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International Collaboration for Conservation of the Environmental Pollution Regulation

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Abstract

The degradation of the global environment has evolved from an isolated, localized concern into one of the most pressing governance challenges of the twenty-first century. Industrialization, rapid urbanization, the extensive use of fossil fuels, and the transboundary movement of pollutants have collectively strained planetary systems beyond safe limits. This manuscript provides a comprehensive examination of the international legal and institutional architecture developed to address environmental pollution, tracing its evolution from foundational principles of customary international law to landmark treaties such as the 1972 Stockholm Declaration, the 1987 Montreal Protocol, the 1992 Rio Earth Summit frameworks, the 1997 Kyoto Protocol, and the 2015 Paris Agreement. Drawing on an empirical survey of 350 participants, the study also explores public perception and awareness of air pollution and its consequences in the Indian context, where cities such as Delhi, Mumbai, and Ahmedabad consistently record Air Quality Index values that exceed safe thresholds by alarming margins. The manuscript further analyses the institutional mandates of the United Nations Environment Program, national pollution control boards, and regional cooperative bodies. Evidence from case studies including the Trail Smelter Arbitration and the ozone-layer recovery driven by the Montreal Protocol demonstrates that legally binding, science-guided international cooperation can reverse environmental harm. The study concludes with policy recommendations calling for a shift from reactive to proactive environmental governance, integrating sustainable development imperatives with equitable, enforceable pollution standards.

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1. INTRODUCTION

Over the last 200 years, the human-natural environment connection has changed drastically. Environmental damage prior to the Industrial Revolution was local in nature. The twentieth century broke down this comfortable separation: sulphur dioxide from Canadian smelters made American farmland unviable; chlorofluorocarbons produced by the industry of any part of the world reduced the ozone layer over Antarctica; carbon dioxide emitted from coal power stations on each continent is heating the global atmosphere, making cities by the ocean and small island states vulnerable. Environmental damages are an unsolvable transboundary issue, which requires a multilateral and collective solution. Today the pollution and conservation of the environment are a single issue of global importance. The results of any single nation's (or narrow group of nations') efforts to protect the environment are inevitably limited. Reversing this trend and ensuring the future of life on earth will be seriously threatened if it is not done in collaboration with all nations. The cost of economic growth in industrialized countries has been extremely high: extensive pollution of air, water and soil. In poor countries,

environmental issues are mainly due to poverty and low level of development, with the effects being just as serious. An investigation conducted at the National Environmental Engineering Research Institute (NEERI) in Nagpur in 1981 revealed that the pollution level in the major metropolitan cities of the country had been deteriorating over the years, including Mumbai and Old Delhi. By 2006, the list of severely polluted urban centre now includes cities like Chennai, Uttar Pradesh urban centre and Ahmedabad. According to IQ Air data, as of 2024, twenty-two of the 30 most polluted cities in the world are in India. The average PM 2.5 level in Delhi during 2023 was more than 18 times higher than the WHO annual guideline level of 5 micrograms per cubic meter. This equates to millions of deaths, hospitalizations, missed school, and lost agricultural productivity. The dilemma of the developing countries was clearly expressed in 1972 by the late Prime Minister Mrs Indira Gandhi, who spoke at the United Nations Conference on the Human Environment held in Stockholm: "Poverty itself is a form of pollution" and "The need to develop is inseparable from the need to protect the environment". Her core idea, development and environment protection go hand in hand, remains relevant half a century later and is the basis for the architecture of international environmental law. The manuscript will look at the history of international cooperation in regulating environmental pollution, from customary international law to the strong treaty regimes of the late 1900's and the climate change, biodiversity and plastic pollution issues of today. It puts the domestic legislative experience of India in a global perspective and brings to light how the common people of India see environmental pollution in light of original survey data, thereby providing a linkage between legal/ institutional analysis and lived experience.

2. ENVIRONMENT AND INTERNATIONAL LAW

International environmental law is a unique field which stands at the intersection of public international law and environmental science and political economy. It is based on principles of customary international law in vogue before the advent of the modern environmental movement, namely, the principle that no state has the sovereign right to use its territory in a manner that causes harm to another state or to areas beyond national jurisdiction. The Latin phrase sicuteretuoutalienum non laedas (use your own property so as not to injure another) was ingrained in the Roman law and would survive into early modern international law in the writings of Hugo Grotius, and foreshadow the main question of transboundary environmental governance.

2.1 The Trail Smelter Arbitral Award

The state responsibility for transboundary environmental injury which was most consequential was the Trail Smelter Arbitral Tribunal (United States v. Canada, 1938-1941). The controversy stemmed from sulphur dioxide pollution from a zinc-lead smelter in Trail, B.C. that severely affected crops, forests and property in the State of Washington. In accordance with the principles of international law, no state can have the right to use or permit to be used its territory in a way that results in injury to another state in its territory, property or persons in its territory, the Tribunal established. It was decided that Canada was responsible, and had to pay compensation and take care that no more damage was done. This decision was to become the basis for transboundary pollution law. The principles outlined in the Trail Smelter Principle were later extended in other international decisions, such as the Corfu Channel Case (1949), the Nuclear Tests Cases (1974), the Gabcikovo- Nagy Maroš Project Case (1997), and the Pulp Mills on the River Uruguay Case (2010), in which the ICJ introduced the procedural requirement for an environmental impact assessment prior to the authorization of activities that may produce transboundary impacts. These decisions created a jurisprudence which imparted to the no-harm principle the contemporary status attributed to it.

2.2 Core Principles of International Environmental Law

In addition to case law, customary international environmental law has become codified in a number of general principles. The no-harm principle is the minimum requirement to avoid trans-border environmental harm. The precautionary principle of the 1992 Rio Declaration, which states that precautionary measures should not be delayed when there is still scientific uncertainty about the effects of a given activity or product but they are likely to cause serious or irreversible environmental damage if not taken, has been fully adopted. The precautionary principle contained in the 1992 Rio Declaration, which says that the absence of full scientific certainty shall not be used as a reason for postponing measures that are cost effective and necessary to prevent serious or irreversible environmental damage, is fully adopted. The polluter pays principle seeks to bring pollution costs back into the economic decision making of the polluters. The principle of common but differentiated responsibilities (CBDR) recognizes that all states have a role to play in the protection of global environment, but that the role of industrialized states is greater because they have historically contributed more to the cumulative global pollution and have a greater financial and technological capacity.

3. INTERNATIONAL COLLABORATION FOR CONSERVATION OF THE ENVIRONMENT

The issue of the protection of the environment in international law had so far been tackled in a piecemeal and rather reactive way, before the United Nations Conference on the Human Environment met in Stockholm in June of 1972. The concept of a special international protocol for environmental protection, as well as its own institutions, principles and financing mechanisms, did not yet have political momentum. International community had negotiated separate instruments for each environmental issue separately, without a common philosophy or a coordinating body which could see the wood for the trees.

3.1 Pre-Stockholm Environmental Agreements

International law, however, didn't have a 100% green conscience in the decades prior to Stockholm. The International Convention for the Regulation of Whaling (ICRW) was the first multilateral wildlife governance regime established in 1946. Marine pollution by ships was dealt with by the International Convention for the Prevention of Pollution of the Sea by Oil (OILPOL) in 1954. The 1963 treaty on the ban of nuclear weapons testing was called the Partial Nuclear Test Ban Treaty and treated radioactive fallout contamination of soils, waters and food supplies. The Outer Space Treaty of 1967 called for parties to not cause harmful contamination of outer space or adverse environmental change on Earth. The importance of wetlands as an ecosystem type was recognized in the Ramsar Convention on Wetlands of International Importance, especially as waterfowl habitat, which was established in 1971. As of 2024, there are 172 contracting parties to the Ramsar Convention and more than 2,400 Ramsar sites.

3.2 The Stockholm Conference (1972) and Its Legacy

The 1972 Stockholm, Sweden United Nations Conference on the Human Environment, convened by 113 governments and hundreds of intergovernmental and non-governmental organizations, was the first large international conference to focus on the environment and bring it to the centre of the global political agenda. It left two lasting legacies: The Stockholm Declaration, a 26-principal manifesto which laid the philosophical principles of international environmental law, and the establishment of the United Nations Environment Program (UNEP) as the main UN institution dedicated to environmental issues, with its headquarters in Nairobi, Kenya in a clear signal that environmental issues were of high importance for the developing world. Following Stockholm, the rate of environmental treaty-making has picked up significantly. A London Convention was passed in 1972 that limited dumping of toxic chemicals and radioactive substances in the ocean. The Convention on International Trade in Endangered Species of Wild Fauna and Flora (1973) (CITES) provides regulation of the wildlife trade to more than 38,000 species. In 1979, the Convention on Long Range Transboundary Air Pollution (CLRTAP) the first legally binding air pollution convention was adopted, establishing monitoring networks and emission-reduction measures in Europe and North America, which showed the feasibility of coordinated air quality management at the regional level. From Stockholm, more than 500 multilateral environmental treaties have been signed, making international environmental law one of the most productive realms of international lawmaking.

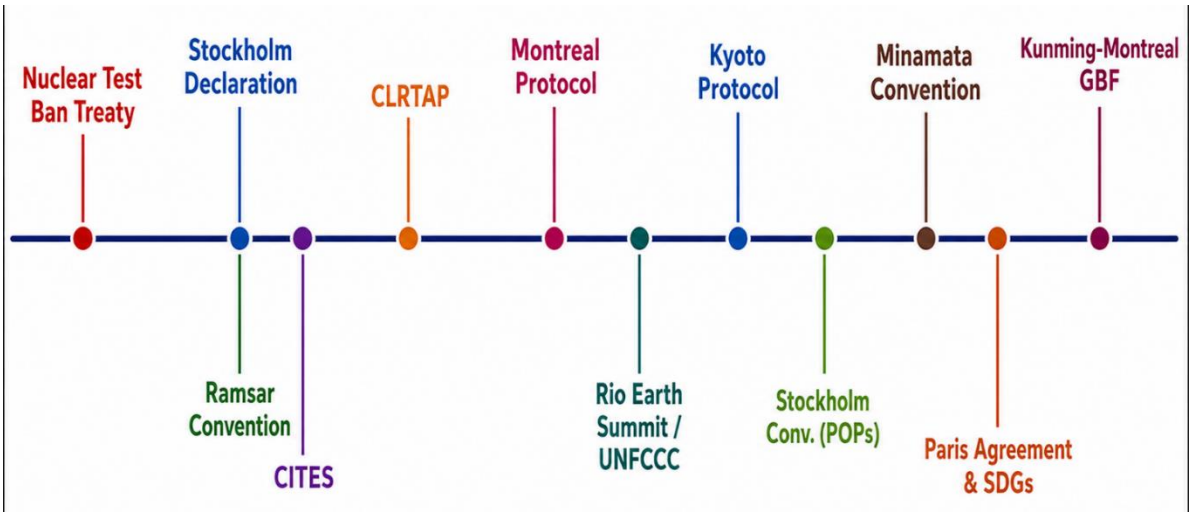

Figure 1: Timeline of Major International Environmental Agreements (1963-2022)

4. MAJOR INTERNATIONAL ENVIRONMENTAL TREATY REGIMES

5.1 The Ozone Layer Regime: Montreal Protocol (1987)

In September 1987, the Montreal Protocol on Substances that Deplete the Ozone Layer was signed, and it is considered to be the most successful international environmental treaty negotiated to date. Scientific evidence, including the discovery of the Antarctic ozone hole by British scientists in 1985, confirmed by the early 1980s, showed that chlorofluorocarbons (CFCs), halons and other related compounds were depleting the stratospheric ozone layer, which protects life from harmful ultraviolet radiation. The Protocol stipulated a phased approach to the elimination of these substances, with the developed countries first, and devolving transition dates to the developing countries and providing finances and technical assistance via the Multilateral Fund. The Protocol's design ultimately served as a template for later multilateral environmental agreements, including "binding" phase-out schedules that grow more stringent as science dictates; a Multilateral Fund for financial transfers to developing countries; technology transfer mechanisms; and a non-compliance procedure to ensure accountability without adversarial legal action. The Protocol was signed by all 197 UN member countries in 2023, it became the first universal treaty ever signed in UN history. The Antarctic ozone hole should fully heal around 2065. The 2016 Kigali Amendment further expanded the Kigali framework to include hydrofluorocarbons (HFCs) with substantial climate co-benefits. In the 1980s, CFC production in the developed countries was about a million tonnes per year, but by 2010 the production had decreased by more than 98 per cent.

5.2 The Climate Change Regime: UNFCCC to Paris Agreement

The United Nations Framework Convention on Climate Change (UNFCCC), adopted at the Rio Earth Summit in 1992, established the overarching framework for international climate action, committing parties to stabilizing greenhouse gas concentrations at levels preventing dangerous anthropogenic interference with the climate system. The Kyoto Protocol (1997) gave this commitment concrete expression with legally binding emission-reduction targets for industrialized countries for the 2008-2012 period.[1] It also introduced market-based flexibility mechanisms: emissions trading, the Clean Development Mechanism (CDM), and Joint Implementation, allowing cost-effective compliance while financing low-carbon development in developing countries. The Kyoto Protocol's shortcomings were significant: The United States never ratified it; Canada withdrew in 2011; and the world's largest emitters China, India, and Brazil faced no binding targets. Global emissions continued to rise throughout the Kyoto era, illustrating the inadequacy of regimes that exclude major emitters. The 2015 Paris Agreement attempted a fundamental redesign: a bottom-up architecture of nationally determined contributions (NDCs) submitted by all parties. Its legally binding obligations applied to processes rather than specific emission levels, with a five-year cycle of submission, assessment, and enhancement through a global stock take mechanism. Its central temperature target limiting global warming to well below 2 degrees Celsius and pursuing efforts to limit it to 1.5 degrees Celsius provided scientific clarity. By

2024, 195 parties had submitted NDCs. The collective gap between current NDC ambition and the trajectory required to meet temperature goals, however, remains the defining implementation challenge of the current era.

5.3 The Biodiversity Regime: CBD to Kunming-Montreal

The Convention on Biological Diversity (CBD) adopted at Rio in 1992 has three co-equal aims: conservation of biological diversity, sustainable use of its components, and sharing of benefits from the use of biological diversity fairly and equitably. Since Rio, biodiversity has been on the decline: The 2019 Global Assessment Report on Biodiversity and Pollution by the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) estimated that some 1 million species would be lost within decades due to land use, overexploitation, climate change, pollution and invasive species. By the 2020 deadline, only a few of the 2010 Aichi Biodiversity Targets have been achieved. The 2022 Kunming-Montreal Global Biodiversity Framework (GBF) established new global goals: 30x30 – at least 30 percent of the planet's land, inland waters, coastal areas and oceans by 2030; and mobilizing at least USD 200 billion annually for biodiversity by 2030, including at least USD 30 billion in international finance flows to developing countries.

Table 1: Comparison of Key International Environmental Treaties and Agreements

Treaty /Agreement	Year	Parties	Core Objective	Key Mechanism
Vienna Convention on the Ozone Layer	1985	198	Framework for ozone layer protection	Scientific cooperation; basis for Montreal Protocol
Montreal Protocol	1987	197	Eliminate ozone-depleting substances	Phase-out schedules; Multilateral Fund; Kigali Amendment 2016
UNFCCC	1992	198	Stabilise greenhouse gas concentrations	National Communications; climate finance; technology transfer
Convention on Biological Diversity	1992	196	Conserve biodiversity; ensure benefit-sharing	NBSAPs; Nagoya Protocol; Kunming-Montreal GBF
Kyoto Protocol	1997	192	Binding GHG cuts for Annex I countries	Emissions trading; CDM; Joint Implementation
Stockholm Convention (POPs)	2001	186	Eliminate Persistent Organic Pollutants	Listing mechanism; BAT/BEP requirements
Minamata Convention	2013	147	Protect health from mercury pollution	Mercury life-cycle management; phase-outs
Paris Agreement	2015	195	Limit warming to 1.5-2 degrees Celsius	NDCs; Global Stocktake; climate finance; adaptation
Kunming-Montreal GBF	2022	196	Halt biodiversity loss; 30x30 by 2030	USD 200bn/yr finance; harmful subsidies reform

5. THE HUMAN ENVIRONMENT DECLARATION

The Declaration on the Human Environment, which is the central normative document of the 1972 Stockholm Conference, is a document containing twenty-six principles that sets the philosophical foundations of international environmental law. In its aspiration it was compared by legal scholar J. G. Starke to the Universal Declaration of Human Rights of 1948: It is, in essence, a "manifesto" expressed as a code of ethics designed to guide and influence future action and program, both nationally and internationally. The Stockholm Declaration was not legally binding on itself, but its impact on the evolution of international law and national environmental legislation has been enormous. The Declaration took the form of two parts. The Proclamation contained seven declarations regarding the relationship of humans to the environment and the need to protect the environment. The second part presented twenty-six principles to serve as guidelines to environmental behavior of states. The tension at the heart of the environmental era was recognized in the preamble: Man is the "creature and the moulder of his environment," with the power to shape it for better or worse. This dichotomy was faced by both developed and developing countries: developed countries realised the damage caused by their development in the past, while the developing countries argued their right to develop without bearing undue burden for the damage they did not cause.

5.1 Selected Tenets of the Stockholm Declaration

Principle 1 recognizes the right of people to enjoy a good life in a decent environment where everyone can live and enjoy a healthy life and the responsibility to safeguard and improve the environment for the sake of future generations. This right and responsibility was doubled, and it brought in the principle of intergenerational equity, developed by the Brundtland Commission and incorporated into the sustainable development concept. According to principle 2, the natural resources of the earth, which include air, water, land, flora and fauna, should be preserved, managed and developed for the benefit of all present and future generations through careful planning or management. In the Stockholm Convention on Persistent Organic Pollutants (2001) and the Minamata Convention on Mercury (2013), Principle 6, which was directly inspired by this principle, was interpreted as requiring that discharges in quantity that exceeds the ability of the environment to render the pollutant harmless are stopped. It is the 21st principle that is arguably the most legally significant provision in the Declaration. It affirms the sovereign rights of States to utilise their natural resources whilst also placing on them the duty to avoid damaging the environment of other States or of areas beyond national jurisdiction where they are located. This "balance of sovereignty and responsibility" has been copied in almost every later multilateral environmental treaty. Principle 22 requires states to cooperate in the establishment of international law on liability and compensation for environmental damage, which has yet to be fully realized after 50 years.

Table 2: Selected Principles of the 1972 Stockholm Declaration on the Human Environment		
Principle No.	**Core Substance**	**Significance and Later Development**
Principle 1	Fundamental right to a quality environment; responsibility to protect it	Foundation for UNGA 2022 resolution recognizing the right to a clean, healthy, sustainable environment
Principle 2	Natural resources must be safeguarded through planning and management	Basis for sustainable use concept in CBD (1992) and Kunming-Montreal GBF (2022)
Principle 4	Wildlife and natural heritage must be preserved	Anticipates CITES (1973), CBD (1992), and the Kunming-Montreal 30x30 target (2022)
Principle 6	Toxic substance discharges must not exceed environmental absorption capacity	Directly inspired Stockholm Convention on POPs (2001) and Minamata Convention (2013)
Principle 13	Integrated development planning to protect and improve environment	Anticipates Agenda 21 (1992), SDG framework (2015), and national sustainable development strategies
Principle 21	Sovereign right over resources coupled with responsibility not to harm others	Most cited principle in transboundary pollution disputes; reproduced in Rio Declaration Principle 2
Principle 22	Develop international law on liability and compensation for environmental damage	Inspired Basel Protocol; Nagoya-Kuala Lumpur Supplementary Protocol on liability and redress
Principle 24	Multilateral cooperation essential for environmental protection	Affirmed in every subsequent multilateral environmental agreement as a foundational norm

6. THE HUMAN ENVIRONMENT ACTION PLAN

In 1972, the Declaration was accompanied by the Action Plan for the Human Environment which set out the normative concepts of the Declaration in an operational programme of international action. It was designed with three interconnected strands: Environmental Assessment Program (Earth watch), Environmental Management Activities and Supporting Measures. These together highlighted the belief that science should guide governance, governance should be integrated through all sectors, and that international cooperation should be built on institutional capacity and financial support, which was novel in 1972.

6.1 Earth watch: Global Environmental Assessment

Earth watch began to develop a structure to monitor, research, assess and disseminate information about the state of the global environment. It included systematic observation, research to help address knowledge gaps, evaluation and review of environmental conditions, information exchange to ensure the dissemination of environmental information to decision-makers at all levels, and technical assistance to strengthen scientific capacities in developing countries. Earth watch is reflected in the modern world-wide environmental monitoring architecture. More than 500 stations around the world are part of the Global Atmosphere Watch (GAW) run by the World Meteorological Organization to monitor greenhouse gases, ozone, aerosols, and precipitation chemistry. The Global Ocean Observing System measures ocean temperature, salinity and circulation. In India, the National Ambient Air Quality Monitoring Program (NAAQM) and the Continuous Ambient Air Quality Monitoring Systems (CAAQMS) are two local interpretations of the Earth watch mantra of 'Management is effective when there is reliable measurement.

6.2 Environmental Management Activities

The environmental management component of the Action Plan aimed to help make science into action in policy in all sectors. The main activities were the formulation of environmental quality standards and technical guidelines, the prevention of habitat destruction and soil degradation as a result of integrated land use planning, the management of human settlements for better living conditions and lower urban pollution, the strengthening of regulatory marine pollution control, the introduction of environmentally friendly technologies and the creation of environmental education and public awareness programmes. This agenda has led to an extraordinary proliferation in laws, institutional arrangements and international standards in the decades since Stockholm from national environmental impact assessment laws to the ISO 14001 standard for environmental management systems that has been adopted by thousands of organizations around the world.

6.3 Supporting Measures: Finance, Institutions, and Education

Financial resources, competent institutions, qualified staff, and an environmentally conscious public are the enabling conditions that would otherwise make environmental management a goal unattainable, and comprise the third element of the Action Plan. An environment fund, created with the support of UNEP, was the source of seed funds for environmental activities. Scaling up international financing for environment has been tried and retried throughout the last five decades since the Stockholm Conference. The loss and damage fund under the UNFCCC in COP27 in Sharm el-Sheikh in 2022, and the Global Biodiversity Framework Fund, were the most recent examples of moving financial resources to support the commitments in the treaties. One of the most disputed fault lines in modern environmental diplomacy is between the promise and the delivery of finance.

7. ENVIRONMENTAL POLLUTION: TYPES, CAUSES, AND CONSEQUENCES

Environmental pollution encompasses the introduction of substances or energy into the natural environment in quantities or concentrations that cause measurable harm to ecosystems, human health, and property. It is not a single phenomenon but a diverse family of challenges, each with distinct causation, pathways, and regulatory requirements. Understanding the full spectrum of pollution types is a prerequisite for designing effective national and international regulatory responses.

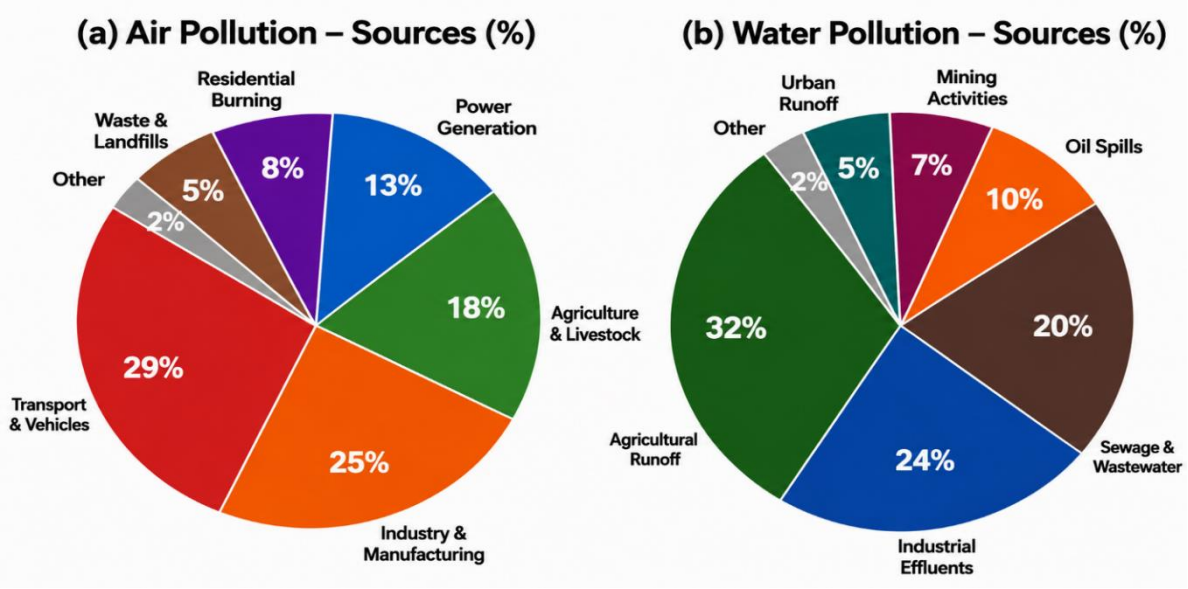

Figure 2: Primary Sources of Air and Water Pollution Globally (Percentage Share)

7.1 Air Pollution

Air pollution is the number one environmental health hazard in the world. According to the World Health Organization, in 2019, ambient outdoor air pollution contributed to the deaths of 4.2 million people, and household air pollution due to solid fuel contributed to an additional 3.8 million deaths, accounting for one in eight of all deaths worldwide. The main pollutants are fine and coarse particulate matter (PM2.5 and PM10), ground-level ozone (O3), sulphur dioxide (SO2), nitrogen dioxide (NO2), carbon monoxide (CO), lead and volatile organic compounds (VOCs). The extremely small size of PM2.5 allows it to penetrate deeply into the lungs and circulate in the blood stream, is responsible for cardiovascular disease, stroke, lung cancer and chronic obstructive pulmonary disease. Transport and vehicles constitute about 29 per cent of air pollution by source, followed by industry and manufacturing (25 per cent), agriculture and livestock (18 per cent), power generation (13 per cent), residential biomass and coal burning (8 per cent) and waste and landfills (5 per cent). In India, the situation is further complicated by burning of crop residues the millions of tons of rice straw which are burnt before the planting of wheat in post-kharif season in Punjab and Haryana. This smoke is carried by north-westerly winds and is trapped due to the temperature inversion, resulting in the largest episodes of pollution in Delhi in the winter when AQI levels often exceed 400, classified as Hazardous. Instructive comparison with the 1980s: Delhi was around 800,000 vehicles in the 1980s, and has now grown to more than 14 million, yet the per-vehicle emissions have actually decreased by a lot, thanks to multiple tougher emission norms.

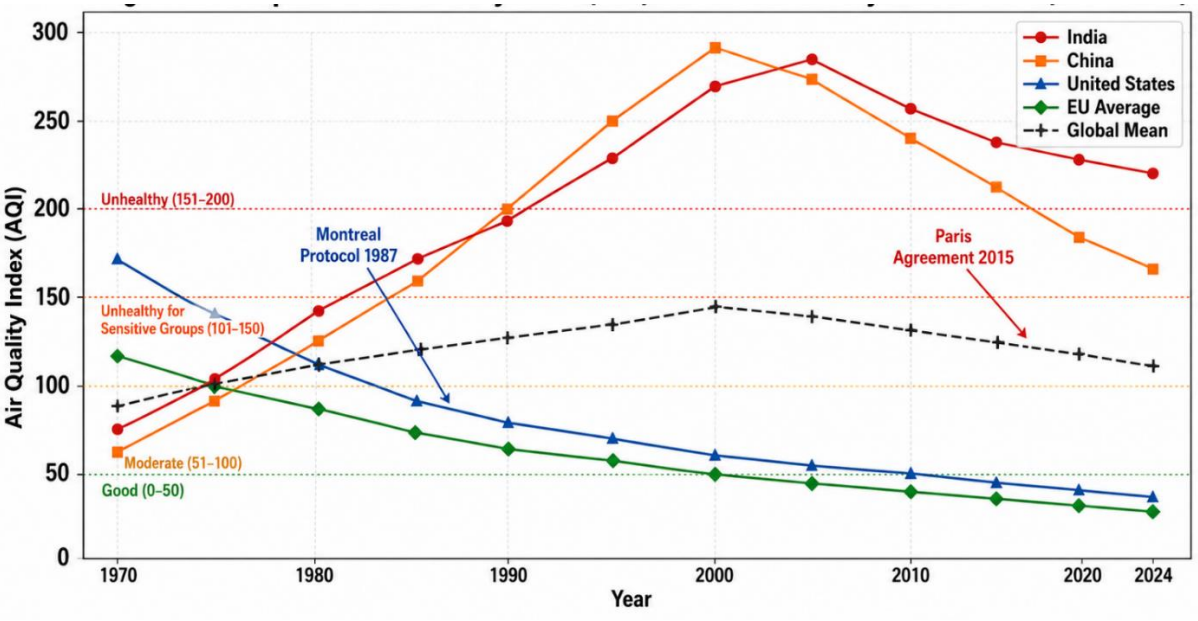

Figure 3: Comparative Air Quality Index (AQI) Trends Across Major Economies (1970-2024)

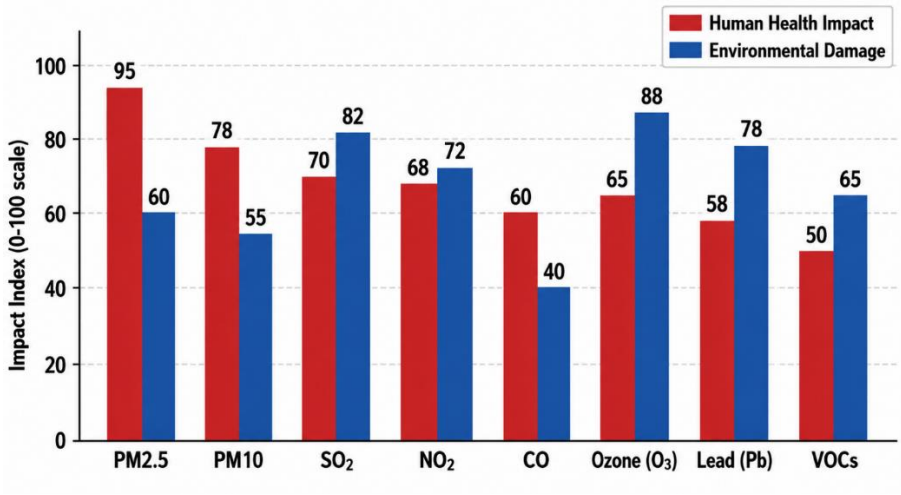

Figure 4: Health and Environmental Impact Indices of Major Air Pollutants

Figure 4 illustrates a revealing contrast between regions. The United States and Europe demonstrate that strong environmental regulation, technological improvement, and fuel switching can produce sustained improvements: US AQI has fallen from approximately 160 in 1970 to around 40 by 2024, reflecting the success of the Clean Air Act of 1970 and its amendments. China, after two decades of rapidly worsening air quality, has shown significant improvement since its 2014 declaration of a war on pollution; national average PM2.5 fell by over 50 percent between 2013 and 2022. India's trajectory is more complex, with modest improvements in some cities contrasting with continuing deterioration in others, highlighting the need for more consistent, comprehensive action.

7.2 Water Pollution

Water pollution degrades the quality of freshwater and marine systems, rendering them unfit for human consumption, agriculture, aquatic life, and recreation. Agricultural runoff is the leading source globally (approximately 32 percent of water pollution), contributing nitrates, phosphates, pesticides, and sediment. Industrial effluents -- heavy metals, acids, solvents, and persistent organic compounds account for around 24 percent. Inadequately treated sewage contributes 20 percent; oil spills and marine pollution 10 percent; and mining activities 7 percent. India's rivers illustrate the scale of the challenge. The Ganga receives an estimated 2.9 billion litres of sewage per day along its 2,525-kilometer course, of which only a fraction receives adequate treatment. The Namami Gange Program, launched in 2014 with an outlay of INR 20,000 crore, has expanded sewage treatment capacity from 1,165 million litres per day in 2014 to over 2,800 MLD by 2023. Yet biochemical oxygen demand in stretches near Kanpur, Varanasi, and Patna continues to substantially exceed the standard of 3 mg/l for bathing water quality.

7.3 Soil and Land Pollution

Soil pollution the accumulation of toxic chemicals, heavy metals, and pathogens at levels impairing soil function receives far less regulatory attention than air and water pollution, partly because it is less visible and partly because its consequences are often delayed. Principal sources include industrial activities such as mining and smelting; agricultural use of pesticides and synthetic fertilizers; indiscriminate disposal of municipal solid waste; and military activities. In contemporary India, the explosion of electronic waste has created a severe soil contamination problem. Informal e-waste recycling clusters in cities such as Moradabad and Firozabad expose workers and surrounding communities to lead, cadmium, hexavalent chromium, and mercury at concentrations far exceeding safety limits. The E-Waste (Management) Rules of 2022 strengthened the Extended Producer Responsibility framework, but enforcement remains irregular and informal recycling continues at scale.

7.4 Marine and Ocean Pollution

Marine pollution has emerged as one of the defining environmental crises of the early twenty-first century. UNEP estimates that eight million metric tons of plastic enter the ocean every year equivalent to emptying a garbage truck into the sea every minute. The Great Pacific Garbage Patch covers an estimated 1.6 million square kilo meter, approximately three times the size of France. Microplastics have been detected in the deepest ocean trenches, in Arctic sea ice, in drinking water, and in human blood and breast milk, raising profound questions about long-term health consequences. The 2022 UN Environment Assembly resolution to develop a global legally binding agreement to end plastic pollution directing an Intergovernmental Negotiating Committee to complete work by 2025 represents the most ambitious environmental policy initiative since the Paris Agreement. Comparing the present with the early 1970s, when the London Convention on ocean dumping was the primary international instrument, the scale of ambition has expanded dramatically even as the scale of the problem has grown proportionately.

Table 3: Types of Environmental Pollution -- Sources, Health Effects, and Regulatory Frameworks

Type	Primary Sources	Key Health / Environmental Effects	Major Regulatory Frameworks
Air Pollution	Transport, industry, agriculture, power generation, residential burning	Respiratory disease, cardiovascular illness, cancer, ecosystem acidification, crop damage	Air (P&CP) Act 1981 (India); Clean Air Act (USA); EU Air Quality Directive; CLRTAP

Water Pollution	Agricultural runoff, industrial effluents, sewage, oil spills, mining	Waterborne diseases, eutrophication, loss of aquatic biodiversity, contaminated drinking water	Water Act 1974 (India); Clean Water Act (USA); EU Water Framework Directive; UNCLOS
Soil/Land Pollution	Mining, industrial waste, pesticides, e-waste, municipal solid waste	Fertility loss, groundwater contamination, food-chain bioaccumulation, ecosystem disruption	Stockholm Convention (POPs); E-Waste Rules 2022 (India); Hazardous Waste Rules 2008
Marine Pollution	Plastic waste, oil spills, shipping, land-based runoff, noise	Ingestion by marine life, reef bleaching, microplastic contamination, fishery collapse	MARPOL Convention; London Protocol; Minamata Convention; UNEA Plastics INC process
Noise Pollution	Road/rail/air transport, industry, construction	Hearing impairment, cardiovascular stress, sleep disorders, wildlife communication disruption	EU Environmental Noise Directive; WHO Night Noise Guidelines; national regulations
Radioactive Pollution	Nuclear power, medical/industrial use, weapons testing	Radiation sickness, cancer, long-term genetic effects, ecosystem contamination	IAEA safety standards; Nuclear Non-Proliferation Treaty; national nuclear regulators

8. INDIA'S ENVIRONMENTAL REGULATORY FRAMEWORK

India's domestic environmental law framework is among the most comprehensive in the developing world in terms of legislative breadth. The constitutional foundation is significant: Article 48A of the Constitution (inserted by the 42nd Amendment in 1976) directs the State to protect and improve the environment and to safeguard forests and wildlife. Article 51A (g) imposes a fundamental duty on every citizen to protect and improve the natural environment including forests, lakes, rivers, and wildlife, and to have compassion for living creatures. These constitutional provisions have been the basis for extensive judicial activism, particularly by the Supreme Court of India, which has treated the right to a healthy environment as an aspect of the right to life under Article 21.[2]

8.1. Key Legislative Instruments

The Water (Prevention and Control of Pollution) Act of 1974 was India's first major environmental statute, establishing the Central Pollution Control Board (CPCB) and State Pollution Control Boards (SPCBs). This Pollution Instrument Panel was established in accordance with Section 3 of the Water (Prevention and Control of Pollution) Act of 1974. In addition to its other responsibilities, it serves as the Central Pollution Instrument Panel for regulating and controlling pollution under this Act. The initial legislation had a number of shortcomings: limited penalties that failed to deter large industrial violators, inadequate funding for boards, and political interference in enforcement. Even after twenty-five years, significant modifications had not been made to deter entities from polluting the air or water for whatever reason. The Air (Prevention and Control of Pollution) Act of 1981 extended the boards' mandate to air quality. The Environment (Protection) Act of 1986 -- enacted in the aftermath of the Bhopal Gas Tragedy, in which an explosion at the Union Carbide pesticide plant killed an estimated 15,000 people and injured over 500,000 -- provided sweeping powers to take measures to protect and improve environmental quality, enact standards, create eco-sensitive zones, and require environmental impact assessments. The Act was enacted to give pollution control boards the ability to decide which geographic areas were appropriate for industry and which were not.

8.2. Pollution Control Boards and National Standards

The Central Pollution Control Board Sets National Ambient Air Quality Standards (NAAQS) the minimum air quality benchmarks that state boards must enforce and prescribes emission standards for industrial sources. India's NAAQS, revised in 2009, set the annual mean PM2.5 at 40 micrograms per cubic meter and the 24-hour standard at 60 micrograms per cubic meter. By contrast, the WHO's 2021 revised Air Quality Guidelines set the annual mean PM2.5 guidelines at 5 micrograms per cubic meter and the 24-hour guideline at 15 micrograms per cubic meter standards far more stringent than India's current statutory requirements, let alone its actual air quality in major cities. This gap reflects both the political economy of environmental regulation and the complex trade-offs between industrial growth, poverty reduction, and environmental protection that developing nations navigate.

8.3. National Capital Territory: A Policy Laboratory

Delhi has served as India's most intensively regulated urban air quality case study. The Supreme Court's landmark orders in M. C. Mehta v. Union of India, beginning in the mid-1990s, forced the conversion of the entire public bus fleet and all auto-rickshaws to Compressed Natural Gas (CNG), completed by 2001. Bharat Stage VI emission norms for vehicles, equivalent to the European Union's Euro VI standards, were introduced from April 2020, significantly reducing per-vehicle NOx and particulate matter emissions. The National Clean Air Program (NCAP), launched in January 2019, set city-specific PM10 and PM2.5 reduction targets and established monitoring and accountability frameworks. Delhi's annual average PM2.5 fell from approximately 113 micrograms per cubic meter in 2016 to around 92 micrograms per cubic meter in 2023 a meaningful improvement, but still far above safe levels, illustrating that regulatory interventions can make a measurable difference while structural drivers -- vehicle growth, coal power, agricultural burning continue to pose formidable challenges.

9. SUSTAINABLE DEVELOPMENT AND GLOBAL ENVIRONMENTAL GOVERNANCE

9.1 The Brundtland Commission and Intergenerational Equity

The concept of sustainable development entered the mainstream of international environmental discourse through the 1987 report of the World Commission on Environment and Development (WCED), chaired by Norwegian Prime Minister Gro Harlem Brundtland. Our Common Future defined sustainable development as development that meets the needs of the present without compromising the ability of future generations to meet their own needs. This formulation captured several fundamental insights: that development and environmental protection are inseparable; that current generations bear obligations to future ones; and that environmental concern extends across time as well as space.

The Brundtland report's influence on international environmental law has been enormous. Intergenerational equity was incorporated into the UNFCCC, the CBD, and national environmental statutes worldwide. The 2030 Agenda for Sustainable Development and its seventeen Sustainable Development Goals represent the most ambitious contemporary attempt to give sustainable development institutional expression.[3]

9.2 Agenda 21 and the Rio Principles

Agenda 21, adopted at the Rio Earth Summit in 1992, is a comprehensive 300-page, forty-chapter blueprint for sustainable development covering virtually every dimension of the interaction between human society and the natural environment: combating poverty, changing consumption patterns, protecting the atmosphere, managing toxic chemicals, addressing the roles of women, children, indigenous peoples, and local authorities, providing financial resources, and transferring environmentally sound technologies. Though non-binding, Agenda 21 inspired national sustainable development strategies, local Agenda 21 processes, and the Sustainable Development Goals that superseded the Millennium Development Goals in 2015. The Rio Declaration's twenty-seven principles built explicitly upon Stockholm: Principle 7 enunciated CBDR; Principle 10 established access to environmental information and public participation rights; Principle 15 codified the precautionary approach; Principle 16 enshrined the polluter-pays principle; and Principle 17 mandated environmental impact assessment.

9.3 The Sustainable Development Goals (2015-2030)

The SDGs, adopted by the UN General Assembly in September 2015, comprise seventeen goals and 169 targets covering all dimensions of sustainable development.[4] Environmental sustainability permeates the entire framework: SDG 3 targets reduction of deaths and illnesses from hazardous chemicals and pollution; SDG 6 targets water quality and universal access to safe drinking water; SDG 7 promotes renewable energy and clean cooking access; SDG 11 addresses urban air quality and waste management; SDG 12 addresses the materials economy driving pollution; SDG 13 covers climate action; SDG 14 targets marine pollution and ocean health; and SDG 15 targets terrestrial ecosystem restoration and biodiversity. The SDGs thus frame environmental governance as a cross-cutting imperative pervading every dimension of development policy, rather than a narrow sectoral concern.

Table 4: Sustainable Development Goals Most Directly Linked to Environmental Pollution and Conservation

SDG	Title	Primary Environmental Target	Key 2030 Milestone
SDG 3	Good Health and Well-Being	Reduce deaths from hazardous chemicals and pollution	Substantially reduce number of deaths from air, water, and soil pollution
SDG 6	Clean Water and Sanitation	Improve water quality; reduce pollution; expand wastewater treatment	Universal access to safe drinking water; halve proportion of untreated wastewater
SDG 7	Affordable and Clean Energy	Expand renewables; clean cooking access	Substantially increase share of renewable energy in global energy mix
SDG 11	Sustainable Cities	Reduce adverse environmental impact of cities	Universal access to safe, inclusive green and public spaces; reduce air pollution
SDG 12	Responsible Consumption	Manage chemicals and waste across life cycle	Environmentally sound management of all chemicals and wastes by 2020 (accelerated)
SDG 13	Climate Action	Integrate climate measures into national policies	Strengthen resilience and adaptive capacity to climate-related hazards in all countries
SDG 14	Life Below Water	Prevent and reduce marine pollution of all kinds	Effectively regulate harvesting; end overfishing; address ocean acidification
SDG 15	Life on Land	Halt biodiversity loss; restore degraded land and forests	30x30 protection target; halt soil degradation; invasive species control

10. OBJECTIVES OF THE STUDY

The present study is guided by the following research objectives:

- To examine the conceptual foundations and historical evolution of international environmental law and its progression from customary principles to the complex multilateral treaty architecture governing environmental pollution in the twenty-first century.
- To investigate the concept of sustainable development and the legislative and institutional mechanisms that give it operational meaning both within global frameworks and in the domestic legal systems of developing nations, with particular reference to India.
- To analyze the theoretical frameworks underpinning international environmental cooperation, including the principles of common but differentiated responsibilities, intergenerational equity, the precautionary principle, and the polluter-pays principle, assessing their practical application in treaty regimes and national law.
- To assess public awareness and perceptions of air pollution and its consequences through an empirical survey of 350 participants, situating the findings within the broader governance context of India's national and international environmental commitments.
- To identify principal gaps, emerging challenges, and opportunities in the current international environmental cooperation framework, and to propose evidence-based policy recommendations for strengthening global environmental governance.

11. LITERATURE REVIEW

The academic literature on international environmental law, pollution governance and sustainable development is very thick and truly multidisciplinary, bringing together public international law, environmental economics, political science, public health and ecology. The following review highlights some contributions most pertinent to the research questions of the study. The micro-scale human exposure to traffic related air pollution was quantified using the Oslo Street Pollution Model

(OSPM) developed by Jensen (1998). Jensen and co-workers showed that the exposure of specific people to the level of harmful pollutants can differ greatly from place to place and from one type of traffic to another, depending on the street geometry, as well as meteorological conditions even in the same city, using population data from Danish municipal databases. The simple ambient air quality data from fixed stations greatly underestimated the population exposure to roadside air quality. The concept of using spatially explicit and population weighted exposure assessment, introduced by the OSPM, has been widely adopted by urban air quality management and regulatory impact assessment and the architecture of the model has been adapted to various European and Asian cities. Mirka Fugas (1999) gave a detailed overview of the 50-year air quality research at the Institute for Medical Research and Occupational Health in Zagreb. Air quality conditions were reported in a range of microenvironments: urban centre, industrial areas, workplaces and residential areas, and dynamic exposure models were created that incorporate various microenvironments that people spend a day in. This micro environmental approach, which takes into account the exposure during all the contexts measured by the time-weighted average of the various measurements, has become the methodological gold standard in environmental health assessment. Another important conclusion of Fugas' work was that indoor air pollution is an important issue in developing countries, where biomass fuels are still used for cooking and heating. Blackman and Harrington (2000) have compiled a summary of the experience of international economic incentives for industrial air pollution control in developing countries which yielded immediate policy implications. They compared the various types of emission fee systems, tradable permit programs, deposit-refund schemes, and civil liability rules and concluded that, although the market-based instruments are theoretically superior in reaching environmental objectives at lowest cost, they often fall short in the context of developing countries due to political economy pressures from regulated industries, weak institutional capacities, and lack of effective monitoring and enforcement. They called for a pragmatic mix of well-designed regulatory standards and economic incentives that fit the institutional capacities of each country; a conclusion very relevant to the ongoing institutional changes in India's environmental regulatory framework, where strong legislation has been stymied by weak enforcement capacities. Apte et al. (2011) found that the exposure concentrations of fine particles and black carbon inside the auto-rickshaws of the commuters in New Delhi were several times higher than ambient levels near the road side. The study highlighted the need to understand exposure levels beyond monitoring stations in transport microenvironments to ensure a proper estimation of population health risk in low-income megacities where a large share of the population in these cities lives for a considerable amount of time in close contact with transport and mobility. This research helped in substantiating the case for Supreme Court mandates for electric auto-rickshaw fleet and toughening up Bharat Stage norms.

12. RESEARCH METHODOLOGY

The degree to which a person is exposed to air contamination is a significant determinant of air pollution's health impacts. The population at risk in terms of urban air pollution is the urban population, in addition to yield losses calculated on the basis of total population. The population at risk in terms of indoor air pollution is evaluated at the overall population level as a function of fuel use. This study employs a mixed-methods research design integrating doctrinal legal analysis of international environmental treaties and national legislation with primary empirical data collected through a structured questionnaire survey.

Figure 5: Overview of the Baseline and Temporal Extrapolation Methodology for Air Pollution Assessment

12.1 Research Design

The research design sets up the logical sequence from the empirical data to the research questions and then to conclusions. It can be defined as the logical sequence of events that leads to the establishment of a connection between the empirical data and the original research questions of a study as well as to the results of the study. The information gathering, measuring and analysing is described in the research design. The structure of the exploration problem and the sequence of the problem's inquiry to gather observational evidence are given in the examination configuration. The doctrinal part included systematic research of treaties, UN resolutions, national environmental laws and regulations, judicial decisions and secondary academic sources. The empirical part involved primary data collection technique which was conducted through a structured questionnaire that was given to 350 respondents.

12.2 Survey Method

The survey method that was utilized was determined by the research questions asked for the study, the population characteristics and practical constraints. Multiple considerations were made for selecting the survey technique, such as sampling approach, type of demographic, question structure, question content, response rate, costs, and time needed to gather information. A structured questionnaire was chosen as the major instrument for data collection because it provides a common format for data collection in a large, geographically spread sample, provides quantitative analysis of attitudinal and perceptual variables, and provides for comparison with demographic sub-groups. Information from respondents in various demographic groups was gathered using a common method of stratified random sampling. Questionnaire data was supplemented with qualitative depth data from interactive surveys, focus groups and workshop discussions on respondents' environmental awareness, perceived causes and types of air pollution and their perceptions of the relationship between air pollution and broader environmental change.

12.3 This was the size of the sample and sampling strategy.

A stratified random sampling technique was used to guarantee representation by relevant sub-groups in various age groups, gender, educational level and occupational groups. Three hundred and fifty respondents were recruited and interviewed using a questionnaire, both face-to-face and online. To prevent sampling bias, those who had been employed in quality assurance or environmental monitoring in their whole career were not included in the respondents. The incidences chosen were selected randomly and are representative of the age distribution of the respondents in comparison to the overall population. One of the most important segments, which accounted for 31.1 percent of the total, comprised respondents older than 55 years of age.

12.4 Data Collection and Sources

Primary data comprised questionnaire responses covering attitudinal ratings on five-point Likert scales, self-reported health effects, and factual knowledge questions. The data collected included the answers obtained from a survey given to participants, with responses in the form of reflections provided by respondents to different parts of the questionnaire. Secondary data was drawn from government statistical databases, reports of the Central Pollution Control Board, National Ambient Air Quality Monitoring Program data, WHO Global Health Observatory data, and UNEP publications. The researcher has also used various compositions -- reviews, books, treatises, articles, notes, and observations -- to combine various points of view on environmental law and governance in the hope of presenting a comprehensive viewpoint. The doctrinal component draws on international treaties and their preparatory works, UN resolutions, reports of treaty bodies, and the scholarship of international environmental law.

13. RESULTS AND DISCUSSION

13.1 Demographic Profile of Respondents

The empirical survey was administered to a total of 350 participants. Of these, 180 (52 percent) were male and 170 (48 percent) were female, representing a broadly balanced gender distribution. The percentage of respondents who had engaged in professional training, school, or higher education was just 5.7 percent, while 38.2 percent had some level of formal education regardless of whether or not they had received instruction in elementary school. As a result, even while controlling for educational background in the study, it is necessary to communicate findings to groups with lower levels of educational attainment. The age distribution skewed toward younger adults, with 32 percent in the 18-25 group, 18 percent in the 25-45 group, 28 percent in the 45-60 group, and 22 percent aged 60 and above. The dominance of the 18-25 cohort reflects both the online administration channel and a deliberate oversampling strategy, ensuring representation of the generation most acutely exposed to long-term pollution trajectories.

Table 5: Participant Gender Distribution (Table 1 from Original Study)

Respondents	No. of Participants	Percentage (%)
Male	180	52%
Female	170	48%
Total	350	100%

Table 6: Participant Age Distribution (Table 2 from Original Study)

Age Group	Number of Respondents	Percentage (%)
18-25 years	115	32%
25-45 years	60	18%
45-60 years	95	28%
60 years and above	80	22%
Total	350	100%

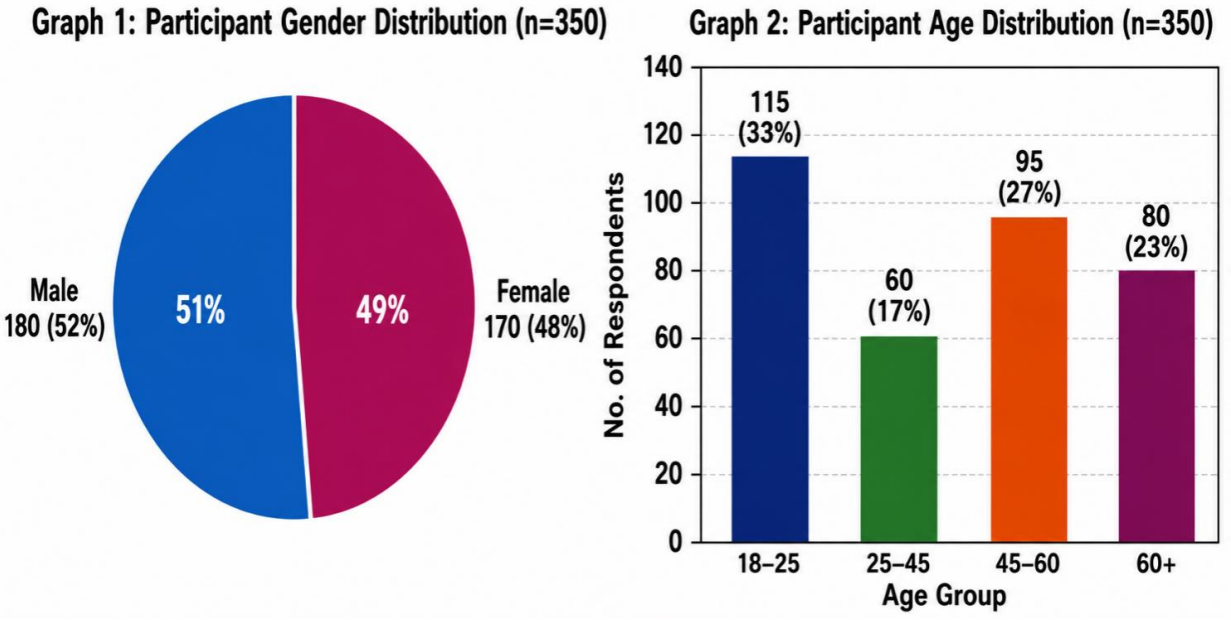

Figure 06: Graph 1 and Graph 2: Gender and Age Distribution of Survey Participants (n=350)

Among the total number of persons who participated in the study, 180 (52 percent) were male participants and 170 (48 percent) were female participants. As a result of the fact that 32 percent of respondents were between the ages of 18 and 25, the outcomes of the survey are reflective of the perspectives of young people, who in many studies demonstrate heightened environmental awareness compared to older cohorts. The balanced gender ratio enhances the representativeness of the findings.

13.2 Perception of Air Pollution (Question 1)

When asked how they felt about air pollution, an overwhelming majority of respondents expressed strong concern. Specifically, 165 respondents (47 percent) selected Strongly Agree when presented with statements reflecting negative perceptions of air pollution's severity, while 125 (36 percent) selected Agree -- together representing 83 percent of the total sample. Only 50 respondents (14 percent) chose Neutral and a combined 10 respondents (3 percent) selected Disagree or Strongly Disagree. This high level of concern is consistent with other survey evidence from India's major cities, where air quality is routinely described by residents as one of their most pressing quality-of-life concerns. When dangerous compounds are released into the atmosphere, they constitute a threat to the health of individuals as well as the health of the planet as a whole.

Table 7: Survey Responses -- How Do You Feel About Air Pollution? (Table 3 from Original Study)

Gender	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Total
Male	95	50	30	3	2	180
Female	70	75	20	4	1	170
Total	165	125	50	7	3	350

13.3 Impact of Air Pollution on Personal Life (Question 2)

The main sources of air pollution are emissions from car systems, the use of non-renewable energy sources, new industry, forest fires, use of Aerosol products and radiation charges. Many chemicals and gases emitted from these emission sources are toxic such as tropospheric ozone (O3), sulphur dioxide (SO2), nitrogen dioxide (NO2), benzo(a)pyrene and particulate matter (PM). Respondents were asked if air pollution had had any tangible impact on their lives. The results were equally striking: 145 respondents (41 percent) Strongly Agreed and 140 (40 percent) Agreed -- together 81 percent of all respondents. Half of the respondents (17 percent) were neutral, while only five (2 percent) disagreed. One of the major concerns raised on this issue is that the rising pollution level in the country could impact the health of people. The perceived impact was extremely high for male respondents (85 strongly agree, 75 agree) as well as female respondents (60 strongly agree, 65 agree). There may be differential awareness and/or differential health seeking behaviour between the sexes, but also, the higher proportion of neutral respondents (42 females to 18 males) may be due to the fact that some women spend more time indoors, where the concentrations of pollutants are higher than outdoors, than do males.

Table 8: Survey Responses -- Has Air Pollution Affected Your Life? (Table 4 from Original Study)

Gender	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Total
Male	85	75	18	1	1	180
Female	60	65	42	2	1	170
Total	145	140	60	3	2	350

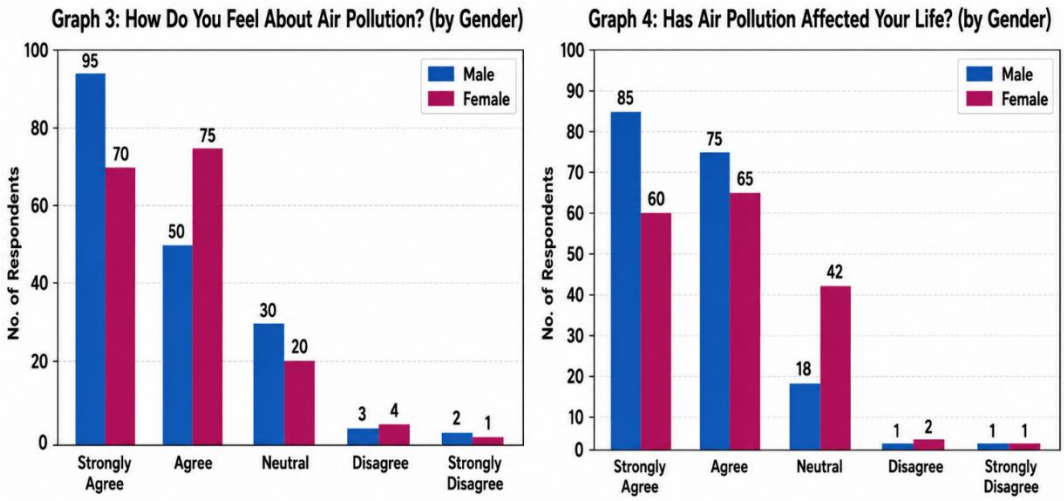

Figure 07: Graph 3 and Graph 4: Respondent Attitudes Toward Air Pollution and Its Life Impact (by Gender)

14. FINDINGS AND POLICY RECOMMENDATIONS

14.1 Principal Findings

The above analysis of the data leads to some practical results. The first is that international environmental treaties work best if they include legally binding targets, differentiated obligations, effective funding mechanisms, technology transfer provisions, and effective non-compliance mechanisms. That is the design of the Montreal Protocol: the universal ratification of the agreement and the fact that the ozone layer has recovered since the 1980s offer the best evidence of the effectiveness of multilateral environmental cooperation when effective institutional structure is in place and environmental damage is reversed. The Paris Agreement's bottom-up NDC approach is more politically inclusive, but is less legally robust ambition of current NDCs are not at the levels in line with the agreed temperature goals. Second, there is a continuous and disturbing gap between the implementation of international commitments and domestic action. The overall coverage of domestic environmental law in India more or less matches the international standards, but the ability to enforce the law, on the part of the State Pollution Control Boards, local bodies and industry is still low. However, the monitoring infrastructure, prosecutorial capacity and judicial enforcement are all under-resourced, compared to the magnitude of the pollution problem. This implementation gap is not peculiar to India, it is a universal characteristic of environmental governance in developing countries and is a function of the politics of regulation, institutional capacity and underfunding of environmental agencies. Third, public awareness and concern for air pollution are high as the survey results clearly show and yet this public concern is not yet being reflected in consistent and sustained political pressure to take action regarding regulation. 83% of the respondents are negatively affected by air pollution, and 81% say it has had a significant impact on their lives. The numbers are alarming, indicating a vast base of support for improved environmental governance, but creating sustainable political alliances for environmental action has been one of the most crucial and overlooked challenges of environmental governance in democratic regimes.

14.2 Policy Recommendations

The above analysis suggests the following policy recommendations for improving international and national environmental governance: Increase international financial transfers for environmental action. There is a significant financing shortfall and an increasing gap between financing pledged in multilateral agreements and financing disbursed. The developed world needs to honour its climate finance obligations and increase funding to the Global Biodiversity Framework Fund, the Adaptation Fund and the Loss and Damage Fund. New financing options, such as debt-for-nature swaps, environmental bonds and compulsory payments from private banks and other financial institutions, should be actively explored. Improve national pollution control boards in terms of both their resources and autonomy. The Indian State Pollution Control Boards should be free from politics, be well funded and well-staffed, be provided with the necessary digital real-time monitoring facilities and be made responsible for the measurable improvement in environmental quality. Institutional reform should be based on a model of an independent, technologically viable, publicly accountable environmental agency (such as the Umweltbundesamt in Germany or the U.S. Environmental Protection Agency). Speed up the transition towards clean energy at the household level. Approximately 700 million Indians who are still using solid biomass for cooking and heating are victims of indoor air pollution as well as contributors of outdoor pollution and climate change. Clean cooking (using LPG, electric induction, biogas or other clean cooking technologies) can lead to a reduction in indoor PM2.5 levels by more than 80% in affected households and could be rolled out to all households in the country within a decade with policy support and investment. Embed EE in all levels of the school curriculum. An age appropriate, well-designed environmental curriculum, which integrates local ecology, environmental issues that have a global impact but are relevant at the local level, whilst building critical thinking skills and scientific knowledge, is one of the best investments any government can make for long-term environmental governance capacity. Invest in extensive, timely, public accessible air quality monitoring systems. Each city with more than 100,000 people should have at least a single continuous ambient air quality monitoring station that could be viewed in real-time via mobile apps and public displays. Monitoring data is transparent and serves to raise awareness, to hold people to account, and to inform evidence-based regulation.

15. CONCLUSION

Pollution of the environment is not a natural force and is not inevitable as a part of economic development. Ineffectiveness of governance, fundamentally, is the failure to incorporate the social and environmental costs of economic activities and the failure of collective institutions to implement the rules that

societies have agreed to for the protection of shared resources and common goods. This manuscript has followed the evolution of international architecture that was developed to correct that deficit, from the basic principles of customary international law, through the great diplomatic successes of the Stockholm era, the explosion of legally binding instruments during the 1980s and 1990s, and the current challenges of the climate change, biodiversity and plastics regimes. Air pollution poses a rapid, chronic and growing threat that adversely affects the well-being of populations, economy and ecosystem. Air pollution, both ambient air pollution in fast-growing megacities and household air pollution due to biomass use, is a major cause of early death in India. Deep concern is the lack of the traditional biomass-burning practices, and the continuous poor air quality in outdoor environment in Indian metropolitan cities is continuing to deteriorate without any significant and comprehensive action. The Indian Parliament and the State Government have recognized the criticality of air pollution and the need to tackle the issue. Institutional will and technical capacity for action exists, as seen in the concrete initiatives put in place such as National Air Quality Index, National Clean Air Program, Bharat Stage VI emission norms, Graded Response Action Plan for Delhi, transition to CNG in urban public transport and increase in renewable energy capacities under the National Solar Mission. Both the Indian Legislative Assembly and the State Governments have seen the negative consequences of air pollution and the seriousness with which they must tackle the issue of poor air quality among all partners. Simultaneously, the switch to sustainable energy is part of the deal, as is the plan that one would like to see clean energy provided to families currently using lamp oil to light the house. The results of the survey included in this study show that 83% of respondents strongly disagree with the current state of air pollution and 81% say that it has had a material impact on their lives. These numbers are an imperative to act. One of the most powerful forces to date for environmental regulatory advances has been the combined force of public concern, channelled through democratic institutions and civil society advocacy. In the USA, because of the outrage against the visible smog and polluted rivers in the early 1970s, there has been a great legislation for the environment. In the USA, a great legislation for the environment has been established in the early 1970s due to the outrage against the visible smog and the polluted rivers. Persistent judicial activism, in response to public interest litigation by concerned citizens, has resulted in some of the most impactful environmental policy shifts in India through the Supreme Court. This is why the same principles could be implemented and expanded in today's digital world and era of environmental awareness. To realize a comprehensive, far-reaching, and long-term action plan – one that reduces air pollution, protects water resources, restores degraded soils, protects marine ecosystems, and ensures residents breathe clean air it is essential to ensure seamless communication and coordination between the multiple agencies, regulatory bodies, scientific institutions, civil society organisations, and international partners involved. Delhi, in the National Capital Territory, has proven in the last ten years what can be achieved and what cannot in terms of regulatory aspirations within one city. The next chapter in India's environmental governance story should be written at the national scale, building on the lessons from Delhi and using their logic to extend to all cities, all rivers, in India. Implementation of agreements is the most significant challenge that remains in international environmental governance today and will continue to be a challenge in the future. The world has devoted tremendous diplomatic effort to building the machinery that has led to the development of multilateral environmental agreements on almost every aspect of the human interaction with the natural environment. The challenge is not what should be done the agreements themselves detail this in great detail but whether the political will, financial resources, institutional capacity and public demand can be mobilised to make their legal commitments a physical reality. The response to that question will not only shape the environments we will leave for future generations; it will make the planet we share habitable.

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Contribution of Authors
RR developed the central concept of the study and established its initial framework. VN and SP provided ongoing academic guidance and made significant contributions to the revision, organization, and overall improvement of the manuscript.VN and SP contributed critical scholarly insights, assisted in data collection, and supported data analysis and interpretation while ensuring that the manuscript adhered to the journal's formatting and submission requirements. PRM, PS and PD played a key role in enhancing the linguistic precision, readability, and technical consistency of the manuscript.

Conflict of Interest
The authors declare that there is no conflict of interest related to the publication of this manuscript.

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