the question of whether saving the species is enough if the means used to achieve it harm the morals of the individuals involved.

Relocation of human settlements

Relocating human settlements from protected areas has been widely implemented as a conservation measure aimed at reducing pressure on wildlife habitats. In India, the practice has been carried out in several national parks and tiger reserves. In some instances, relocation has enhanced forest

cover and the wildlife population. There are negative aspects to this as well. A large portion of those who are relocated are tribal and forest-dependent communities who have been living in these areas for a long time. After the relocation, they find it difficult to make a living.

Besides, the point touches on the method of relocation that has been undertaken. In some cases, the community has not, for the most part, been made aware of their rights and options or the long-term consequences of relocation. Moreover, when relocation is considered voluntary, the displaced villagers may be under some kind of pressure due to, for example, resource use restriction or fear of legal actions. Therefore, the question arises whether the process was just and whether the villagers gave their consent.

Relocation should be the least preferred option rather than a default solution. If relocation is non-negotiable, it should be voluntary and well compensated. Local communities should be seen as partners and not as hindrances.

Ancestral Land Rights

The term 'ancestral land rights' means the traditional rights of the indigenous and forest-dwelling communities on the lands that they have been occupying and managing for generations. Most of these lands are in areas that have now been declared national parks or wildlife sanctuaries. This has resulted in disagreements between conservation authorities and local communities that are dependent on the land. To begin with, conservation policies were based on the presumption that human beings living in an area were detrimental to the environment. Hence, communities were not allowed into forests, and their traditional practices were either restricted or declared illegal. This approach led to a loss of livelihood and the emergence of distrust in conservation institutions.

Studies show that indigenous communities often use natural resources in sustainable ways through seasonal harvesting and land management. This challenges the notion that conservation can only succeed by removing people from forests. The Forest Rights Act, 2006, was passed in India as a means of remedying the injustices of the past by recognising the individual and collective rights over the forest land and resources of the tribal and other traditional forest-dwelling communities. However, this has been inconsistently implemented, and there are still conflicts in many protected areas. Giving up ancestral land is not only an ethical issue, but also a very practical one. The upheaval of indigenous people is always a dominant feature in conservation projects, and such people become victims of these projects. Dispossession and uprooting of local peoples result in a loss of their identity and culture, and hence their alienation. Hence, it can be argued that a land is not only a productive space but also a cultural space and therefore, respecting local land rights is important. The acknowledgement of indigenous land rights goes beyond ethical considerations. It is also a matter of social justice and a step towards regaining the trust

of the local communities that are regularly in conflict with conservation authorities. Community involvement in conservation activities is not only beneficial but also necessary. People become supporters of conservation when their rights and means of subsistence are respected.

Fortress conservation

The fortress conservation strategy suggests that the best way to conserve nature is by isolating it physically from humans. This is achieved by restricting access and implementing stringent regulations. It has contributed to the survival of certain species and the preservation of some habitats. However, it has also raised serious ethical issues. Forest-dwelling and indigenous people rely on the forest for their daily needs. Fortress conservation typically limits these activities, so traditional practices are made illegal. This situation can lead to conflicts between the communities and the forest rangers, and also to a loss of trust in conservation efforts.

Another issue is that strict enforcement may disregard the social conditions of those living near protected areas. When communities are thrown out without having any alternatives, they may become poorer. At times, anger against the conservation policy may lead to more instances of illegal activities such as poaching or the use of natural resources, which, in the end of the day, is harmful to wildlife. Nowadays, conservationists are aware that nature can only be preserved in the long term with the support of the locals. Community-based conservation and co-management are two of the models that promote collaboration between the authorities and the local people. Through these methods, communities obtain permission to use natural resources in a sustainable way and, at the same time, they do their part to help the environment.

CAPTIVITY AND CONSERVATION

CAPTIVITY AND CONSERVATION

Species worldwide have been deteriorating due to the recent anthropogenic pressures on the environment. Many species, like the Dodo, have already gone extinct, and some are on the verge of extinction. Despite many government-protection measures, the safety of species in their natural habitats and unrestricted spaces is difficult to guarantee, as activities like hunting and poaching remain significant despite the measures taken to prevent them. Owing to these factors, protecting and enclosing these species in controlled and safe spaces to preserve them from extinction becomes crucial. This essentially means restraining these species in places like zoos or natural parks where they are safe from external threats such as hunting or other predators. This is referred to as "ex-situ management". Certain species that were otherwise destined for extinction were saved by these ex-situ programmes, and they have also assisted their progress towards recovery and sustainability. Apart from saving species from extinction, ex-situ programmes are also valuable for research.

Researching and studying the behaviour of animals that are in captivity in a controlled environment is considerably simpler and more productive than doing the same with animals in uncontrolled spaces, where various other external factors are influencing the animal's behaviour. Additionally, some critics argue against conducting research on captive species because it may reduce the quality of life of the test subjects. The most prominent and major problem with ex-situ management is the costs incurred. It involved a plethora of costs, like preparing a controlled environment for them to stay, collecting them from the wild and safely bringing them to the zoos or natural parks, which involved collection and transportation costs, costs of feeding them, and many others.

As the number of species requiring intensive remedial attention rises without a proportional increase in resources, it is more important than ever that actions are carefully chosen to improve the status of the target species (McGowan et al., 2016). Thus, important decisions need to be taken with careful and extensive research and analysis to determine which species need to be help captive to keep them from becoming extinct. Although ex-situ management involved high costs and may deteriorate the quality of lives of the captive species, it is sometimes a necessary evil as it may prevent the captive species from becoming extinct, and it should be done only to a certain extent, because if overdone, it may reduce the survival skills of

the confined species, so when they are released back into the wild, they may face threats from other organisms and predators.

CLIMATE JUSTICE

Climate justice concerns the disproportionate environmental burdens suffered by underserved and marginalised people, and the unfair distribution of environmental benefits to those with the influence and financial resources to enjoy them. It recognises the responsibilities of empowered groups, large corporations, and industrialised countries to correct environmental harms, such as pollution and rising seas from climate change, that they have, unwittingly or not, inflicted on those who are less powerful (Hill, 2025).

Climate justice is required because the most serious impacts of climate change, resulting from the warming of the Earth's atmosphere and other harmful activities, are often experienced by those who have contributed the least to climate change and have the fewest economic resources to protect themselves. An example of these types of communities would be the people living in the Pacific. The residents of the small islands in the Pacific produce a negligible amount of carbon emissions, which are responsible for climate change, yet they face a constant threat to their coastline, along with recurring cyclones and rising tides.

Droughts, wildfires, heat waves, or floods affect the rural communities, islands or locations where people are relying on the weather conditions to grow their crops more. These are portions of Africa, Asia, South America, the Pacific and the Arctic. There are also comparatively higher risks of climate to old people, people living secludedly, people who are affected by war or new migrants who do not have access to health care facilities or friends to assist them.

Climate justice means paying attention to the fact that different people are affected by climate change in different ways, and collaborating to solve the issues of climate in ways that treat people with dignity. Climate justice implies that we should not discriminate against individuals according to their wealth, religion, or culture. However, due to the fact that the climate affects not all people in a similar manner, we cannot simply treat all the people in the same way. We must also consider equity in order to be fair. For that, we need to know how varying individuals encounter various issues and dangers, and what sort of assets and assistance they may require to manage in a shifting climate.

Climate justice entails considering four ideas:

1. Equity - Ensuring individuals receive equal treatment by acknowledging their conditions and by distributing the impacts, duties and choices of climate to the society, generations and gender.
2. Procedural Justice - It involves making decisions in a compelled way that is transparent and involves all people, and even those not in agreement with the outcome.

3. Distributional Justice - Making sure that the positive and the negative impacts of climate change are equally felt, shared and distributed across the board.
4. Recognition Justice - Dignifying people in recognition of the fact that various people have diverse needs depending on their cultures, identities and life experiences.

In conclusion, climate justice implies that one should be thoughtful about who is most susceptible to climate change and what predisposes them to it. The concept of climate justice compels us to stop and wonder why, as global warming progresses, there are always winners and losers among people. It then challenges us to consider ways to transform this to build a better future where we are all fair, by listening attentively and respectfully to the various opinions and acting in a considered manner to address the various needs. Climate justice is ensuring a better and fairer future for all.

CONCLUSION

CONCLUSION

This report clearly illustrates that wildlife and economics are so interwoven that they cannot be considered separate issues. Wildlife is a crucial factor in economic systems that provide people with a living and allow for development over time. The disregard of the value of wildlife in economic decisions often entails the pursuit of short-term profits and the creation of long-term economic and environmental problems. Hence, the protection of wildlife should be regarded not only as a matter of the environment but also of economics.

The acknowledgement that most people don't realise the economic value of wildlife is probably the most significant focus of the report. Economic benefits from tourism and forest-based employment, which are very visible, undoubtedly make up only a small part of the whole set of contributions from nature. On the whole, indirect contributions like water regulation, climate stability, soil fertility, and disaster mitigation are so far not included in formal economic calculations. This lack of recognition leads to decisions that undervalue nature and allow for its unsustainable use. Eventually, the loss of natural services that could have supported the economy will be more expensive than the sacrifices made to achieve immediate developmental benefits.

The report also points out that conservation policy measures frequently put a heavy economic burden on local communities. Those residing around the protected areas suffer from crop damage, limited access to resources, and human-wildlife conflict, whereas the more significant economic benefits of conservation are enjoyed by people who are far away. For one thing, such a discrepancy from the point of view of economics, it lowers the effectiveness of conservation efforts. Sustainable wildlife management is, therefore, a matter of incentive structures that share costs and benefits pretty, so that conservation becomes a way of supporting local livelihoods rather than a local livelihood threat.

Tourism and eco-tourism have become essential parts of the wildlife economy, bringing in revenue, creating jobs, etc. Yet, depending on tourism too much may lead to environmental degradation and social inequality. Areas with famous wildlife attractions usually get more investments, while the less attractive in terms of tourism landscapes remain without adequate funding and care. The problem with this unequal distribution of funds accentuates the necessity for alternative economic models that will be able to support conservation besides tourism, driven by incentives.

Other instances of how economic factors influence the results of conservation

initiatives include the illegal wildlife trade and poaching. High market demand, poverty, and a lack of alternative sources of income all contribute to the illicit exploitation of wildlife. Enforcement alone is insufficient to properly manage these activities. In order to address the underlying reasons of wildlife crime, economic solutions, including benefit-sharing arrangements, community involvement, and job creation, are equally important.

Another important finding is that conservation projects face financial and institutional challenges. Fund shortages, inefficient administration, and lack of coordination weaken the economic efficacy of wildlife saving. Private investment and public-private partnerships may provide some answers, but they need to be tightly controlled so that commercial interests do not conflict with the conservation objectives. Economic expansion should be a vehicle for conservation, not a substitution.

The entire paper emphasises the importance of considering wildlife as a profitable asset when making economic plans. Future economic sustainability depends on stable biodiversity and healthy ecosystems. Developing without taking wildlife into account is a surefire way to make oneself more vulnerable to social disorder, resource depletion, and climate-related risks. In conclusion, rather than viewing conservation and development as opposing forces, the application of the wildlife economics principles to policy frameworks promotes their peaceful coexistence. The key to unlocking sustainable success is a comprehensive and well-balanced economic policy that ensures institutional responsibility, empowers local communities, and acknowledges the value of the natural environment. The conclusion of the interaction between nature and human society is determined by the wise economic decision to conserve wildlife, which goes beyond ethical considerations.

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