Chapter Four

Aviation-Related Environmental Problems
I. Introduction

As the world approaches the 21st century, one of the main and perhaps most pressing challenges that faces mankind is preservation of the environment and its fragile ecosystem. Increasing activities of man, in the modern society, have accelerated the pace of environmental degradation. Urbanization, industrialization and modern agricultural practices have upset the equilibrium between human activities and nature. Ecological danger is greater than that posed by social, economic, political or other problems. Depletion of the ozone layer, pollution of air and water, erosion of soil, destruction of forests, contamination of oceans, etc. are the major problems associated with environmental degradation.¹

In the first half of this century, aviation industry's prime objective was to develop a safe, secure and economical air transport for the benefit of the peoples of the world. With the ushering in of the jet transport in the 1950s environmental issues came to the fore, for the first time. In the 1960s and 1970s the emergence of super-sonic and sub-sonic air transport has further heightened the environmental problem. Today, ecological considerations are a major concern in airline operations. Airlines are being asked to consider the possibility of a permanent and ultimate restraint on growth, not just local airspace and capacity limits but also a global capacity limit including a noise barrier.

Increasingly, they must accommodate environmental requirements in their growth strategies, no matter how difficult this is.²

"Protecting the environment", as Maurice Strong, Secretary-General, UNCED, rightly observed, "is both a moral obligation and a business imperative for the travel and tourism industry. As the world's largest industry it can effectively reach millions of customers with a coherent, compelling environmental message. And the leadership of the industry can and must persuade its members to adopt ecologically sound business practices. After all, a healthy environment is the travel industry's core product. If you can get it right, travel and tourism can truly become environmentally sustainable."³

There are three dimensions to the problem of environment in relation to aviation: scientific, technological and political. The role of science is crucial to our understanding of air transport's environmental impact on the quality of life on the planet. Moreover, without technology there can be no solution to environmental problems. At the same time, pressures from politicians, reactions of the media and activities of environmental consumer groups are of prime importance and cannot be ignored. Aviation related environmental problems include the relationship between aviation fuel and global warming, the effect on climate induced by jet engine emissions at high altitudes and waste originating from passenger services, cargo transport and aircraft maintenance.⁴

Aviation, the heart of travel and tourism sector, is, today, the world's largest industry. By 1994, travel and tourism supported roughly 212 million jobs, or 1 out of every 9 workers in the world. According to the World Travel and Tourism Council Report (1996), the travel and tourism sector serves around 500 million customers each year and generates an annual gross output of roughly US $3,600 billion, which is about 10 per cent of the world's total GDP. Clearly, the civil aviation sector, together with travel and tourism, has a major role to play in improving the quality of environment. Further, public attitude towards environment has changed from ambivalence to awareness, and the airline industry has been forced to follow suit.

International travel is important in political, cultural and economic terms. For the foreseeable future this travel will, largely, be by air. International and domestic passenger and freight transport in developed as well as developing countries is, therefore, expanding rapidly. There is no disputing the role aviation plays in the global economy and in transforming the skies into highways of world commerce. But keeping pace with air travel's growing popularity are the attendant concerns over environmental degradation. Could high-altitude flights be contributing to global warming? Are we risking the future health of the Earth in a headlong rush to fly people farther and farther than ever before?

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Due to the seriousness of these questions and their implications for future generations, the time has come to intensify global efforts to address aviation-related environmental problems. However, the environmental impact of aviation has so far attracted far less attention than it deserves. First, there is a feeling that the aviation industry is responsible for a relatively small proportion of global energy use, and the resultant pollution. Second, the lack of will among the majority of sovereign states and the absence of effective global mechanism are responsible for lax to improve environmental standards. Finally, unlike emissions from motor vehicles and power plants, aircraft emissions, as well as sound, have little perceptible impact on local environment.\(^7\)

However, air transport is one of the world's fastest growing energy-using sectors. It is a matter of concern that after several decades of rapid growth, gaseous and noise pollution emitted by the aircraft has a significantly adverse environmental impact. Air transport is most likely to contribute to global warming, which will have a direct impact on the upper atmosphere in the coming decades.\(^8\)

The potential growth in air travel has heightened public and regulatory concern over air transport's contribution to climate change. Stratospheric ozone depletion will increase in the future, particularly if the combined effect of carbon dioxide (CO\(_2\)) and oxides of nitrogen (NO\(_X\)) emissions from aircraft is taken into account. More is known about the radiative effects of CO\(_2\) emissions from aircraft than about


the climate change impact of aircraft NOX emissions (through ozone generation) water vapour, soot and other particles, sulphur gases and other trace constituents. The impact of these emissions on radiative forcing is uncertain and the possible effects of aircraft operations on climate change have yet to be evaluated.9

Though in recent years environmental regulations have assumed greater importance, especially in industrialized countries, they remain uneven in practice and limited in scope. Many countries have largely imposed these regulations unilaterally and, often, carriers face different environmental standards in different countries. The need of the day is the introduction of internationally accepted and enforceable environmental regulations with the goal of establishing a more standardized aviation regime.10

Existing studies on air transport's present and future global environmental impact are in the form of inventories, forecasts and scenarios. They are generally based on assumed changes in aviation related variables such as traffic growth and distribution, fleet mix, fuel consumption and prices, technology and emission reduction policies. Some of them encompass predictions about external factors such as GDP and population trends, trading patterns and economic activity. Usually, all such studies seek to characterize how air transport's environmental impact could evolve in the future with or without policy

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changes, though some of them suggest policy options.\textsuperscript{11}

Aviation industry groups concerned with environmental issues primarily focus on aircraft noise and engine emissions, whereas the operational area of aircraft ground activity, passenger, baggage, cargo and mail processing at airports have received limited attention. Apart from aircraft noise and engine emissions, airports utilize large portions of land, contribute to air and ground water pollution, produce vast amount of waste and consume excess energy. All these indicate an urgent need for upgrading airports and their infrastructure environmental record. Some of the main environmental issues facing world aviation are air pollution, depletion of ozone layer and greenhouse effect, surface water, soil and ground water contamination, waste disposal, noise and engine emissions, consumption of resources, natural resource conservation and sustainable development, environmental laws and legislation, technology transfer and development, harmonization and implementation of environmental standards and practices\textsuperscript{12} etc., are some of the aviation-related environmental problems are highlighted in this chapter.

II. Environmental Problems Associated With Civil Aviation

The use of air transport services has grown dramatically in such a vast proportion that it is reckoned today as a common mode of transportation. But these developments have not been without

\begin{itemize}
\item[IATA Environmental Review 1996(Geneva, 1996), p. 57.]
\item[A.D. Groenewege, Compendium of International Civil Aviation, (Montreal, 1996), p. 57.]
\end{itemize}
regressive consequences, or difficulties. The interrelated crisis of environment is a global issue. First, any advance in aviation spreads in a short span of time to all parts of the world. And second, the impact on environment cannot strictly be confined to national boundaries. In essence, the provision of a clean environment is a global need.\textsuperscript{13}
Predicting the future aviation-related environmental problems, India argued in the 18th session of the ICAO Assembly:

Aviation is rapidly becoming one of the mankind's predominant activities. There have been many spectacular developments since the beginning of this century, but none matches the phenomenal growth of aviation. This session takes place at the dawn of a new era, in which aircraft carrying several hundred passengers are already speeding across the air routes of the world. Side by side, we are on the threshold of civil supersonic traffic, and the extraordinary achievements in rocketry and space travel will certainly have a continuing impact upon civil aviation. Thus, the vistas that open out before us are unlimited and exciting. But, as always, each technological advance brings with it a host of complex problems which can be neglected only at grave peril. The ecological aspects of air and sound pollution, for example, will have to be squarely faced if modern aviation is not to become in the long run a curse rather than a boon to humanity.\textsuperscript{14}

In its commitment to foster the standards of international civil aeronautics, the ICAO has given special attention to the impact of civil aviation on the environment with a view to ensuring maximum compatibility between the safe and orderly development of civil aviation and the preservation and enhancement of a wholesome human environment. Chiefly, environmental problems associated with civil aviation are aircraft and aircraft engine emissions as well as various problems of a local nature arising at airports. The ICAO's


\textsuperscript{14}See Minutes of the Plenary Meeting of the ICAO Assembly, Eighteenth Session, Vienna, 15 June-7 July 1971. ICAO Doc. 8963, p. 17.
environment-related activities are largely undertaken by the Council through its Committee on Aviation Environmental Protection (CAEP). The committee is supported by the Air Navigation Bureau and, as regards economic aspects, by the Air Transport Bureau. There is an increasing co-operation among various bodies in the air transport industry and agencies of the United Nations, all aiming to address environmental concerns.

Against this backdrop, an inventory of environmental problems associated with civil aviation was compiled by a multi-disciplinary group of the ICAO secretariat, in the course of 1992, based on the assumption that the environment meant all natural and man-made surroundings adversely affected by the presence of civil aviation, though not directly involved in aviation itself. The inventory is grouped into the following seven categories:

(a) *Aircraft Noise*: Noise in the vicinity of airports caused by aircraft operations, engine testing, and other noise sources at airports; sonic bomb caused by supersonic aircraft and noise caused by aircraft en route.

(b) *Air pollution near airports*: Aircraft engine emissions and emissions from airport motor vehicles, access traffic and other airport sources;

c) *Global Phenomena*: Long-range air pollution (e.g. acid rain); green-house effect and depletion of the ozone layer;

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15 Committee on Aviation Environmental Protection (third meeting) Montreal, 5-15 December 1995, ICAO Doc. 9675, CAEP/3.

16 Groenewege, n. 12, p. 242.
(d) **Airport/infrastructure construction.** The loss of land, and soil erosion, impact on water tables, river courses and field drainage and impact on flora and fauna;

(e) **Water/Soil Pollution Near Airports.** Water pollution caused by the inadequate treatment of contaminants in airport waste water; and water and soil pollution caused by leakage from storage tanks;

(f) **Airport Waste Management** The disposal of environmentally harmful materials used in aircraft servicing and maintenance and disposal of waste from the airport and incoming aircraft; and

(g) **Aircraft accidents/incidents.** Accidents or incidents involving dangerous goods carried as cargo, other environmental problems arising from aircraft accidents and emergency procedures involving fuel dumping. 17

A. **Aircraft Noise**

In early days of aviation, aircraft noise was equated with progress and prestige. The sound of an aircraft flying past signified a rapidly expanding nation. As travelling increased, so did the frequency of flights, which meant more facilities such as the building of new airports - or new infrastructure for access to airports. Disturbance from these activities would inevitably increase and was bound to adversely affect tolerance levels. 18 The disturbance arises mainly from the noise of

17Ibid., p. 399. See also, John Craystone, "ICAO identifies Environmental Problems Associated with Civil Aviation", ICAO Journal, August 1992, pp.4 and 5.

aircraft at landing and take-off, or while taxiing around an aerodrome and passing through aerospace, as well as from the testing, maintenance and servicing of aircraft engines at an aerodrome. Aircraft noise has been considered for many years, the most important environmental problem associated with civil aviation, particularly the noise levels in the vicinity of airports. The problem has led to two conflicting trends: the replacement of noisy aircraft by quieter ones and the increasing number of aircraft movements.

The problem of aircraft noise was a grave concern even in the 1950s, when civil aviation experienced a very notable growth and gained its place on the agenda of air transportation, but it was limited, then, to the noise caused by propellers, whose tips rotated at speeds equalling sound. The real problem began, however, with the introduction of first-generation jets and was aggravated with the rise in the number of jet operations. Aircraft noise can be very disturbing to local communities which prevented some airports from expanding their capacity, thereby contributing to another of the civil aviation’s ills: airport congestion. Other noise problems also exist, but are much less significant. For example, engine testing and noise from sources other than aircraft [such as installed auxiliary power units] contribute to noise levels in the vicinity of airports, while some aircraft types cause disturbance en route.

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20 Craystone, n. 17, p. 4.

21 Ibid.
Rapid developments, without the adequate redress of environmental issues, have been manifest in various ways ranging, for instance, from civil disobedience - in the case of the Japanese Tokyo-Narita airport in 1971, to protracted objections to London-Stanstead airport. Another recent case of this concern is evident in the present and near-future expansion of Manchester airport. The emergence of national, regional and international committees and advisory bodies represented another form of response to aircraft noise resulting from increased air transport activities.22

Several attempts at solving these issues had failed, however, until 1966, despite the widespread alarm over aircraft noise levels in the 1940s. Although environmental issues were not discussed in the 1944 Chicago Conference, they have now become part of the Chicago Convention. In 1966, officials and aircraft engine manufacturers held an 'international noise conference' in the UK to address this issue, which was fast becoming critical.23 At the same time, a special meeting on aircraft noise [in the vicinity of aerodromes] was convened in 1969 under the auspices of the ICAO. On the basis of the latter meeting, aircraft noise regulation has now become part of Annex 16 of the Chicago Convention.24

Over the past 30 years, much of the effort at tackling aircraft noise has aimed to curb noise at sources - building quieter aircraft, withdrawing noisy aircraft from service, installing engine hushkits, or re-engining. The ICAO's extraordinary Assembly Session in October

22 See Davies and Goh, n. 18, p. 123.


1990 allowed for a phase-out of aircraft whose engine levels exceeded the limits specified in chapter 3 of vol. 16, by 18 April 2002. Today, in service are both stage 2 aircraft produced in the 1970s and the later and quieter stage 3 aircraft now in existence. Stage 2 aircraft currently occupy about 30 per cent of the world's jet fleet. The ICAO rules provide for their total withdrawal by April 2002 by a gradual reduction of this type. The European Commission has ruled for a similar reduction, while the US FAA stipulates a total ban by 1999-end through gradual control.

Aircraft built today are required to meet the environmental standards set by the ICAO, which are contained in Annex 16 of the Chicago Convention. For jet-powered aircraft, there are two levels of stringency in the standards. Chapter 2 of Annex 16 contains the standards, which are essentially applicable to jet aircraft designed before October, and chapter 3 contains more stringent standards applicable to aircraft designed after that date. The ICAO's CAEP keeps the noise certification standards under review and will propose more stringent standards in future, when feasible.

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26 See Environment Friendly JAL, n. 4, p. 19.


28 Philippe Roocht, "Key Environmental issues range from Aircraft noise to the Greenhouse Effort", ICAO Journal, July-August 1993, pp. 31-34, at p. 31.
The future drive will have to centre on specific noise-reduction technology. Engines will have to be even quieter, and airplane design improved, to reduce aerodynamic noise. The question is not necessarily whether such specific noise reduction improvements are technologically feasible, but at what price will they be achieved by the air transport and travel industry. Noise technology research and development (R&D) programmes should thus be established to facilitate future noise reductions as part of an integrated approach to reduce aircraft designing and airports.29

B. Aircraft Engine Emissions

The main environmental problem faced by aviation in the past has been the effect of noise around airports. But, over the past few years, attention has increasingly turned to the impact of aircraft engine emissions. Two types of emission problems are distinguishable: the impact on local air quality near airports (which is an old problem) and the global impact which engine emissions create [a new problem]; both are major concerns for aviation and regulatory authorities. This is manifest, particularly, in the context of ozone depletion and climate changes.30

Over the past two decades, aircraft and engine manufacturers have succeeded in obtaining a significant reduction in hydrocarbons (HC), carbon monoxide (CO), and smoke emissions. With increased focus on NOx emissions, the manufacturers are incorporating the best available low-Nox technologies in new engine types. However, the

29See Gil, n. 25, p. 11.

30See Craystone, n. 17, p. 5.
concern about the impact of CO₂ on global warming has refocused the industry's attention on the critical need to maintain and improve its fuel efficiency. Assuming that aviation will continue to depend largely on fuel, as is the case today, the ICAO estimates that the annual consumption of jet fuel by the world's air carriers will increase by about 65 per cent - from 133 million tonnes to about 220 million tonnes - between 1990 and 2010; without the benefit of fuel productivity improvements, fuel consumption would increase by about 180 per cent over this 20-year period, an increase that is equal to the growth forecast for traffic. The US National Aeronautics and Space Administration (NASA) estimates that fuel consumption by subsonic aviation will, on the whole, increase to 304 million tonnes by 2015.³¹

The formulation of ICAO policies to minimize the environmental effects of aircraft operations takes into account these very real scientific uncertainties and global dimensions of the issues. It also takes into account the environmental need, technical feasibility, safety and economic consequences of any proposed action. A cost-benefit analysis is used to set priorities and test select actions.

Presently, ICAO 'Annex 16 standards' define emission levels for unburned hydrocarbons (HC), carbon monoxide (CO) and oxides of nitrogen and smoke. They do not address aircraft emissions of carbon dioxide (CO₂), sulphur dioxide (SO₂), and water vapour (H₂O). Neither are there any ICAO standards for trace compounds, such as particulars, aerosols, certain types of hydrocarbon, and nitrogen compounds. There is a general consensus within the ICAO that it will be premature to consider the standards to control or reduce them until

there is evidence of the need to do so. 32

In keeping with Annex 16 requirements, the ICAO standards do not presently address aircraft emissions at cruising attitudes. Although the measures taken to reduce NOX during the landing-take-off (LTO) cycle also help control NOX at climb and cruise, there is a growing opinion that a certification regime for cruise is needed, besides the standards devised to maintain local air quality around airports. There is also a wider question of whether engines or aircraft should be certified, for aircraft certification makes more sense in a global perspective. These matters are under the ICAO's consideration, as is the possibility of developing emission standards for future supersonic engine aircraft. 33

With the emergence of new environmental problems of global nature, however, aircraft engine emissions causing air pollution near airports can no longer be considered in isolation. Consequently, future efforts to resolve this problem are likely to be heavily influenced by the threat of long-range air pollution, ozone layer depletion and global warming. 34 The ICAO, through its CAEP, has intensified its efforts to curb aircraft engine emissions. The ICAO initiated measures, together with other international organizations, to reach a consensus on the extent to which aircraft engine emissions can be minimized, based on complete and accurate information. This initiative has led to increased co-operation at the export level with those responsible for the IPCC and Montreal Protocol scientific assessments. In both cases, the next

32IATA Environmental Review, n. 11, p. 51.

33ibid.

assessments are scheduled for completion shortly and will specifically address the impact of aircraft engine emissions. In order to help those scientists assess the impact of aircraft engine emissions, the CAEP is advising on inventories of aircraft emissions for use as inputs to atmospheric chemistry/climate models.35

Air Pollution Near Airports: Air pollution is considered a major environmental problem in many countries, especially in urban areas. The main pollutants of concern are sulphur dioxide, nitrogen oxides, carbon monoxide, volatile organic compounds (unburned hydrocarbons) and suspended particulate matter (smoke) - which are mainly produced by power plants, manufacturing industries and ground transportation and heating systems. The sources of pollution at airports include emissions from aircraft engines during approach, landing, taxiing, take-off, and the initial climb. The other sources of air pollution at airports are airport motor vehicles, access traffic, heating or power facilities, etc.36

En Route Air Pollution: Aircraft engine emissions enroute [different from those in the vicinity of airports] make a small contribution to air pollution, which has adverse affects, such as acid deposition. The ICAO is yet to address specifically this problem, although action aimed at ensuring local air quality have helped reduce civil aviation's complicity.

Transboundary Air Pollution: Transboundary pollution occurs wherein a pollutant, once released in a country, flows into another. The most common occurrence of this type of pollution is acid depositions, caused

35Outlook For Air Transport to the Year 2003, n. 25, p. 20.

by aircraft engine emissions in the upper atmosphere. The main pollutants are nitrogen dioxides and oxides of sulphur which, when reacted with water, turn into nitric and sulphuric acids.\textsuperscript{37}

C. Global Developments Relating to Aviation Environment

Initially, the main concern over aircraft engine emissions involved the impact on air quality in the vicinity of airports. Resultantly, the ICAO developed standards for the control of gaseous emissions through an engine certification scheme.\textsuperscript{38}

In recent years, renewed attention has focused on global environmental problems such as "long-range" air pollution (e.g. acid rain), global warming (the greenhouse affect), and depletion of the ozone layer. These three types of atmospheric pollution associated with aircraft emissions may, however, be the subject of an intense study in future and would draw a direct relation between atmospheric pollution and aircraft engine emissions.\textsuperscript{39}

These global environmental problems have a few common characteristics which the aviation community needs to address. First, they are of a very serious nature and could even be life-threatening in the long term. Second, there is an uncertainty about the scientific bases of these global problems. Some causes have been identified, yet others are not yet fully understood. Third, the responsibility for these global problems also rests on many other types of emission sources.

\textsuperscript{37}Ibid., p.239.


Therefore, while the aviation community takes appropriate action to address its fair share of the problems, it is equally important that non-aviation sources do likewise.\textsuperscript{40}

**Long Range Air Pollution:** Long-range air pollution refers to the adverse affects which air pollution can create at a considerable distance from the source. One such adverse affect is acid rain, caused by pollutants such as NO\textsubscript{2} being 'washed out' of the atmosphere. Aircraft engine emissions en route make a small contribution to long-range air pollution, although action aimed at resolving local air quality problems near airports has helped reduce civil aviation's role.\textsuperscript{41}

Agenda 21, the Action Plan adopted by states at the Earth Summit in Rio,\textsuperscript{42} has given strong support to the example of the United Nations Economic Commission for Europe, which in 1979 adopted the convention on Long-Range Transboundary Air Pollution. This convention and its subsequent protocols are concerned with the prevention of acid rain and photochemical smog. There are no specific provisions regarding aviation, but there are indications that the member countries may eventually address the issue of aircraft emissions.\textsuperscript{43}

**Global Warming (the Greenhouse effect):** The accumulation, in the atmosphere, of certain gases resulting from human activities, it is now accepted, is contributing to greenhouse effect. Greenhouse gases remain in the atmosphere for many years, so the planet would continue

\textsuperscript{40}See ICAO Secretariat, n. 34, p. 58.

\textsuperscript{41}Abeyratne, n. 39, p. 273.


to warm up our climate changes [even if all emissions of greenhouse gases end immediately]. This is due to the increase in the levels of carbon dioxide (\(\text{CO}_2\)), carbon monoxide (CO), oxides of nitrogen (\(\text{NO}_x\)), Methane (\(\text{CH}_4\)), water vapour and in the chlorofluoro carbons (CFCS) atmosphere. These significantly raise surface air temperature, whereas an increase in suspended particulate matter (SPM) could reduce air temperature.\(^{44}\)

The increasing public concern over global warming raises questions about the possible contribution of aircraft engine emissions to this problem. The most important greenhouse gas is \(\text{CO}_2\) - an unavoidable by-product of the combustion of conventional fossil fuels; one of the key parameters to assess civil aviation's complicity in this phenomenon is the quality of aircraft fuel and its future consumption growth.\(^{45}\) The carbon dioxide produced when aircraft burn fuel certainly contributes to this problem, although this problem is considerably less in magnitude than many other sources, such as power generation, manufacturing industries, and road transport. However, aircraft engines, too, contribute in other ways. In the stratosphere \(\text{NO}_x\) causes ozone depletion, but in the troposphere - where ozone acts as a greenhouse gas - \(\text{NO}_x\) instead may increase ozone levels. In its recent assessment (1992), the inter-governmental panel on climate change (IPCC) identifies aircraft as one of the sources of \(\text{NO}_x\) in the troposphere and suggests that aircraft emissions may be particularly significant because they are injected into the atmosphere at high

\(^{44}\)See *Outlook for Air Transport to the Year 2003*, n. 25, p. 20.

altitudes. The panel acknowledges, however, that there is considerable uncertainty over the atmospheric process involved.\textsuperscript{46}

There are three sets of factors which can produce improvements in the fuel productivity of the airline fleet. The first set relates to engine, airframe and avionics design, and the gradual introduction into the fleet of new aircraft with improved fuel efficiency. The second relates to operational changes, including more direct routings and improved flight management techniques. The third is the improvement in aircraft load factors.\textsuperscript{47}

**Depletion of Ozone Layer**: Evidence has emerged in recent years that the ozone layer around the earth, which protects mankind from harmful ultra-violet radiation, is facing depletion due to complex chemical reactions involving man-made gases. In addition to the principal cause of this problem, chlorofluorocarbons (CFCs), primarily caused as aerosol propellants or as refrigerants, nitrogen dioxides which are emitted by aeroplanes flying in the atmosphere are also considered culprits for the depletion of ozone.\textsuperscript{48}

The depletion of the ozone layer is being widely investigated by governments and several inter-governmental organizations and is one of the subjects addressed in the Agenda 21 Action Plan adopted by the 1992 UNCED. Of particular importance is the Vienna Convention for the Protection of Ozone Layer, adopted in 1985 under the auspices of the UNEP and the protocol to this convention, which was subsequently

\textsuperscript{46}See IATA Environmental Review, n. 2, p. 19. Also see Environment Friendly JAL, n. 4, p. 9.

\textsuperscript{47}Ibid.

\textsuperscript{48}Abeyratne, n. 36, p. 238. Also see Environment Friendly JAL, n. 4, p. 16.
negotiated in Montreal, in 1987. The Montreal Protocol on substances depleting the ozone layer provides for a regular scientific assessment of the causes of ozone layer depletion and establishes specific, time-bound obligations to limit and reduce the use of CFCs. The protocol's 1991 assessment includes a chapter on aircraft, which states that the addition to the atmosphere of NOX emitted by aircraft is expected to decrease ozone, while much of the work in the field has so far focused on the likely impact of possible new supersonic aircraft. The assessment notes that a proportion of emissions from the subsonic fleet is deposited directly into the lower stratosphere. The assessment also underlines the uncertainties in this area.49

D. Other Aviation Related Environmental Problems

Apart from the three major environmental problems associated with aviation (i.e. aircraft noise, engine emissions and global developments), there are other types of pollution contributed by civil aviation; airports/infrastructure construction; water/soil pollution near airports; airport waste management; cabin air quality; smoking on aircraft; aircraft accidents/incidents; and effects of the electromagnetic environment. These will be discussed here briefly.

Airports/Infrastructure Construction: The construction of a new airport and its associated infrastructure can give rise to environmental problems, notably the inevitable loss of land, the threat of soil erosion and adverse impact on water tables, review courses, field drainage, or flora and fauna. The nature of the problem varies from one airport to another. Relatively, a few new airports are, no doubt, being developed, but these

49 Outlook for Air Transport to the Year 2003, n. 25, p. 20.
problems are imminent to a rise in the expansion of existing airport facilities.50

Water/Soil Pollution Near Airports: Various chemicals are used by airports and aircraft operators. The chemicals used in aircraft de-icing and runway, ice prevention or removal may through rainwater, cause pollution if they find their way into local water courses, or become part of airport waste water and go inadequately treated. In addition, water and soil pollution is caused by leakage from runways which also function as catchment areas for rainwater. The new water pollution control programmes include upgradation of the existing surface water drainage facilities, operational changes designed to minimize pollution discharged into the environment and the selection of more environmentally acceptable de-icing and washing materials.51

Aircraft Waste Management: In aircraft servicing and maintenance, environmentally harmful materials (oils, cleaning fluids, paints, etc.) are used. They need to be disposed of in a satisfactory manner, such as recycling. Airports and incoming aircraft also generate large quantities of waste material, capable of causing environmental damage if not disposed of properly. The amount of trash generated by the US airports easily exceeds one million tonnes per year. Since the cost of sending the trash to landfills has increased dramatically over the past few years, airports have more than just an altruistic motive to cut down waste.52

50Crayston, n. 17, p. 5.
51Ibid.
52Kapur, n. 10, p. 64.
Waste management is increasingly becoming an important component of the airport pollution abatement programmes. The emergence of waste management as an essential part of environmental protection strategies has been prompted by rapidly rising costs associated with waste disposal; the inexorable statutory and civil law liabilities involved in waste management; and the notion that waste streams are often symptomatic of inefficient processes. 53

In recent years, waste management has become a key airline environment issue. Governments - national and local - are setting stringent standards for waste disposal and treatment and a growing numbers of airlines are required to sort out waste on board prior to landing. 54

Cabin Air Quality: Cabin air quality has received increasing attention from consumer organizations like the IAPA, which are calling for new international regulations to control cabin atmospheres. An international conference is proposed on the issue, and the ICAO should, it is suggested, take immediate steps to create international airworthiness and operational standards for cabin air quality.

A complex issue in this field is the use of insect sprays to prevent agricultural pests being carried from one country to another. These sprays - they, of course, serve agricultural interests - can, it is now alleged also risk passenger safety and possibly health. 55

Smoking in Aircraft: In the past, smoking was permitted on aircraft


55 See Regulatory Developments in 1994, n. 43, p. 51.
except in location like toilets, where safety was, of course, compromised. In recent years, most airlines have taken steps to separate smokers and non-smokers in passenger cabins, despite the costs. In 1987, the ICAO, in co-operation with the World Health Organization (WHO), proposed a ban on smoking and sought the advice of member states over the issue. This eventually led to the adopting of a resolution in 1992, and, consequently a complete worldwide smoking ban on all international flights in 1996.

Many airlines are now taking steps to implement the smoking ban on international and domestic flights, or on flights shorter than a specific time. Sometimes this is in response to specific legislative requirements, yet, increasingly, on a voluntary basis. In February 1995, the US Department of Transport (DoT) granted anti-trust immunity to eight airlines to discuss voluntary agreement to ban smoking on all transatlantic flights to and from the US.56

Aircraft Accidents/Incidents: Aircraft disasters spell a different set of problems. Cargoes of dangerous goods, or the fuel from aircraft, pose by far the greatest risk to environment. Incidents are generally localized, however. Improved safety is the best means to prevent this environmental hazard.

In the event of accidents, fuel spills could be an environmental concern, but fire is a much greater risk. Fuel dumping during emergency landing poses yet another problem. Many aircraft are not structurally capable of withstanding a landing in the highways conditions of take-off. In the event of an early emergency landing, it is sometimes

56Ibid.
necessary to dump fuel into the atmosphere, although this is a rare occurrence.\textsuperscript{57}

Effects of Electromagnetic Environment: Activities of international civil aviation such as future air navigation system (FANS) and the concept of communication navigation surveillance/air traffic management (CNS/ATM), by which satellite technology is used for air-to-air and air-to-ground communications, can affect the electromagnetic environment, which surrounds the earth and permeates the atmosphere. The disadvantage of the CNS/ATM system is that, in addition to unsettled international policy questions over the electromagnetic environment (allocation of radio frequencies and deployment of satellites for communications and remote sensing), the proposed use of microwave transmissions of energy from satellites for the CNS/ATM systems has the deleterious affects of electromagnetic radiation.\textsuperscript{58}

\section*{III. The Role of The ICAO and IATA in Environmental Protection}

Environmental protection in civil aviation is relatively a new issue. It was not specifically mentioned in the Chicago Convention, although the preamble makes a reference both to international civil aviation being developed in a "safe and orderly manner"; and to international air transport services being operated "soundly and economically". Environmental issues came to the fore in the 1950s with the birth of jet transportation. Today, ecological considerations are of chief concern in


\textsuperscript{58}Aheratyna, n. 36, p. 240.
airport construction and airline operations.\textsuperscript{59}

On 26 October 1990, the 28th extraordinary session of the ICAO Assembly adopted Resolution A38-3 on the possible operating restrictions on subsonic jets exceeding the noise levels as stated in volume I, chapter 3 of Annex 16 (Chicago Convention). There are Resolutions A22-12, A22-13 and A22-15, which address environmental matters, the most recent being Assembly Resolution A29-12 on the environmental impact of civil aviation in the upper atmosphere.\textsuperscript{60}

On aircraft noise, Annex 16 (Volume I) of the Chicago Convention sets out noise certification standards for the production of new and existing types of subsonic aeroplanes and helicopter, and certification guidelines for future supersonic aeroplanes. The ICAO initially focused on the effects of engine emissions on air quality in the vicinity of aerodromes, adopting international provisions for the regulation of gaseous emissions, smoke and vented fuel from turbojets and the turbofan engines of subsonic aeroplanes. The ICAO's work has resulted in stiff standards being adopted by the Council on all aspects of ecology, as published in Annex 16 (volume II) of the Chicago Convention.\textsuperscript{61}

Despite the ICAO's considerable achievements in environmental protection, a number of factors, however, point to the need for an even greater ecological consciousness in future. These factors are the continuing growth in demand for air transportation, and changing

\textsuperscript{61}See Groenewege, n. 12, p. 242.
public attitudes towards the environment. Moreover, new information is emerging over environmental problems caused by civil aviation.\textsuperscript{62}

The IATA's role has considerably increased in environmental matters in the recent past. The IATA Executive Committee established its environmental task force (ETAF), in May 1990, to co-ordinate the airlines' overall response to environmental issues and develop appropriate strategies. The ETAF has been working in close co-ordination with aircraft and engine manufacturers, airports, governments, industry associates and environmental groups to carry out the aircraft industry's policies and publicize airline achievements over environmental issues. It liaises with the IATA's aircraft on noise and emissions task force (ANETAF) and reports to the IATA Technical Committee.\textsuperscript{63}

A.. Annex 16 - Environmental Protection (Volumes I & II)

Annex 16 establishes the basic regulatory procedure for the control of aircraft noise and engine emissions. The aircraft or engine manufacturer has to demonstrate that its product meets noise and emission standards, much like safety standards, before it can enter commercial service. Annex 16, therefore, sets worldwide standards for measuring and classifying noise and engine exhaust emissions produced by a variety of aircraft and engine types and models.\textsuperscript{64} These regulations have to be accepted by each ICAO member state and sometimes


\textsuperscript{63}Groenewege, n. 12, p. 339.

\textsuperscript{64}\textit{IATA Environmental Review}, n. 2, p. 7.
embodied in their legal framework. Only later can the national regulatory authority implement them. The ICAO member states are also required to caution the ICAO of any differences between their national legislation and practices and the its regulations.

1. Setting up of Annex 16

In 1968, the ICAO Assembly held in Buenos Aires, adopted a resolution conceding the seriousness of noise in the vicinity of airports and instructed the ICAO council to establish international specifications and associated guidance material to control aircraft noise. The resolution also instructed the ICAO to include in its annexes, or other relevant documents, the descriptions and methods of aircraft noise measurement and establish suitable limitations on the noise caused by aircraft. Annex 16, dealing with various aircraft noise problems, was adopted in 1971 on the basis of the recommendations of a special meeting on aircraft noise in the vicinity of aerodromes, held in Montreal in November-December 1969. Aircraft noise involved the consideration of six categories: the procedure for describing and measuring aircraft noise; human tolerance to aircraft noise; aircraft noise certification; the criteria to establish aircraft noise abatement procedures, land use control and ground run-up noise abatement procedures.

One of the recommendations of this meeting resulted in the establishment of a committee on aircraft noise to assist the ICAO in the

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65 Article 37 of the Chicago Convention.
66 See Article 38 of the Chicago Convention.
67 See Resolution A16-3 of the ICAO Assembly.
68 Groenewege, n. 12, p. 557.
development of noise certification requirements for different classes of aircraft. The committee's first meeting introduced the first amendment to Annex 16, which was adopted by the ICAO Council and became applicable in 1973, covering noise certification for future production, derived versions of subsonic jets and the updating of terminology used in the annex. The committee on aircraft noise, during its subsequent meetings, developed noise certification standards for future subsonic jets and propeller-driven aeroplanes, and for the future production of gisting supersonic aeroplane types and helicopters.  

The ICAO's 18th Assembly session adopted a resolution on environmental protection, in 1971, which led inter alia to specific action on engine emissions and detailed proposals for the ICAO standards to control emissions from certain types of aircraft engines. These standards, unveiled by the Council in 1981, set limits to the emission of smoke and gaseous pollutants from large turbojet and turbofan engines to be produced in future; they also prohibited the emission of raw fuels. The scope of this annex was widened to include provisions on engine emissions and the document was re-entitled as 'Environmental Protection'.

Annex 16 consists of two volumes. Future updating and improvements, if any, are now the responsibility of the CAEP, which was established in 1986 through the amalgamation of the 'committee on aircraft noise' and the 'committee on aircraft engine emissions'.

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69 Ibid.

70 See 18th session of the ICAO Assembly Resolution.

71 See Annex 16, n. 24.

2. **Volume I - Aircraft Noise**

Volume 1 of Annex 16 contains provisions related to aircraft noise and describes different aircraft types in a classification, for each of which a noise evaluation measure has been standardized. Maximum noise levels at lateral, approach and flyover noise measurement points, besides flight test procedures, have been designated by the state of registry of an aircraft, on the basis of satisfactory evidence that the aircraft complies with the requirements which are at least equal to the standards set out in the Annex 16.\(^{73}\)

Volume 1 of Annex 16 is divided into five parts. Part I defines important terms like aeroplane, aircraft, associated aircraft systems, auxiliary power unit (APU) bypass ratio, derived version of an aircraft, helicopter and subsonic aeroplane. Part II outlines standards, recommended practices and guidelines for noise certification applicable to aircraft engaged in international air navigation. Parts III, IV and V state recommended practices and guidance material for use by states with a view to monitoring the noise measurement; the use of an international noise exposure reference unit for land use planning; and the establishment of noise abatement operating procedures.\(^{74}\)

Part II of the volume 1 stipulates standards, recommended practices and guidelines for noise certification applicable to aircraft engaged in international commercial operations. Part II contains 11 chapters. Chapter 1 - administration - outlines the information required to obtain noise certification and procedures to be followed. Chapter 2

\(^{73}\)See Groenewege, n. 12, p. 557.

deals with subsonic aeroplanes whose type of certificate was requested before 6 October 1977. [This chapter establishes the maximum permissible noise levels for the second-generation jets at each of the three measurement points, i.e., lateral, flyover and approach.] Chapter 3 focuses on subsonic jets whose application for type certificate was accepted on or after October 1977. [This chapter explains maximum noise levels for all new subsonic jets entering service and also for certain heavier propeller-driven aeroplanes; it defines three reference noise measure points.] Chapter 4 - supersonic aeroplanes - shows there are no specific standards for supersonic aeroplanes, and certain relevant provisions of part II, chapter 2, are used as guidelines. Chapters 5, 6, 7 and 10 provide the standards for different types of propeller-driven aeroplanes. Chapters 8 and 11 cover helicopter noise, while chapter 9 sets out guidelines for the noise certification of APU's, and associated aircraft systems during ground operations.\textsuperscript{75}

Chapter 2, part II of Annex 16 sets out the standards for subsonic jets whose application for airworthiness certificate for the phototype was accepted before 6 October 1977, with some rare exceptions concerning particular jets. An aeroplane, when tested in accordance with the flight test procedures, shall not exceed the noise levels specified in 2.4 at the following points:

(a) The lateral noise measurement point: The point on a line parallel to and 650m from the runway centre line, or extended runway centre line, or extended runway centre line - where the noise level is maximum during take-off.

\textsuperscript{75}Ibid.
(b) The flyover noise measurement point: the point on the extended centre line of the runway and at the distance of 6.5 km from the start of the roll.

(c) The approach noise measurement point: The point on the ground on the extended centre line of the runway, 120m (395 ft) vertically below the 3 descent path originating from a point 300m beyond the threshold. On the level ground, this corresponds to a position 2000m from the threshold.76

The maximum noise levels must not exceed:

(a) at the lateral and approach noise measurement points: 108 EPNdB77 for aeroplanes with maximum certificated take-off mass of 2,72,000 kg, or over, decreasing linearly with logarithm of the mass at the rate of 2 EPNdB per halving of the mass down to 102 EPNdB at 34,000 kg, after which the limit remains constant;

(b) at the flyover noise measurement point: 108 EPNdB for aeroplanes with maximum certificated take-off mass of 2,72,000 kg or over, decreasing linearly with the logarithm of the mass at the rate of EPNdB for halving of the mass down to 93 EPNdB at 34,000 kg after which the limit remains constant.78

The ICAO's extraordinary Assembly session on 26 October 1990 adopted a resolution representing a comprehensive policy of operating

76Ibid., Article 2.3.1.

77EPNdB - Effective Perceived noise level, expressed in decibel.

78Annex, n. 24, Article 2.4.1.
restrictions on subsonic jets exceeding the noise levels. The operating restrictions for non-noise certificated (NNC) (Chapter 2) aircraft, to be implemented over a seven-year phase-in period, were to commence on 1 April 1995. The earliest deadline for the phase-in will be 1 April 2002. There is a distinction between noise-restricted areas and non-restricted areas. The phase-in period of seven years, adopted by the ICAO, was introduced to assist airlines in reducing the economic impact of aircraft replacement. The retrofitting option for certain chapter 2 aircraft types in preference to the early replacement of aircraft, will be available.

Chapter 3 of Annex 16 is more important because of its scope. Its standards are applicable to all subsonic jets, in which case either the application for airworthiness certificates for the phototype is accepted, or another equivalent prescribed procedure is carried out by the certificating authority on or after 6 October 1977. Two successive amendments have been made to chapter 3: (a) propeller-driven aeroplanes of 5,700 kg for which the application for airworthiness certificate was accepted on or after 1 January 1985 and before 17 November 1988; and (b) the propeller-driven aeroplanes of over 9,000 kg for which the application for airworthiness certificate was accepted on or after November 1988.

The three measurement points are similar to those provided for the aircraft of chapter 2, but, with one modification: the lateral measurement point is 450 m (and not 650 m) from the runway centre.

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79 See Resolution A31-11 of 1190, consolidated statement of continuing ICAO policies and practices related to environmental protection.

80 See Groenewege, n. 12, p. 323.

81 Article 3.1 of the Annex 16.
The requirements of the maximum noise levels are stricter, too:

- At the lateral reference noise measurement point: 103 EPNdB for planes with maximum certificated take-off mass, at which the noise certification is required to be 40,000 kg and over, decreasing linearly with the logarithm of the mass down to 94 EPNdB at 35,000 kg after which the limit remains constant. 83

- At the flyover reference noise measurement point: the requirements depend on the number of engines (a) 101 EPNdB for planes with maximum certificated take-off mass of 385,000 kg and over, decreasing down to 89 ENPdB; (b) aeroplanes with three engines [as (a) but with 104 EPNdB for planes with maximum certificated take-off mass of 385,000 kg and over]; (c) aeroplanes with four engines or more [as (a) but with 106 EPNdB for planes with maximum certificated take-off mass of 385,000 kg and over]. 84

- At the approach noise measurement point: 105 EPNdB for planes with maximum certificated take-off mass of 280,000 kg and over, decreasing down to 98 EPNdB at 35,000 kg, after which the limit remains constant. 85

Chapter 3 carefully describes some of the conditions in which the noise certification procedure must take place, particularly the atmospheric conditions (air pressure, temperature, humidity, wind), the take-off and approach procedures (thrust, speed). However, the test

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82 Ibid., Article 3.3.1.
83 Ibid., Article 3.4.1.
84 Ibid., Article 3.4.1.2.
85 Ibid., Article 3.4.1.3.
procedure itself, noise measurement methods, acoustic data, recording and analysis systems are published in the highly technical Appendix 2 of Annex 16.86

The dividing line between chapters 2 and 3 aircraft is whether the application for airworthiness certificate for the prototype was accepted before or after 6 October 1977. The main concerns of the developing states over the economic and financial viability of their own air carriers became extremely acute when the 26th ICAO Assembly considered imposing future limitations on the operations of the second group of aircraft, subsonic jets, which do not meet chapter 3 requirements.87


Volume II of Annex 16 was drafted in the late 1970s in response to pressures for improvements in local air quality around airports. The Committee on Aircraft Engine Emissions (CAEE) recommended that the ICAO develop international certification standards for three gaseous emissions: unburned hydrocarbons (HC), carbon monoxide (CO), and oxides of nitrogen (NOX) as well as smoke. The standards for turbo-jet and turbo-fan subsonic engines were adopted by the ICAO Council on 30 June 1981 became applicable on 18 February and were published subsequently as Volume II - aircraft engine emissions - Annex 16.88

Volume II of Annex 16 is divided into three parts. Part I spells out definitions and symbols, part II specifies that the international

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86 Appendix I describes the test procedures for the aircraft of chapter 2.


discharge of liquid fuel should be prevented during shutdown following normal ground or flight operations; part III deals with aircraft engine certification and specifies the measurement procedures to be used and also the maximum values of the regulated emissions. These standards are based on a specified landing and take-off (LTO) cycle; but they have also helped limit emissions at cruise altitudes. The NOX limit varies with the engine pressure ratio. Engines with a higher pressure ratio - generally required for more efficiency - are allowed to emit more NOX/unit thrust than the low-pressure ratio ones. Volume II also gives specifications for the tests, fuel used as well as reference to standards for supersonic power plants.89

Volume II contains provisions related to aircraft engine emissions and describes the standards which prohibit the international discharge of raw fuel into the atmosphere by all turbine engine-powered aircraft manufactured after 18 February 1982.90 Similarly, standards limit the emission of smoke from turbojet and turbofan engines introduced for propulsion at subsonic speeds and manufactured after 1 January 1983. For engines intended for supersonic propulsion, similar limitations apply to engines manufactured after 18 February 1982. The standards also limit the emission of carbon monoxide, unburned hydrocarbons and oxides of nitrogen from large turbojet and turbofan engines intended for subsonic propulsion and manufactured after 1 January 1986.91

For NOx, more stringent standards apply to an engine "of type or model of which the date of manufacture of the first individual

89IATA Environmental Review, n. 11, p. 7.
90See Part II, Chapter 1 of Ananex 16. Aircraft Engine Emissions, p. 11.
91Ibid.
production model is on or before 31 December 1995 or for which the
date of manufacture of the individual engine is after 31 December
1999". This stringency on NOX emission limits was agreed upon at the
CAEP/2, in December 1991, and adopted by the ICAO on 11
November 1993.92

The ICAO's committee on aviation environment protection
(CAEP-3) made a stringent clampdown on the recommendation for
NOX emission. The proposal was for a 16 per cent reduction in NOX
emissions relative to the limit imposed at the CAEP-2. The new limits
would be applicable to new engine types first certificated after 31
December 1999, and to all engines manufactured after 31 December
2007. A relaxation was made for low-thrust engines which, for reasons
of physical size - have difficulty in incorporating the most recent
low-NOX technologies.93

B. Committee on Aviation Environmental Protection (CAEP)

The ICAO's environmental activities are largely undertaken by the
'committee on aviation environmental protection' (CAEP), established
in 1983 as a successor to both the ICAO 'committee on aircraft noise'
(CAN) and the 'committee on aircraft engine emissions' (CAEE). At
present, the committee consists of 15 experts,94 nominated by the
ICAO contracting states. A number of observers from international

92IATA Environmental Review, n. 2, p. 27.
93IATA Environmental Review, n. 11, p. 51.
94They are: Australia, Brazil, Canada, France, Germany, Italy, Japan, the
Netherlands, Poland, Russian Federation, Spain, Sweden, Switzerland, the United
Kingdom and the United States.
organizations and associations also sit on the committee; some observers attend specific meetings on an ad hoc basis. The AEP meets once every four-five years to formally review Annex 16 standards. In the interim period, its working groups consider and evaluate major issues and make specific recommendations for the next CAEP meeting. The CAEP has held three formal meetings to date - June 1986 (CAEP/1), December 1991 (CAEP/2) and December 1995 (CAEP/3).

The CAEP is a technical committee reporting directly to the ICAO council, although its recommendations are usually reviewed by the ICAO Air Navigation Commission. Recently, the CAEP's recommendations have also been vetted by the ICAO Air Transport Committee. CAEP activities are co-ordinated, when necessary, by regional civil aviation bodies other international organizations and the United Nations agencies.

At its first meeting (CAEP/1), the committee made a number of specifications to the noise certification procedures for all types of aircraft and wrote a new chapter to Annex 16, Vol. 1, which contains a simplified noise certification scheme for light propeller-driven aeroplanes. It also devised the text of the Environmental Technical Manual and ICAO Circular 205. The Environmental Technical Manual carries information on procedures used in the noise certification

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95The European Union (EU), Greece, Airports Council International (ACI), the International Business Aviation Council (IBAC), the International Co-ordinating Council of Aerospace Industries Associations (ICCAIA), the International Federation of Air Line Pilots Association (IFALPA), and the IATA.

96IATA Environmental Review n. 2, p. 7.

97See ICAO Doc. 9501.

98See ICAO Circular 205.
of aircraft, while Circular 205 unveils a recommended method for computing noise contours around airports.\textsuperscript{99}

In 1991, the CAEP/2 set in motion an extensive work programme to evaluate the need and potential for further changes in Annex 16 certification standards for engine emissions. This decision was taken in the backdrop of mounting public and government pressure to regulate airports compatible with a healthy environment and of greater scientific and governmental focus on air transport's potential contribution to the global ecology. The CAEP/2 thus determined that the main objective of its gaseous emissions review would be to:

- minimise or, if necessary, decrease the adverse impact of aircraft emissions on the environment around airports, on the ozone layer, and on the global climate change. In particular, this work should address the possibility of increasing the stringency of the gaseous emissions requirements for subsonic aircraft, and establishing standards for supersonic aircraft, when the environmental need has been accepted by an international scientific consensus [e.g. by UNEP/WMO] and is technically feasible and economically reasonable.\textsuperscript{100}

In short, the CAEP/2 initiated several decisions: the heightened stringency of NOX emission limits; a cost-benefit analysis as the criteria (to evaluate proposed changes in existing standards; a balanced approach to minimize noise; and a scientific assessment and study of the effects of gaseous emissions sin the upper atmosphere.

The CAEP/3 was convened on 5-15 December 1995 in Montreal. Two main issues were addressed, concerning changes to Annex 16 specified standards: (a) the permitted noise levels for turbo-jet and propeller-driven heavy aeroplanes; and (b) the permitted levels of


\textsuperscript{100}IATA Environmental Review n. 11, p. 51.
engine emissions of nitrogen oxides. In both cases, the CAEP working group has since investigated the technical feasibility, costs and environmental benefits of the increased stringency.\textsuperscript{101}

Of the permitted noise levels, the CAEP/3 debate eventually focussed on an option of increased stringency, but members were divided. In consequence, no recommendation was made to change the permitted noise levels at this meeting. On emissions, the discussion centred on a proposal for the reduction by approximately 16 per cent, of the permitted levels of NOX to be implemented in 2000 for new engine designs and in 2008 for newly manufactured engines. The CAEP/3 decided, on the basis of a majority vote, to recommend this proposal to the ICAO Council. The other significant results of the CAEP/3 meeting were:\textsuperscript{102}

(a) the recommendation for a new take-off noise abatement procedures;

(b) recommendations calling on the states to study land-use control near airports and effect a comprehensive amendment to the Airport Planning Manual;

(c) the endorsement of the ICAO's proactive role in determining the impact of aircraft engine emissions at high altitudes;

(d) the assurance of more work on operational measures to reduce fuel consumption and hence carbon dioxide, other emissions;

\textsuperscript{101}See Committee on Aviation Environmental Protection (third meeting), Montreal 5-15 December 1995. See ICAO Doc. 9675, CAEP/3, p. 8.

\textsuperscript{102}Ibid.
(e) the proposed report into emission-related charges in response to CAREFM Recommendation 2/13 - this could consider the policy options and practical issues associated with such charges;

(f) the proposed review of the existing Annex 16 standards and procedures, insofar as they apply to supersonic aircraft, at the CAEP/4;

(g) the promise to constitute a working group to consider "other" environmental problems at airports (i.e. other than noise and emissions); and

(h) the simplification of CAEP structures and the plan to set up a steering group, which will meet annually and inter alia provide annual reports to the ICAO council.

The proposed work programme of the CAEP/4 will inter alia highlight: (a) noise standards for subsonic jets and heavy propeller-driven aeroplanes; (b) noise certification standards for propeller-driven light aeroplanes; (c) noise certification standards for helicopters; (d) noise certification provisions for future civil supersonic transport (SST) aeroplanes; (e) aircraft engine emissions; and (f) airports and operations. Some aspects of the work programme are still being finalized, yet the new working group's meetings have already begun.103

C. IATA and Environmental Protection

The International Air Transportation Association (IATA) is a global, non-profit, trade association, representing more than 250 airlines which carry over 98 per cent of the scheduled international air traffic.

103IATA Environmental Review n. 11, pp. 102 and 103.
The IATA aims to integrate environmental requirements into its overall strategy and also identifies and tackles environmental problems posed by air transport. It seeks to strike a balance between environmental and growth considerations, and also between more stringent environmental regulation and the costs of such regulation to the airlines themselves.\textsuperscript{104}

In essence, the IATA has a three-fold environmental role. First, it acts as an "environmental watchdog" for its members, monitoring the compliance of environmental requirements, analysing their implications and developing common industry positions. Second, it also presents an "industry conscience", promoting the "best practice" and research into aviation's impact on the environment and into new technologies to reduce environmental pollution. Third, the IATA is the "voice of the industry", disseminating to regulators and the public at large information on its members' efforts to reduce the impact of their operations on the environment, while simultaneously endeavouring to curb aviation-related environmental hazards.\textsuperscript{105}

The IATA's basic environmental goals are to:

(a) assist its members to contain or reduce, within technical and economic constraints, the effects of airline operations on the environment;

(b) endorse and support the ICAO's role as a global forum to develop environmental measures for air transport;

(c) preserve and protect the airline industry's role as an economic catalyst for sustainable development by ensuring that the industry continues to grow in an environmentally compatible way; and

\textsuperscript{104}Ibid., p. 28.

\textsuperscript{105}Ibid.
(d) keep in review the strategic responses to environmental challenges in the coming decade, and to promote and publicise the airlines' commitment to the clean environment.\textsuperscript{106}

Currently, the IATA has two task forces dealing with environmental issues: the Aircraft Noise and Emissions Task Force (ANETAF) and the Environmental Task Force (ETAF). The ANETAF is a successor to the Aircraft Noise and Emissions Advisory Committee (ANEAC), established over 20 years ago. These groups have addressed environmental issues of technical nature, beginning with aircraft noise. The ANETAF continues to focus on the technical aspects of noise and emissions and provides policy guidance on the technical-environmental standards to be achieved by the airline industry.\textsuperscript{107}

The IATA's environmental task force was formed in May 1990 in recognition of the growing political dimensions of the environmental debate. The ETAF's basic mandate is to co-ordinate the airlines' overall policy response to environmental issues and develop appropriate strategies. Reflecting this role, the ETAF is a multi-disciplinary group composed of senior airline staff performing aeropolitical, technical, public relations and environmental functions. At present, the IATA's overall committee organization makes provisions for separate reporting lines to each task force. The ANETAF is under the authority of the IATA technical committee, while the ETAF is responsible to the IATA's executive committee, through the strategic planning committee.\textsuperscript{108}

\textsuperscript{106}Ibid., p. 96.

\textsuperscript{107}IATA Environmental Review, n.2, p. 60.

\textsuperscript{108}Groenewege, n. 12, p. 265.
In 1995, the activities of the ANETAF and the ETAF were integrated into a single, high-level, multi-disciplinary task force, called the Environment Task Force (ENTAF). The ENTAF is the focal point for the IATA on environmental issues, responsible to the strategy and policy committee of the IATA board of governors through the director-general. Specifically, it (a) monitors environmental developments and regulations of concern to IATA members airlines; (b) analyses and assesses the implications of such regulations; (c) develops and recommends common industry positions on environmental issues; and (d) advises on strategies to promote IATA positions vis-a-vis regulatory bodies and stakeholders.\textsuperscript{109}

In 1995, the IATA also formulated the airline industry’s policy on airport noise charges, aviation fuel taxes and proposed new noise limits at the three London airports. It is currently developing positions in other areas: global emissions issues and inter-model issues. The IATA is mobilizing other industry sectors to promote action on issues of common concern, such as land-use, planning and control. The IATA also promotes the implementation of its regulations and minimum standards for the carriage of live animals by air, subscribes to the travel and tourism industry’s environmental guidelines and supports the international business community’s initiatives on environmental protection.\textsuperscript{110}

\textsuperscript{109}\textit{IATA Environmental Review}, n. 11, p. 95.
\textsuperscript{110}\textit{Ibid.}, p. 29.
IV. International Law Relating to Aviation Environmental Protection

A. Customary Environmental Law

Air law is a branch of international law; the latter's customary principles applicable to aviation-related problems have been developed on the basis of the general practices of states - the phrase "general practices" referring to actions habitually carried out and, thus, acquiring the status of legal rights.

Most aviation-related environmental problems are associated with aircraft noise and air pollution. The traditional legal remedies for anybody adversely affected by aircraft noise have been nuisance action and inverse condemnation suits. Plaintiffs have moved the courts to claim compensation for the damage caused by noise. The monetary costs to the dependents will, it is hoped, result at least in a partial elimination of noise. In the United States v. Causby case,\(^\text{111}\) the US Supreme Court held that continued low-altitude flights by the US military, which made the plaintiff's property unsuitable for a chicken farm, constituted a wrongful taking of an air easement, so entitling the plaintiff to compensation under the Fifth Amendment. This decision, combining the elements of trespass and nuisance, marked the advent of the theory of inverse condemnation.\(^\text{112}\)

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The later *Griggs v. Allegheny County* case\(^\text{113}\) was also based on the inverse condemnation theory. The plaintiff and his family claimed that they were forced to move out by the noise, vibration and dangers from regular and frequent low-altitude flights over their home. The noise on take-off was, they argued, comparable "to the noise of a rivetting machine or steam hammer", and on landing "to that of a noisy factory".

The US Supreme Court ruled that the local government-authority was guilty of taking an air easement, and that compensation was required under the Fourteenth Amendment. It was the local authority which decided whether to build an airport, and where to locate it, the court concluded, and, in designating the airport, it did not acquire enough private property by constitutional standards, i.e. satisfying the requirements of the Fourteenth Amendment.\(^\text{114}\)

There are two kinds of air pollution: site-specific pollution and long-range air pollution. Site-specific pollution normally exists in the ambient air, in the area of the site from which noxious fumes or particulates emanate. Long-range air pollution results, very often, from tall stacks, say smelters, which disperse the pollutants over a wide area. During the dispersion process, nitrogen and sulphur oxides emitted into the air by factories, smelters, power plants and vehicles undergo chemical transformation in the atmosphere and result in acid rain.\(^\text{115}\)

\(^{113}\)369 US.84 (1962), cited ibid.

\(^{114}\)See North, n. 111, p. 801.

\(^{115}\)See G.F. Fitzgerald, "The proposed Canada-US Transboundary Air Pollution Agreement : The Legal Background", *Canadian Year Book of International Law*, vol. 20, 1982, pp. 219-43,
The general rule of customary international law on environmental protection is based on the oft-quoted 1941 *Trail Smelter* Case. The United States and Canada Arbitration Tribunal, dealing with such case for the first time, declared: "...under the principle of international law as well as of the US no state has the right to use or permit the use of its territory in such a manner as to cause injury by fumes in or to the territory of another or the properties or persons therein, when the cause is of serious consequence and the injury is established by clear and convincing evidence". Many experts regard the ruling as a bedrock principle of 'state responsibility' and view it as significant, because it applies the principle of *sic vetro tuo vt alienum non leades* to cases of transboundary air pollution.

In 1949, the International Court of Justice (ICJ), in the *Corfu Channel* Case, declared that every state had an obligation "not to allow knowingly its territory to be used for acts contrary to the rights of other states". This verdict, it has been said, will not apply if the states generally support a different rule. The *Trail Smelter* and *Corfu Channel* cases, one commentator points out, stretched beyond their limits as constituting a basis for an international liability rule.

The 1963 Nuclear Test Ban Treaty, forbidding nuclear explosions in the atmosphere, extra-atmospheric space and under water, also forbids a state to conduct nuclear tests on its territory when there is a risk of "radio active debris" being carried beyond its territorial limits.

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118 ICJ Report, 1949, p. 422.
The ICJ, in the Nuclear Test Cases of 1973-74, did not focus on the Trail Smelter principle. Nevertheless, Judge de Castro, in a dissenting opinion, referred to "a right to demand prohibition of the emission by neighbouring properties of noxious fumes".

The principle of Trail Smelter was recognized by the 1979 Convention on Long-range Transboundary Air Pollution, and the 1982 Law of Sea Convention. It was further embroiled/embodied in the ILA Montreal Rules on International Law applicable to transboundary pollution, which reads: "States are in their activities under an obligation to prevent, abate and control tranfrontiers pollution to such an extent that no substantial injury is caused in the territory of another state." Principle 21 of the Stockholm Declaration on the Human Environment (1972) elucidates: "States have, in accordance with the Charter of the UN and the principle of international law, the sovereign right to exploit their own resources pursuant to their own environmental policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other states or of areas beyond the limits of national jurisdiction."

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121 For the Text of the Convention see 18 ILM, vol. 18, no. 6, 1979, pp. 1442-5.

122 Ibid., pp. 1261-1354.


jurisdiction.\(^{125}\) "States shall", it goes on to elaborate, "co-operate to develop further the international law regarding liability and compensation for the victims of pollution and other environmental damage caused by activities within the jurisdiction or control of such states to areas beyond their jurisdiction.\(^{126}\)

The legal significance of this principle is not undisputed, yet it is generally regarded as a reflection of the existing customary law by legal experts; some states insist, too, that this principle is an expression of the existing international law.

B. Conventional Environmental Law


The Convention on Long-range Transboundary Air Pollution was adopted on 13 November 1979.\(^{127}\) It came into force on 16 March 1983. The convention lays down the general principles of international co-operation for air pollution abatement and sets up an institutional framework bringing together research and policy. The parties shall, the convention states, endeavour "to limit, and as far as possible, gradually reduce and prevent air pollution including long-range transboundary air pollution."\(^{128}\) They shall "develop without undue delay policies and strategies which shall serve as a means of combating the discharge of air

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\(^{125}\)Ibid., Principle 21.

\(^{126}\)Ibid., Principle 22.

\(^{127}\)For the text of the Declaration see *ILM*, vol. 18, 1979, pp.1416-21.

\(^{128}\)Ibid., Article 2.
pollutants". The Convention has established an executive body to review its implementation, while the secretariat functions are entrusted to the Executive Secretary of the United Nations Economic Commission for Europe (ECE).

The Convention aims to prevent the development of acid rain and photochemical smog. It provides a platform for five associated protocols: the 1984 EMEP [programme for monitoring and evolution of long-range transmission of air pollution in Europe] protocol, the 1985 Sulphur Protocol, the 1988 NOx Protocol, the 1991 Volatile Organic Compounds (VOC) protocol, and the 1994 Sulphur Protocol. There is also a close contact between the ICAO and the ECE. This led to the ICAO's participation in an ECE workshop on emissions from mobile sources, held in Oslo in June 1995 - where the ICAO emission-related activities were explained. Subsequently, late in 1995, the Convention's executive body requested delegations to consult their national experts to harmonise with the ICAO the approaches and emission reduction levels needed to fulfil the convention's objectives.

In addition, the Convention Executive Body has established an expert group to prepare a draft proposal to amend technical annexes to both the NOX and VOC protocols, concerning emissions from mobile sources. The early drafts recommended that Annex 16, volume II, on

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129 Ibid., Article 3.

130 Ibid., Article 10(1) provides: The representatives of the contracting parties shall, within the framework of the Senior Advisers to ECE Governments on Environmental Problems, constitute the Executive Body of the present convention, and shall meet at least annually in that capacity.

131 IATA Environmental Review n. 11, p. 16.

emission standards, be used to control emissions in the context of the LRTAP Convention. Some provisions, however, go beyond Annex 16.\textsuperscript{133}

**Sofia Protocol 1988**: The Sofia Protocol, in force since February 1991, requires the parties, as a first step, to freeze total national NOX emissions from all sources at 1987 levels, by 1994-end. It also contains specific abatement measures targeting "mobile sources", such as road vehicles. Fourteen of the 22 parties to the protocol have reached the target and stabilized emissions at 1987 levels or - in the case of the US - 1978 levels, or reduced their emissions below such levels.\textsuperscript{134}

Of air transport, there are no specific provisions regarding aircraft, but rail transport, ships, aircraft and marine craft are listed in the technical annex to the Sofia Protocol as "mobile sources", which are not covered under [the] existing protocol, but may need to be so in future. These sources are the major cause of high NOX concentrations at some airports, notably those located in high-population density areas. At such airports, aircrafts' contribution is minimal. Nonetheless, NOX emissions from aircraft engines are far more strictly controlled than in other transport modes and industrial sources.\textsuperscript{135}

2. **Vienna Convention for Protection of Ozone layer 1985, and Montreal Protocol on Substances that Deplete the Ozone Layer 1987**

Most international agreements on ozone depletion aim to eliminate or control the use of ozone depleting substances (OD\textsubscript{3}) - such

\textsuperscript{133}IATA Environmental Review, n. 11, p. 16.


\textsuperscript{135}Ibid.
as chlorofluoro carbons (CFC₃), and halons - which, it is believed, trigger upper atmospheric ozone depletion. Other protocols and conventions control gaseous emissions - for example, sulphur compounds (SO₂), nitrogen oxides (NOₓ), and volatile organic compounds (VOC₃) - which set off acid rain and photochemical smog.

The Montreal Protocol and its associated amendments provide for the phase-out of the manufacture or use of CFCs, halons and, also, chlorinated solvents, such as trichloroethane as well as carbon tetrachloride. These substances react with stratospheric ozone and break it down, thus depleting the ozone layer. The CFCs and related chemicals have widespread applications as refrigerants, cleaning agents in the electronics industry, and as from blowing agents in manufacturing processes. Halons are used extensively in fire-fighting systems and extinguishers, in air transport industry.¹³⁶

The Montreal Protocol, 1987, and subsequent amendments set deadlines for the phase-out of most ozone-depleting substances. States are required to assess the control measures concerning substances which deplete the ozone layer on the basis of available scientific, environmental, technical and economic information. Two assessments were undertaken in 1991 and 1994 under the auspices of the world meteorological organization (WMO), and the United Nations Environment Programme (UNEP) respectively. There are three assessment panels viz. scientific, environmental effects, and technology panels. These work under the auspices of the UNEP and, in the case of the scientific panel, under the WMO and the UNEP.

The 1994 scientific assessment included a chapter on the

¹³⁶IATA Environmental Review, n. 11, p. 15.
atmospheric impact of aviation, focussing on the potential effects of second-generation supersonic aircraft. The December 1995 meeting of the Montreal Protocol states that the next scientific assessment is to be completed by the latter half of 1998, for consideration by states in 1999. In particular, the scientific assessment panel has explicitly been asked to work as appropriate with the ICAO on aircraft emissions.\textsuperscript{137} The December 1997 meeting of the United Nations Framework Convention on Climate Change (UN FCCC) in Kyoto, Japan, reaffirmed that work on greenhouse gas emissions from civil aviation should be carried out through the ICAO. This decision confirms ICAO's pre-eminent role as the organization within the UN system globally responsible for developing international aviation environmental standards and practices.\textsuperscript{138}

3. United Nations Framework Convention on Climate Change (UNFCCC), 1992

This convention was enforced in March 1994 with the objective of stabilizing the concentration of gases at an acceptable level, that is, one which "would prevent dangerous anthropogenic interference with the climate system". In other words, the convention fundamentally aims to stabilize `greenhouse gas concentration' at a specified level, within an acceptable time frame. OECD members and some East European countries are supposed to stabilize their `greenhouse gas emissions' at 1990 levels by 2000, but this is not a binding commitment. It is a framework convention and leaves national governments to formulate their own strategies to meet the suggested targets. Its implementation is

\textsuperscript{137}Ibid.

dependent on negotiations between the parties within the UNFCCC process and also on regional and national policies.

Thus, the convention contains a series of obligations requiring all parties to:  
(a) develop national inventories of ‘greenhouse gas emissions’, using comparable methodologies agreed to by the parties; 
(b) formulate national programmes to combat climate change; 
(c) promote technologies, practices and processes which control, reduce, or prevent emissions in all relevant sectors, including transport; and 
(d) report periodically on the progress made. 

Air transport is not specifically mentioned, but, in principle, it is within the ambit of the convention. Thus, in 1993, while developing methodologies on national inventories of ‘greenhouse gas emissions’, the UNFCCC encountered difficulties in allocating international aviation and marine emissions [known as "bunker fuels"]. The ICAO provided advice on this issue - and, pending a solution, such emissions are presently reported by the country where the fuel is loaded, but not included in that country's national total. The convention's first conference of parties [COP/1 Berlin, Germany, 28 March- 7 April 1995] agreed that the conference subsidiary bodies should address the issue of the allocation and control of emissions from international bunker fuels (taking into account the ongoing work in the ICAO) and report to the COP. 

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The COP also acknowledged that no commitments had been made to reduce 'greenhouse gas emissions' beyond 2000, and created the "Berlin Mandate". This calls for the negotiation of strengthened commitments by developed countries, through the adoption of a protocol or other legal instruments, by early 1997, for the consideration of the third session of the conference of parties (COP/3). An ad hoc group on Berlin Mandate (AGBM) has been set up to facilitate such discussion and is specifically responsible for the negotiation - and adoption - of any new protocol, or other legal instrument. The AGBM has met three times, but failed to reach a consensus on targets or approaches for specific emissions.141

4. UN Commission on Sustainable Development, 1992

In 1992, the UN General Assembly established the Commission on Sustainable Development (CSD) to ensure an effective follow-up of the UN Conference on Environment and Development (UNCED), including the "Agenda 21" action plan. The CSD is responsible to the UN Economic and Social Council.

The major task of the CSD has been to mobilize financial resources necessary to implement the UNCED and "Agenda 21" programmes, actively contemplating the imposing of global taxes and user charges in this context. One of the options under consideration is a tax, or charge, on users of air transport. In April 1995, the CSD third session decided to carry out an in-depth study on the need and feasibility of an "environmental user charge on air transports" and held that such a study should "address environmental, economic, legal, administrative

and political aspects of such a mechanism, taking into consideration the particular needs and conditions of developing countries and should be undertaken in co-operation with ICAO and other relevant bodies". ²⁴²

The work undertaken has, since, provided a few new insights into the major issues involved. The progress report presented to the CSD in April 1996 (fourth session) referred to "an internationally agreed tax on air transport", not "an environmental user charge on air transport". The CSD did not act on the matter, but has now included the ICAO in the list of UN and other international organizations, whose involvement it would seek in the implementation of such taxes.

In short, the activities of the various UN agencies involved in environmental matters may have important ramifications for air transport, particularly of the UN policymaking bodies, directly determining emission policies and applying new taxes and charges to air transport.

C. Aviation-related Environmental Regulations in the EU and the US

1. European Aviation Environmental Regulation

Civil aviation in Europe hinges on regulation by three main governmental entities: the European Civil Aviation Conference (ECAC), the European Union (EU) and the Joint Aviation Authorities (JAA).

*European Civil Aviation Conference (ECAC):* The ECAC is an autonomous inter-governmental organization, established in 1954 under the auspices of the ICAO, "to work towards a simplified European regulatory

²⁴²Ibid., p. 16.
structure under-pinned by workable and enforceable rules". Three years after the adoption of Annex 16, the ECAC established an expert group to deal with environmental matters (abatement of noise caused by air transport, ANCAT) and, in 1976, its activities were extended to include aircraft engine emissions. Thereafter, the ANCAT became the group of experts on the abatement of nuisances caused by air transport (ANCAT). The ANCAT held meetings in April (ANCAT/31) and December 1994 (ANCAT/32); it has since continued to develop the proposed guidance material on the implementation of the ECAC chapter 2 phase-out rules, and the ECAC environmental policy statement. The ANCAT/32 also dealt with numerous 'aircraft noise certification' issues: it studied a revised version of the draft environmental policy statement, reviewed developments in the CAEP and considered the general working relationship between the JAA and the ANCAT, as well as the situation of certain chapter 2 'African cargo operations'.

In 1995, the ECAC issued a landmark statement on its environmental policies, setting out how ECAC member states were developing a sustainable European air transport system, and also the ECAC efforts to tackle environmental issues. The policy statement was developed by the ANCAT, and, subsequently, endorsed by the ECAC. It is a comprehensive blueprint for future ECAC action on major environmental issues of aircraft noise and engine emissions, as well as soil and water pollution, and environmental management.


144 IATA Environmental Review, n. 11, p. 18.
European Union (EU): The EU, the successor to the European Economic Community (EEC), has a pivotal role in the promotion of environmental regulations affecting air transport and currently supports tougher environmental controls in air transport. The pace and stringency of the EU's environmental policy has been bolstered since the Treaty on European Union (Maastricht Treaty) was enforced in November 1993.

Since the end of the 1970s, the legal basis for 'Community Legislation' in the field of air transport had been Article 84(2) of the Treaty of Rome, establishing the European Community. The existing legislation on aircraft noise and emissions was also based on Article 84. However, environmental policymaking is now subject to Articles 130R, 130S and 130T of the Maastricht Treaty, enshrined under Articles 189(c), or Article 189(b), according to the context. This means that the EU proposals for new noise and emission directives could be considered on the basis of Article 189(c) [the co-operation procedure] currently of the Maastricht Treaty. The Fifth Environmental Action Programme (5EAP) provides a framework for the European Commission's environmental policy for the period 1993-2000. Its principal theme is "sustainable development" and it sets out basic principles and medium-term targets, concurring closely with the conclusions of the UNCEO. It also identifies three main groups of responsibility to develop air activities along more sustainable lines: public authorities, public and private enterprises and the general public. In addition, five target sectors receive special attention on account of their environmental impact and economic significance: industry, energy, transport,

agriculture and tourism. In short, the ECAC and the EU have a pivotal, if not determinant, role in aviation's 'environmental policy-making'. They are setting environmental targets which, at times, exceed those applied internationally, or in other geographic regions.\footnote{IATA Environmental Review, n. 11, p. 20.}

**Joint Aviation Authority (JAA):** The JAA was formally established on 11 September 1990 by the European states, including all member states of the European Union. It is a European airworthiness authority with the status of an associated body of the ECAC. It deals chiefly with rule-making on safety-related matters linked to aircraft [i.e. design, maintenance, operations and manning], while the ECAC deals with policy considerations arising in these areas. The JAA, therefore, provides standard functions to harmonise regulations of the European states which have accepted its authority. It is developing joint airworthiness requirements covering both noise (JAR 36) and emissions (JAR 34).\footnote{Ibid., p. 24.}

2. **The US Federal Aviation Administration Regulations**

The Federal Aviation Administration (FAA) is the US airworthiness authority. It is one of the nine administrations established under the umbrella of the Department of Transportation (DoT), which develops national transportation policy under the authority of the United States Congress. The FAA's primary role is to regulate airspace, airport operations and aircraft [including design and safety standards for aircraft and aircraft operations]. This authority is endowed by means of various statutes, such as the Federal Aviation Act, 1958, and the Airport
Noise and Capacity Act, 1990. The FAA is the US representative to the ICAO, the CAEP, and other international aviation bodies.\textsuperscript{148}

Most of the FAA's environmental regulation centres around aircraft noise. In response to statutory requirements, the US Environmental Protection Agency (EPA) has recently proposed a Federal Implementation Plan (FIP) for California south coast airports, which will regulate nitrogen oxides (NOX), and volatile organic compounds (VOC) emissions from air transport. This has raised jurisdictional issues concerning the respective roles of the EPA and the FAA in regulating aircraft engine emissions. The problem is one of overlapping jurisdiction, for the scope of the EPA authority has not been carefully defined. Under the Clean Air Act and the Clean Water Act, the EPA has a broad authority to regulate all pollution sources, which include aircraft emissions, but the proposed FIP regulatory action counters the FAA's authority.\textsuperscript{149}

V. Civil Aviation And Environmental Regulations In India

As seen already, the ICAO standards and recommended practices for the aviation-related environment are contained in the Annex 16 of the Chicago Convention. The Annex 16 is divided into two volumes. Volume I deals with aircraft noise,\textsuperscript{150} and Volume II with aircraft engine

\textsuperscript{148}See IATA Environmental Review, n. 2, p. 11.

\textsuperscript{149}IATA Environmental Review, n. 11, pp. 26 and 28.

\textsuperscript{150}On Aircraft Noise, see n. 24.
emissions.\textsuperscript{151} India, being a ICAO member, has, ever since it ratified the Chicago Convention on 15 December 1945,\textsuperscript{152} adopted ICAO Annexes into its municipal law. It has also adopted Annex 16 of the Chicago Convention, which sets standards for the noise evaluation of subsonic aircraft,\textsuperscript{153} airworthiness of (noise) supersonic supersonic aircraft,\textsuperscript{154} and the overall monitoring of aircraft noise,\textsuperscript{155} smoke emissions,\textsuperscript{156} and gas emissions,\textsuperscript{157} or measurement techniques.\textsuperscript{158}

However, the impact of these regulations on national airlines, and the challenges of survival in the global competitive market have added to the developing nations' financial and other difficulties. The ability, to some observers, of the developing nations' airlines to create economic wealth in their home countries may be severely compromised by the industrialized world's noise reduction goals which are briefly capital-intensive.

For this and other reasons, it is neither in the ICAO's nor in the industry's interest to permit a similar phase-out of chapter 3 aircraft if noise certification standards are adopted. A key question is how to prevent this in the foreseeable future and guarantee "protection" for the

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\textsuperscript{151} On Aircraft Engine Emissions, see n. 72.

\textsuperscript{152} See ICAO 50 Years, Notification of Acts of Signature, Ratification or Accession. Attachment to state letter, Le 3/2-9/54.

\textsuperscript{153} Annex 16, vol. 1, no. 2.2.1 and Appendix 1, no. 3.2.1 and Appendix 2.

\textsuperscript{154} Ibid., Chapter 4.

\textsuperscript{155} Ibid., Part III.

\textsuperscript{156} Annex 16, Volume II, no. 2.2.

\textsuperscript{157} Ibid., Appendix 3.

\textsuperscript{158} Ibid., Appendix 5.
chapter 3 fleet. Another matter is whether noise reduction regulatory objectives are, or will come, increasingly in conflict with the goals of "sustainable development".\textsuperscript{159}

India has also been following the ICAO Airport Planning Manual,\textsuperscript{160} which provides information and guidance on airport planning. It also provides a comprehensive list of planning subjects - such as sizes and types of projects, task identification, preparation of a manpower and cost budgets, selection of consultants, and standard contract provisions. An ecological survey of five international airports is being carried out by the Mumbai Natural History Society, with its first round completed and preliminary reports submitted.

A. Legislative Measures

Under Section 4 of the Indian Aircraft Act 1934, the Union Government may, by notification in the official gazette, make such rules as appear necessary to enforce the convention on International Civil Aviation signed in Chicago on 7 December 1944, including its annexes relating to international standards and recommended practices as amended from time to time.

According to Section 5 (2)qq of the Aircraft Act, 1934, the Union Government has the power to make rules to prohibit the slaughter of animals and depositing of rubbish, filth and other polluted, obnoxious matter within the radius of 10 km from an aerodrome.

\textsuperscript{159}See, IATA Environmental Review, n. 2, p. 42.

\textsuperscript{160}Airport Planning Manual, ICAO Doc. 9184-AN/902, Part 3.
Rule 25 of the Aircraft Rules 1937 puts curbs on smoking in aircraft. According to it, the owner or the operator, and the pilot-in-command of every aircraft registered in India shall exhibit or cause to be exhibited in prominent places in the aircraft notices stating where and to what extent smoking is prohibited or permitted therein. Under Rule 29A, no person shall operate a civil aircraft at a true flight match number greater than one over the territory of India or over the high seas in a manner which may cause or likely to cause sonic bomb over the territory of India. Rule 81B also mentions the same rationale of section 5(2)qq of the Aircraft Act 1934, under Rule 81B, the Director-General, or the Deputy Director-General, have the power to grant permission in writing after adequate arrangements.\textsuperscript{161}

B. Other Legislative Provisions Relating to Air and Noise Pollution

The legal control of air pollution is in its infancy in India. An easement is a right of a person in possession of land to do and continue to do something, or prevent something being done on another's land. The Easement Act 1882, describes easements as restrictions on a natural right.\textsuperscript{162} In respect of air travel, there are two rights: (i) right to ventilation; and (ii) right to purity of air. Every person has a natural right whereby the air passing to his land shall not be unreasonably polluted by others.\textsuperscript{163}


\textsuperscript{162}The Easement Act, 1982, Section 4.

\textsuperscript{163}Ibid., Section 7.
The Bengal Smoke Nuisance Act of 1905 provides for the abatement of nuisance from the smoke of furnaces, or fire places. The Indian Factories Act 1948 contains provisions to prevent air pollution. The Act requires factories to ensure effective arrangements for adequate ventilation by circulation of fresh air, and empowers the state governments to make rules on the same. The Act prohibits pollution caused by dust and fumes inside the factory. Under the Gujrat Smoke Nuisance Act 1964, the state government has the power to constitute a commission to supervise and control smoke nuisance.

The subject of air pollution has been given secondary importance in these Acts, however. There arose, therefore, a need to introduce comprehensive legislation to deal, as the primary objective, with air pollution. Hence, the Air (Prevention and Control of Pollution) Act 1981 was passed by parliament under Article 253 of the constitution. The Act seeks to implement the UN Declaration of the Human Environment 1972, of which India is a signatory. It deals exclusively with the preservation of air quality.

Under Section 2(6) of the Act, "air pollution" means the presence in the atmosphere of any air pollution. Under Chapter II, Sections 3-15 of the Act provide for the enforcement machinery in the form of central and state boards for the prevention and control of air pollution in their respective geographical jurisdictions. But air pollution control boards are not to be constituted separately but ought to function under water

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165 Ibid., Section 14.

166 Gujarat Smoke Nuisance Act, 1964, Section 4.
pollution control boards, constituted under the water (prevention and control of pollution) Act 1974. This has been intended to achieve an integrated approach for tackling environmental problems relating to pollution.

Under Section 16 of the Act, the functions of the Central Pollution Control Board are to: (a) advise the Central Government on any matter concerning the improvement of air quality, and the prevention, control, or abatement, of air pollution; (b) plan and cause to be executed a nationwide programme for the prevention, control or abatement of air pollution; (c) co-ordinate the activities of state boards and resolve disputes among them; (d) provide technical assistance and guidance to the state boards for the prevention of air pollution; (e) plan and organize the training of persons engaged in air pollution prevention; (f) organize, through mass media, a comprehensive programme for the prevention of air pollution; (g) collect and publish technical and statistical data on air pollution; (h) lay down standards for the quality of air; (i) collect and disseminate information in respect of matters relating to air pollution; and (j) perform such other functions as may be prescribed. Under Section 17, the state boards also perform more or less similar functions as the central board in their respective jurisdictions.

Under chapter 4, sections 19-31A of the air pollution Act deal with major regulatory mechanisms contemplated by the Act. Section 19 relates to the declaration of certain areas as "air pollution control areas", and provides for regulatory measures. Section 20 of the Act deals with automobile pollution - a matter now covered by detailed rules under the Motor Vehicles Act 1988. Section 28 provides for restrictions on the
establishment of industrial plants in air pollution control areas without the consent of the state boards. The emission of pollutants in excess of the notified standards is dealt with in Section 22. Section 22A creates an additional procedure in that a pollution control board can apply to court to pass orders restraining a person from causing air pollution. Section 23 to 25 deal with access to information on pollution, etc. Sections 26 to 30 empower authorities, to take samples of air, or of 'emission', for analysis. Section 31 provides for appeals against orders made by a state board. Section 31A empowers a board to issue "directions" in the exercise of its powers and performance of its functions under the Act.

The problem of aircraft noise was of concern even in the 1950s, but was then limited to the noise caused by propellers. The real problems, however, began with the introduction of the first-generation jets and aggravated with the multiple rise in aircraft operations. Added to this, the advancement of science and technology has deepened the crisis in recent years, the aircraft noise emerging as an important environmental threat. In fact, it has prompted legislation: the water pollution Act, and the air pollution Act. But no comprehensive legislation has been enacted yet, despite the fact that the aircraft noise is no less hazardous, delicate than water and air pollution.

In India, it might be noted that there is no law which exclusively deals with problems of noise and its control. The Indian Constitution, the Indian Penal Code, the Criminal Procedure Code, etc, deal with the problem under the concept of nuisance. No doubt, India's water pollution Act, air pollution Act and Environment Protection Act have carried out the decisions of the Stockholm Conference, but the gravity of the aircraft noise has not yet been fully grappled or reflected in the
lows. Anyway, noise has been included in Section 2 of the Air Pollution Act; Section 6(6) of the Environment Protection Act enables the Central Government to enact the rules for the control of noise pollution. The problem of noise defies curbs as long as legal controls remain inadequate and ineffective.

C. Environment (Protection) Act 1986

The Environment Protection Act 1986, for the first time attempts to lay down a comprehensive law on environment and goes beyond the scope of the water and air pollution Acts passed in 1974 and 1981 respectively. Section 2(A) of the Act defines "environment" as atmosphere which includes water, air and land, and the inter-relationship which exists among and between water, air and land and human beings, other living creatures, plants, micro-organisms, and property. So this definition covers a much broader area than pollution. The Act provides for securing environmental protection through a co-ordination of activities by various regulatory agencies, creation of an authority or authorities with adequate powers of environmental protection, regulation of discharge of environmental pollutants and handling of hazardous substances, speedy response in the event of accident-threatening environment, and deterrent punishment to those endangering human environment, safety, and health.

Under Section 3 of the Act, the Central Government is empowered to protect and improve the environment, and prevent and control pollution. Another power given to the Central Government is to make rules laying down standards of the quality of air, water or soil for various areas and purposes and to specify maximum allowance limits.
of concentration of pollutants, including noise.

The Central Government has the power to impose restrictions on areas in which any industries, operations, processes, or class of industries, shall not be carried out; or shall be carried out subject to certain safeguards. The Central Government is also empowered to issue directions to close, regulate or prohibit any industry or process, or to stop or regulate the supply of water, electricity, or any other services. All persons are prohibited from carrying on any industry, operation, or handling hazardous substances, except in accordance with prescribed procedures. The penalty for the contravention of the Act is five years' imprisonment, or a fine up to Rs. 1,00,000 or both.

The Central Government may establish authorities to perform its functions. The authorities are empowered to enter any premises, search and inspect any plants, records, registers, documents, etc. and also to seize any of these objects. The authorities also have the power to take for analysis samples of air, water, soil, or other substances.

Prosecution for the violation of the Act may be initiated by filing a complaint in the district magistrate's court. Such a complaint may be filed by the government, or an individual. An individual can file the complaint, however, after giving 60 days' notice to the government. The individual's complaint will abate if during these 60 days the government itself files complaints, or writes back to the individual to file a complaint. Thus, an individual's complaint will be considered only if during the period of 60 days the government does not itself take any action.
VI. Conclusion

In retrospect, aviation-related environmental problems are varied and diverse: aircraft noise, aircraft engine emissions, air pollution near airports en route, air pollution, transboundary or pollution long-range air pollution, global warming, ozone depletion, airports infrastructure construction, water/soil pollution near airports, aircraft waste management, cabin air quality, smoking in aircraft, aircraft accidents/incidents, and effects of electromagnetic environment. The ICAO is mandated to combat these problems, particularly through Annex 16 of the Chicago Convention, and the Committee on Aviation Environmental Protection. The legal regulations to protect the environment involve customary and conventional methods. Lastly, the conventional law derives from the Convention on Long-Range Transboundary Air Pollution 1979, the Sofia Protocol 1988, the Vienna Convention for Protection of Ozone Layer 1985, the Montreal Protocol on Ozone Layer 1987, the United Nations Framework Convention on Climate Change 1992, and the UN Commission on Sustainable Environment 1992.

To summarise, the aviation-related environmental problems in India are not severe, compared with those of the industrialized nations. However, some problems arising out of aviation are dealt with in the Aircraft Act 1934, and the Aircraft Rules 1937. Other general environmental problems are tackled by the water pollution Act 1974, the air pollution Act 1981, and the Environmental Protection Act 1986. In a developing country like India, any clampdown on environmental pollution needs to be executed in a careful manner, with due attention given to aircraft design, airport construction and also the potential growth of the civil aviation industry.