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Importance of Environmental Science in Contemporary India and the World

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Abstract

The interdisciplinary discipline of environmental science has developed in reaction to increased environmental crises which are increasingly jeopardizing environmental stability, human health, economic prosperity, and social justice. Environmental problems in India have been exacerbated by the fast and high rate of industrialisation, urbanisation, population pressure, climate exposure, and mismanagement of waste materials, including air and water pollution, climate induced calamities, extinction of biodiversity, and poor disposal of waste materials. On a global scale, global warming, plastic contamination, environmental degradation, and international environmental threats have become the characteristics of the twenty-first century. The significance of environmental science in comprehending, tracking, and solving these dilemmas using scientific proof, statistical data, and recent Indian and worldwide case studies is explored in this research paper. The paper emphasizes the role of environmental science in sustainable development, environmental governance and policy making as well as outlining technical and institutional constraints that limit its successful implementation.

Keywords: Environmental Science, Environmental Degradation, Climate Change, Air Pollution, Sustainable Development, Environmental Governance

Introduction

The twenty-first century has seen environmental degradation as one of the most urgent problems facing humankind. In contrast to previous times, where environmental harm used to be local and low scale, the modern-day environmental issues are global, intertwined and systemic. The general effect of climate change and air and water pollution, loss of biodiversity, deforestation, and depletion of resources, is more and more evident on the health of man, food security, livelihoods, and economic stability. Environmental sustainability has become the core of the discourse of development and the public policy due to these challenges.

Environmental science is considered a core field in the study of the intricate interplay between human activities and nature. It combines the physical sciences, biological sciences and social sciences knowledge in the analysis of environmental processes and impacts. The demographic pressures, uneven development, and environmental vulnerability exacerbate the environmental problems in India. Environmental crisis does not recognize national borders across the globe and thus requires international collaboration based on scientific evidence. It is against this background that the necessity of environmental science in modern governance and development planning cannot be overstated. Environmental science is the science that merges the understanding of the physical science, biological science and social science in investigating the interactions of the natural systems with human activities. It is significant in the sense that it could offer scientific reasons as to why environmental change occurs, the reason behind environmental degradation and how they affect the environment in the short or long run. Scientific instruments used in analyzing the environment, e.g. environmental monitoring, modelling, impact assessment, etc., produce credible data that are crucial in making informed decisions. This scientific knowledge helps societies to stop responding to environmental crises but take precautionary and preventive measures towards development.

The significance of environmental science is acute in the Indian context because the country is characterized by a high level of population and the development goals coupled with the diversity of its ecological systems. India is undergoing a fast economic development and urbanisation and this factor has increased pressures on the environment in different regions. Extreme air-pollution of urban areas, pollution of large river systems, loss of groundwater supplies, and destruction of forests and biodiversity emphasize the necessity of a scientific intervention. Environmental science is very important in determining the source of pollution, the magnitude of environmental degradation, and the sustainability of development operations. It offers the empirical foundations of policy based on balancing of the environment and economic growth.

Climate change has also given prominence to the role of environmental science in the national and international arena. Increase in temperature, alterations in rainfall, common heatwave, flooding, cyclones and droughts have enhanced vulnerability of the environment and socio-economic risks. Environmental science provides the opportunity to study the climate trends objectively, assign extremes, and determine future risks. Such information is critical in formulating the climate adaptation and mitigation measures, disaster risk alleviation measures, and resilience-enhancing approaches, especially in the climate-sensitive areas.

Environmental issues are international in scope, and said issues necessitate international collaboration and international governance through environmental sciences. Global warming, ocean pollution, loss of biodiversity, and transboundary air pollution are issues that need to be dealt with in a coordinated manner using common scientific evidence. Environmental science has been shown to form the popular knowledge base that supports international environmental agreements, sustainable development goals and conservation of the environment around the world. In the absence of scientific agreement and reliable information, the global environmental issues would not be effectively addressed on common grounds. Moreover, environmental science is also significant in ensuring environmental justice and sustainable development. It has been scientifically proven that vulnerable and marginalised communities are disproportionately affected by environmental degradation which contributes to the increase of social and economic inequalities. Environmental science can help with more inclusive and fair policy interventions by recording such disparities. Therefore, the increased complexity, magnitude, and immediacy of environmental issues present the key role of environmental science in fostering ecological sustainability, human welfare, and the sustainability of societies in the long term.

Objectives of the Study

This study aims at analysing the increasing significance of environmental science in modern India and the world, studying significant issues of environmental concern in the light of empirical data and recent examples, evaluating the role of environmental science in the sustainable development and environmental governance, and outlining major technical and institutional difficulties in utilizing scientific knowledge in policy-making.

Methodology

The study adopts a qualitative and analytical research methodology based on secondary sources. Data have been collected from peer-reviewed journals, reports of Indian and international environmental institutions, and authoritative global assessments. Comparative and contextual analysis is used to examine environmental issues in India within a broader global framework.

Environmental Challenges in India: Scientific Evidence and Statistics

The environmental science has been a significant factor in recording the extent of environmental problems in India by gathering a lot of data, monitoring and scientific interpretation. Air pollution is given as one of the most significant risks of environmental health in the country. India is home to some of the most polluted cities in the world and in many cases, Delhi records a high amount of particulate matter (PM 2.5) which is much higher than the allowable levels provided by the national and international regulations. National health estimations indicate that air pollution causes millions of premature deaths every year, mostly caused by respiratory disease and heart diseases. There are various causes of pollution as established through scientific studies such as vehicle emissions, industrial establishments, dust during construction, and burning of the agricultural residues especially during the winter months in northern India. Environmental science has made it possible to not only trace the areas of pollution but also to develop solutions to reduce these risks like the National Clean Air Programme.

Another significant problem in India is the water pollution and its lack. A good percentage of the rivers within the country such as the Ganga, Yamuna and other minor tributaries are categorized to be polluted as a result of release of untreated sewage, industrial effluents, and agricultural runoffs. The rate of depletion is pronounced in the states like Punjab, Haryana, Rajasthan, and Tamil Nadu where groundwater is being extracted much faster than it is replenished posing a threat to water security in the long run. Urban centres such as Chennai and Bengaluru are experiencing chronic water stress and realistic approaches of water management that are sustainable are urgently required, as has been warned by hydrological studies. Environmental science provides the key information in terms of water quality evaluation, monitoring of the aquifer recharge, and policy guidelines on the integrated water resources management.

Extreme weather conditions and climate change have also increased the vulnerabilities of the environment of India. The frequency and intensity of heatwaves, floods, cyclones, and droughts in the country have increased significantly within the last twenty years. The risk of coastal areas is especially great because of the increase in sea levels as well as the intensifying hurricanes as evidenced by the recent occurrences at the eastern coast of India. Such tendencies have been attributed to the altered monsoon patterns and global climate change by environmental science, which forms the basis of climate adjustment strategies and diminishing the hazard of disasters through planning. The knowledge can play a crucial role in defending the vulnerable communities as well as promoting the socio-economic stability of disaster-prone areas. There are also other concerns such as deforestation and loss of biodiversity. The western ghats, the Eastern Himalayas and the central Indian forests are ecologically delicate areas under growing pressure in mining, infrastructure development and urban sprawls. Although India is also a megadiverse nation in the world, habitat fragmentation has been intensely experienced in the country to the detriment of wildlife corridors, endemic species, and ecosystem services. Environmental science has played a significant role towards the evaluation of deforestation level, species concentration, and conservation measures to maintain the health and biodiversity of ecosystems. There is also the rapid urbanisation, which has also led to

accumulation of solid waste and plastic pollution. The production of solid waste in municipalities has rocketed in large urban areas and the control of plastic waste is still poor leading to land and water pollution. Environmental science offers the necessary data in planning waste management, mitigation of pollution, and formulation of policies thus there is a great need to have sustainable environmental planning in an urban setting.

Global Environmental Issues and Scientific Insights

Environmental science has presented some worrying trends at the international level that jeopardize the stability of the planet and the welfare of the human beings. Climate change is the most serious international issue where scientific evidence indicates that the average temperatures in the world have risen by a large margin since pre-industrial times. The consequence of this warming has been the melting of glaciers, the rise in sea levels and the frequency of extreme weather conditions. It is always evident in climate models that the main cause of these changes is the direct effect of human-caused greenhouse emission of gases, which should be met by urgent mitigation and adaptation efforts in the global community. Another urgent issue that is of concern in the world is the biodiversity crisis. Deforestation on the Amazon rainforest, coral bleaching in the Great Barrier Reef, and degradation of habitats on a large scale depict the loss of species and ecosystems at an alarming rate. According to the estimates of environmental science, the extinction rates of current species are much higher than those in a natural background and pose a threat to ecosystem services which are important to food security, climate regulation and the survival of humankind. On the same note, pollution of the oceans has become a significant ecological issue. Plastic waste and microplastics have been recorded in most of the marine ecosystems, which are extremely risky to aquatic life and find their ways into the food chains. The scientific research has attributed the plastic pollution to expose toxic chemical effects, ecological damages, and the future health effects on humans and wildlife.

Air and water pollution is also an issue of concern globally especially in the fast industrialising areas. Air quality is still being threatened by industrial emissions, vehicle pollutants and chemical pollution, as untreated industrial effluents and agricultural runoffs impact on freshwater systems across the world. It is through environmental science that we offer the empirical evidence to comprehend all these compound issues, to monitor sources of pollutants and to implement international environmental agreements and plans of sustainability. Environmental science makes it possible to establish coordinated interventions based on evidence to protect the ecological and human health because it records local and global trends.

Key Environmental Indicators

Environmental Issue	Statistics	Importance Environmental Science	Source (2024–25)
Air Pollution (PM_{2.5})	Delhi: Annual PM _{2.5} ≈ 128 µg/m ³ ; AQI peaks ~490	Monitoring air quality, identifying pollution sources, guiding clean air policies, mitigating health risks	SigmaEarth, 2024; Times of India, 2025
Air Pollution Mortality	>1.26 million deaths in India annually	Quantifying health impacts; supporting public health interventions and policy planning	Drishti IAS, 2025
Water Pollution & Scarcity	80% of rivers polluted; 600 million Indians face water stress; reservoirs <40%	Assessing water quality, groundwater levels, supporting sustainable water management, urban planning	NITI Aayog, 2025; DowntoEarth, 2025
Groundwater Depletion	135 districts extracting >40 m deep groundwater	Hydrological modelling; identifying over-exploited aquifers; ensuring sustainable irrigation and drinking water supply	PLR IAS, 2025
Climate Change & Extreme Events	Heatwave 2024: peak 50.5 °C; floods, cyclones increasing	Climate risk assessment; adaptation and mitigation planning; disaster management	IMD, 2024; WMO, 2025
Deforestation & Forest Cover Loss	India: 29,000 ha diverted 2023–24; Global Forest loss ~29.6 Mha	Monitoring forest cover; assessing biodiversity loss; guiding afforestation and conservation policies	FSI, 2024; FAO, 2024
Biodiversity Loss	7,000+ species threatened in India; 1 million species globally at risk	Habitat mapping; species monitoring; conservation prioritisation; ecosystem service evaluation	MoEFCC, 2024; IPBES, 2023
Plastic & Solid Waste Pollution	India: 4.14 M tons plastic waste; global recycling <10%	Waste tracking; policy support for recycling, circular economy; mitigating land and marine pollution	CPCB, 2024; UNEP, 2024
GHG Emissions	India: 3.22 billion tonnes CO ₂ ; global emissions at record highs	Emission inventory; modelling climate scenarios; guiding renewable energy policies	CIVILSDaily, 2024; IEA, 2025
Coral Reef & Marine Health	~84% of global coral reefs impacted (2023–25)	Ecosystem monitoring; evaluating climate impacts on marine biodiversity; informing international conservation efforts	Wikipedia, 2025; UNEP, 2024

Role of Environmental Science in Sustainable Development and Governance

Environmental science is crucial in enhancing sustainable development by offering empirical basis of the environmental policy and governance. Environmental laws, pollution regulation policies, climate response plans, conservation policies and management of natural resources are informed by scientific research. The processes of Environmental Impact Assessment are dependent on scientific data that can be used to assess the ecological impact of development projects. Environmental science in India assists in the efforts that are connected with renewable energy, climate adjustment, biodiversity protection, and calamity preparedness. Scientific modelling and risk assessment would empower the policymakers to foresee the impacts of the environment instead of reacting to the crisis. The application of environmental science is also relevant in the realization of the Sustainable Development Goals as it entails the combination of environmental sustainability with economic and social goals. Environmental science also enhances the justice of the environment by reporting the imbalanced distribution of environmental dangers. Studies have indicated that the marginalised communities tend to have a skewed level of pollution, climate effects and resource degradation. Environmental science will help in inclusive and fairer policy frameworks by shedding light on these inequalities.

Institutional Challenges

Environmental science is an important discipline, but is subject to serious technical and institutional problems. Inadequate surveillance systems particularly in rural and remote areas limits access to and quality of data. The uncertainty in scientific predictions arises because of the complexity of environmental systems that make it difficult to make decisions. Discontinuous institutional structures and poor cooperation of scientific agencies and policymakers also restrict the successful application of scientific knowledge. The challenge of balancing economic development and environmental protection is still an issue. The lack of scientific evidence in policy making is mainly caused by short term economic priorities at the expense of long term ecological priorities. It is therefore important to strengthen the science policy interface so that the environmental science can be used to provide good governance.

Conclusion

The environmental science has become a necessity in solving the environmental issues facing India and the world. Scientific facts and recent ecological disasters prove that unsustainable development is a great threat to the ecological balance, human lives and economic well-being. Environmental science offers the instruments needed to comprehend the environmental processes and evaluate the risks, as well as create the policy interventions that are efficient. The enhancement of environmental science by means of better monitoring, interdisciplinary studies, and closer links to policymaking is the key to sustainable development, environmental justice, and the welfare of the current and future generations.

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Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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