

Ecotourism and Tourism-Induced Pollution in India: Environmental Impacts, Future Projections and Sustainable Pathways

Dr. Neetu Mahawar*

Assistant Professor, Department of Environmental Science, Kanoria P.G. Mahila Mahavidyalaya, Jaipur.

*Corresponding Author: neetu.m@kanoriacollege.in

Citation: Mahawar, N. (2026). *Ecotourism and Tourism-Induced Pollution in India: Environmental Impacts, Future Projections and Sustainable Pathways*. *Journal of Commerce, Economics & Computer Science*, 12(03), 197–203. <https://doi.org/10.62823/jcecs/12.03.9527>

Abstract

Ecotourism is often viewed as a means of biodiversity conservation, rural development, and sustainability, but the fast growth of ecotourism in India's environmentally sensitive areas is causing the rise of solid waste, plastic waste, food waste, wastewater, and transportation pollution. This paper provides an analysis of existing literature on the subject, focusing on the sources, impacts, trends, and management of pollution generated by tourism in India. The results of the analysis demonstrate that the volume of tourist waste is much higher than that of domestic waste per capita because of intensive consumption, peak loads of population, and poor infrastructure. Key issues include untreated sewage release, accumulation of single-use plastics, water resources conflict, vehicle emissions, habitat fragmentation, and wildlife disturbances. If no changes occur, the levels of tourism-driven consumption and pollution will increase rapidly until 2050. The gaps identified in this review include the lack of data about pollution inventory, life cycle assessment, carrying capacity modeling, microplastic presence, geospatial observation, and community engagement. Sustainable development model is suggested based on the following elements: circular economy, decentralized sewage treatment, renewable energy, sustainable mobility, monitoring, carrying capacity, and community engagement. Only when the development in the ecotourism industry of India is disassociated from resource utilization and pollution can it contribute to conservation and development.

Keywords: Ecotourism, Tourism-Induced Pollution, Solid Waste, Wastewater, Plastic Pollution, Carrying Capacity, India, Sustainable Tourism, Circular Economy.

Introduction

Tourism is one of the primary industries that contributes to the economy of India, providing job creation, foreign exchange earning, and employment opportunities for people living in rural and ecologically fragile areas. National parks and wildlife sanctuaries, Himalayas, coastal areas, wetlands, and other sites of cultural and historical importance attract many tourists both from within and outside the country. Ecotourism, by definition, involves traveling to natural areas that help preserve the environment as well as benefit local people. However, in reality, construction, transportation, and number of visitors increase rapidly at destinations that are tagged as ecotourism sites, thereby creating a mismatch between the tourism demand and capacity of these destinations.

Following are the main pollutants that contribute to the development of tourism in India:

- Municipal solid waste and plastic material
- Waste food from hotel restaurants, resorts, and pilgrim centers
- Inadequately treated sewage and grey water
- Freshwater usage in accommodation and leisure
- Emissions from vehicles and traffic creation
- Constructions resulting in change in land use
- Noise pollution and littering
- Marine and fresh water ecosystems contamination

The greatest problems exist in locations where there are no proper infrastructures developed for handling waste disposal, sewage disposal, and transport facilities. Locations in arid areas have the added challenge of facing depletion of groundwater supplies due to the extraction of water by tourists in the area. Since the infrastructures in destinations are normally planned for resident populations as opposed to tourist peaks in the form of festivals, pilgrimages, holidays etc., small increases in visitors can cause large pollution spikes that are beyond the average annual number of visitors.

Tourism impacts are economically related to the environment. Tourism revenues that are collected in the form of entrance fees, permits, and enterprises related to tourism could be used to provide funding for conservations and waste infrastructures but this revenue usually goes to places external to the destination communities. The problem of revenue generation and the location of costs is a common thread among the papers reviewed here. This is why a lot of the gaps in management mentioned in Section 5 exist.

Objectives

- Identify the major sources and types of tourism-induced pollution in India.
- Analyze the environmental effects of tourism development across key ecosystems.
- Assess the economic gains and losses associated with ecotourism development.
- Present available quantitative data on waste generation, water consumption, effluents, and CO₂ emissions.
- Evaluate the environmental implications of future tourism growth scenarios.
- Identify methodological and data-related research gaps.
- Propose sustainable pathways for environmentally responsible tourism development.

Tourism Growth and Environmental Pressure

The tourism industry accounted for about 6.6% of India's GDP in 2025 (US\$263.6 billion) compared to 7.5% in 2024, while foreign exchange earnings fell from US\$35.02 billion in 2024 to US\$31.4 billion in 2025. The sector employs around 46.5 million people in 2024, 46.2 million people in 2025, and is expected to employ 48.1 million people in 2026 at the rate of 8.5% growth per year.

Table 1: Selected Indicators of India's Tourism Sector

Indicator	2024	2025	2026 (Proj.)	2027 (Proj.)
GDP contribution (%)	~7.5%	6.6%	6.7%	~6.9% (est.)
GDP contribution (US\$ bn)	~\$244 (est.)	\$263.6	\$286.1	~\$310 (est.)
Employment (million jobs)	~46.5	46.2	48.1	~50 (est.)
Employment share of total jobs	~9.1%	10.8%	11.1%	~11.5% (est.)
Foreign-exchange earnings (US\$ bn)	35.02	31.4	~31.7 (partial)	n/a

Expansion of tourism creates a combination of opportunities and threats: it may increase local employment, support small businesses, and finance the conservation programs, but unchecked growth of this industry will go beyond the environmental and institutional carrying capacity of the destination areas. The percentage of tourism employment in total employment increased from 9.1% in 2024 to 10.8% in 2025 and is estimated to be 11.1% in 2026, which indicates increasing importance of the sector for the national economy and thus the magnitude of the environmental management task related to further expansion.

Environmental Footprint of Tourism

Growth of tourism not under control leads to accumulation of plastic pollution, food waste, sewerage leakage, and emissions of transportation. The Himalayan areas, coastal regions, and deserts are particularly vulnerable because of lack of infrastructure for waste management.

- **Solid Waste and Plastic Pollution**

The average generation of solid waste per tourist per day is 0.85 kg (the range is 0.5–1.2 kg depending on the location and traveler's conduct). Ecotourism destinations produce less solid waste, but higher environmental sensitivity makes the consequences of its inappropriate disposal more severe.

Table 2: Solid Waste Composition in Tourist Regions

Waste Component	Approximate Share
Plastic	20–25%
Food and other organic waste	35–45%
Paper	15–20%
Glass and metal	5–10%
Other materials	10–15%

Single-use plastics such as PET bottles, snack bags, disposable packaging, and hotel supplies make up 18–32% of the waste in hotspot areas at high altitudes and coastlines. The breakdown of these plastics into microplastics happens without refill systems, extended producer responsibility, and enforcement due to their lack of degradation into the soil, water bodies, and marine food chain.

- **Food Surplus and Organic Wastes**

Organic wastes generated by hotels, resorts, and pilgrimage centers are responsible for landfill gas emissions, odor production, pest breeding, and hazardous leachate. Wastes are generated in proportions depending on the class of the accommodations provided.

Table 3: Indicative Food-Waste Generation by Accommodation Category

Accommodation Category	Food Waste
Five-star hotel	0.45 kg/room/day
Three-star hotel	0.35 kg/room/day
Budget hotel	0.20 kg/room/day
Homestay	0.15 kg/room/day

Water Consumption and Wastewater

Tourism infrastructure in the higher range uses 250 to 450 liters of water per tourist per day. The average 220 liters of water consumption by tourists produces 125 liters of waste water. In arid zones like Rajasthan, this leads to the depletion of underground water and also creates pressure on the local community. Untreated waste water leads to contamination of the water system with disease-causing organisms and excess nutrients.

Table 4: Indicative Tourism-Related Sewage Conditions

Region	Sewage Generation	Treated (%)	Primary Ecological Risks
Himalayan destinations	40–60 L/tourist/day	~15%	Water contamination, slope instability
Coastal destinations	50–80 L/tourist/day	~25%	Coral reef stress, degraded fisheries
Urban tourism hubs	60–100 L/tourist/day	~50%	Surface water pollution, aquatic decay

Transport Emissions and Air Quality

Domestic tourism transport generates an average of 42.5 kg CO₂ per tourist trip, driven mainly by aviation and diesel road transport.

Table 5: Indicative Emission Factors for Tourist Transport

Vehicle Type	CO ₂	NO _x	PM _{2.5}
Tourist bus	850 g/km	4.5 g/km	0.15 g/km
Diesel taxi	180 g/km	0.8 g/km	0.05 g/km
Petrol car	150 g/km	0.2 g/km	0.01 g/km
SUV / 4×4	220 g/km	0.9 g/km	0.06 g/km

Traffic pollution contributes to degradation of air quality; in mountain areas, black-carbon deposition from fuel burning leads to faster melting of snow and glaciers.

Unique Environmental Concerns for Different Ecosystems

- Himalayas: traffic and construction activities lead to black-carbon deposition, slope instability, and wildlife disturbance.
- Coastal zones and islands: marine debris, sewage pollution, and land pressures contribute to coral reef damage, beach degradation, and depletion of groundwater resources.
- Forests and protected areas: traffic activities lead to habitat destruction, roadkill, and plastic ingestion by wildlife.
- Wetlands and arid regions: water over-extraction results in depleted aquifers, while excess runoff leads to nutrient enrichment and loss of biological diversity.

Future Projections on Environmental Pressures and Sustainability

Projections for the long term (2024–2050) show significant future growth in environmental pressures due to tourism activities: solid waste production (+251%), energy consumption (+154%), water consumption (+152%), and greenhouse gases (+131%). The figures above are model projections and do not represent any official national projections.

Table 6: Long-term Environmental Projections (2024–2050)

Parameter	2024	2030	2040	2050	Growth
Tourist arrivals	2.56 bn	3.20 bn	4.80 bn	6.50 bn	+154%
Solid waste	12.5 MT/yr	18.2 MT/yr	28.5 MT/yr	42.0 MT/yr	+251%
Water demand	1.5 BCM/yr	2.1 BCM/yr	3.2 BCM/yr	4.5 BCM/yr	+152%
GHG emissions	42 MT CO ₂	52 MT CO ₂	80 MT CO ₂	120 MT CO ₂	+131%

Gaps in Present Management System

- Tourism-related waste and emissions data are not distinguished from resident data.
- Several environmentally delicate locations lack basic facilities for waste segregation and sewage treatment.
- Ecological rules and usage of plastic bags are mostly dependent upon individual responsibility.
- Lack of life cycle assessment, GIS and AI based monitoring, microplastics tracking and carrying capacity modeling in real time.

Towards Sustainable Tourism Management

This paper advocates the concept of sustainable tourism management through three main pillars:

- **The practice of circular economy approach** – deposit refund system for bottles; mandatory composting on site for larger hotels.
- **Green infrastructure** – constructed wetlands and low energy sewage treatment systems; electric safaris and hill station transport.
- **Smart Governance** – Internet of Things based visitor management to maintain carrying capacity in real time and GIS based auditing for land use changes and encroachments.

The implementation of the above pillars necessitates collective efforts at three tiers of governance. In terms of national governance, the Ministry of Tourism and MoEFCC will be required to integrate ecological carrying capacity assessment into the planning and licensing of destinations. In

terms of state-level governance, the state pollution control boards will have to develop capacities for monitoring compliance with the sewage treatment system and microplastics, as well as developing a mechanism for enforcing rules other than self-regulating codes. At the local level, it is the community institutions and home stay/resort associations that will manage decentralized facilities like constructed wetlands, composting and refill stations if they get their rightful share of the tourism pie.

Conclusion

Ecotourism in India stands at a crucial crossroad. It offers significant prospects of becoming a driver for economic development, income generation and nature conservation; however, its current pattern of growth cannot be sustained in the long term. Unrestrained tourism flows are producing large amounts of per capita waste, untreated sewage, accumulations of single-use plastics, and carbon emissions that endanger India's most vulnerable eco-systems. The sustainability of ecotourism in the coming years will depend on the ability to achieve the right balance between growth and environmental protection through changing the paradigm from unrestrained growth to growth based on value creation, low impact and circularity in terms of enforcement of carrying capacity, investments in green decentralized infrastructure, adoption of circular economy approach and providing true ownership to local communities. Using smart technologies, data gathering and multilevel policy frameworks, India can develop a sustainable climate resilient economy of tourism.

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