

AIR POLLUTION PREVENTION AND CONTROL ACTIONS AROUND THE WORLD: A REVIEW PAPER

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INTRODUCTION

According to a 2021 worldwide survey by IQAIR, a Swiss firm, out of the 118 countries surveyed internationally, India was ranked at the 5th position in the “Countries with Worst Air” category. What this reveals is not only an indicator of poor environmental consciousness but also a rather poor Human-Ecological relationship. Poor air quality has become a cause of concern as breathing in such air manifolds the risk of Non-Communicable Diseases (NCD) like cardiovascular diseases, respiratory disorders, and strokes. Discomfort in breathing and a hazy atmosphere have become a common sight in major cities of India.

The necessity of ambient air quality has been greatly stressed upon in the developed parts of the world but fails to find acknowledgment in the developing and under-developed countries. Atmospheric air in its pristine and natural state is called Ambient Air. Over the course of human evolution, a variety of toxins have entered the air owing to unregulated industrialization and heavy dependence of conventional sources of energy. Vehicular transmissions have contributed magnificently to disturbing the natural state of air. On an average, urban centres seem to have been facing the brunt of air pollution much more than the rural areas, although setting of industries in “backward regions” has led to a significant drop in air quality in such places as well.

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Historically, India or *Bharat* has been known to have sustainable lifestyle with environment and the same applied to air as well. According to ancient *Bhartiya* Sciences, Air or *Vayu* forms an integral part of the “*Panchmahabhoot*” or the great five elements which combined together in order to make life possible. The importance of *Vayu* in *Hindu-Vedic* scriptures is a field of great interest as *Vayu* is associated as the ethereal vibration and *Brahman* (the supreme being) itself. Indian scriptures speak praises of *Vayu*, which is evident in the “*Shanti Path*” of the “*Taittiriya Upanishad*” as well, stating, “*O Vayu! You are the directly perceivable Brahman.*”

Being the descendants of such a rich cultural and scientific heritage, the sorry state of affairs of air quality in India today are symbolic of breaking cultural identities, degeneracy, and the loss of the most important component of human nature- being in sync with environment.

Air pollution is a matter of public health concern since a majority of Indians today are breathing in unclean air. The World Health Organisation (WHO) has come up with **The WHO Global Air Quality Guidelines** in order to limit air pollutants like Particulate Matter (PM), Ozone (O₃), Nitrogen Dioxide (NO₂) and Sulphur Dioxide (SO₂). It must be underlined that India exceeded the threshold limit for almost each of the following parameters.

In order to bring the issue of clean air to the forefront the **Ministry of Environment, Forest, and Climate Change (MoEF&CC)**, Government of India (GOI) formulated the National Clean Air Programme, 2019 with the objectives of implementing sustainable development goals and ensuring better quality of air for Indians by preventing and controlling air pollution.

S.no.	First Author & Year	Name of the Study	Source of Publication	Place of Study	Type of Problem Addressed and Specific Issues dealt	Recommendations of the Study in Relation to Systematic Review
1.	(Huang et al., 2017)	Air Pollution Prevention and Control Policy in China	Advances in Experimental Medicine and Biology book series (AEMB, Volume 1017)	CHINA	Examines the past and present circumstances of China's responses to air pollution.	The unravelling of the connections between air pollution and climate change is highlighted, opening up new avenues for integrated research and action in China.
2.	Kanada et al., 2013)	The long-term impacts of air pollution control policy: historical links between municipal actions and industrial energy efficiency in Kawasaki City, Japan	Journal of Cleaner Production	JAPAN	There is an increasing emphasis on the successful implementation of co-benefit policies that are aimed to reduce both air pollutants and CO2 emissions.	Consideration of the connections between low-carbon technology advances and policy approaches that could foster additional cobenefits.
3.	Silvoa et al., 2001	Integrated pollution prevention and control—the Finnish approach	Resources, Conservation and Recycling Volume 35, Issues 1-2, April 2002, Pages 45-60	FINLAND	This paper reflects and discusses a systematic approach to integrate environmental permitting	Several research and development programmes have also been developed to provide a solid knowledge base and supported approaches for increasing integrated pollution prevention.

4.	Raniab et al., 2008)	Air pollution control residues from waste incineration: Current UK situation and assessment of alternative technologies	Waste Management Volume 28, Issue 11, November 2008, Pages 2279-2292	UNITED KINGDOM	Examines current disposal alternatives for APC wastes in the UK.	Stringent interpretation and enforcement of waste legislation is essential if new, potentially more sustainable solutions are to become commercially viable.
5.	Ghorani-Azam et al., 2016	Effects of air pollution on human health and practical measures for prevention in Iran	Journal of Research in Medical Sciences: The Official Journal of Isfahan University of Medical Sciences	IRAN	This study suggests effects of air pollution on human health and realistic solutions for reducing air pollution in Iran.	Standardising vehicle fuel, development of engines with low fuel consumption, public transportation network should be improved.
6.	Lövgren, 1994)	Economic Instruments for Air Pollution Control in Sweden	Economy & Environment book series (ECEN, Volume 9)	SWEDEN	Traditional means of regulation have been mixed with economic mechanisms in Swedish air pollution control strategy in recent years.	Both economic instruments and administrative restrictions have contributed to emissions reductions, but the new economic instruments must be seen as the primary driving force behind the reductions.

OBJECTIVES OF THE STUDY

1. To understand the phenomena of air contamination on a deeper level.
2. To check the causes of air pollution and learn from the response mechanism applied in other countries.
3. To explore the possibilities of newer innovations in environmental sustainability.

MATERIAL & METHODS

For the purpose of this review, the Air pollution curbing mechanism of 6 counties has been studied, namely, China, Japan, Finland, the United Kingdom, Iran, and Sweden. These countries have a good record of restricting environmental degradation and hence were selected for this study.

For a systematic evaluation of the literature, data was obtained by developing subtopics, and data abstraction was completed in Excel. There were columns in Excel with the study's name, authors, location, year, problem category, methods used, outcomes, and recommendations. Data from each research was extracted into a comparable table with a set of significant categories to enable rigorous and consistent interpretation.

REVIEW STUDIES

1) CHINA

In their study, Huang et al., (2017) examined the past and present circumstances of China's responses to air pollution. The control issues and future options for improving China's air quality are then examined. The unravelling of the connections between air pollution and climate change is highlighted, opening up new avenues for integrated research

and action in China. The importance of research and evaluation is suggested.

2) JAPAN

Kanada et al., (2013) in their study, emphasised on the successful implementation of cobenefit policies that are aimed to reduce both air pollutants and CO₂ emissions. However, the concept of co-benefit policies must be further developed in order to determine its quantitative and qualitative validity, which can be assessed using a reliable methodology for estimating co-benefits and by clarifying the importance of this approach for stakeholders in urban environmental policymaking. Based on a systematic review of cobenefit research and air pollution control policies in Japan, the local air pollution control policy in Kawasaki City, one of Japan's industrial centres, was investigated and confirmed to have contributed to both a sharp decline in atmospheric sulphur dioxide (SO₂) levels and energy efficiency improvements in local industries. The findings of this study imply that preventive activities and local-scale compliance enforcement instruments (that are uniquely developed and operate as a type of agreement between government and particular enterprises) could considerably contribute to the long-term effectiveness of co-benefit policies. The study concludes with a consideration of the connections between low-carbon technology advances and policy approaches that could foster additional co-benefits.

3)FINLAND

According to Silvoa et al., (2001) the Finnish environmental policy regarding industrial activities is based on three principles: (1) greater involvement of industry and other stakeholders in the development of new legislation and the establishment of environmental targets; (2) rigidly enforced but realistic and cost-effective implementation of regulations, standards, and permit provisions, in which operators can choose appropriate technical measures; and (3) stringent but functional and

premium execution of regulations, norms, and licence provisions. Finland implemented the European Union's (EU) Directive on Integrated Pollution Prevention and Control (IPPC) by enacting a new Environmental Protection Act on March 1, 2000. The Act places a renewed emphasis on the principles of best available techniques (BAT), a holistic and integrated approach, a high degree of environmental protection through cost-effective solutions, energy efficiency, and risk management. Several research and development programmes have also been developed to provide a solid knowledge base and supported approaches for increasing integrated pollution prevention. As a result, this paper reflects and discusses a systematic approach to integrate environmental permitting.

4)THE UNITED KINGDOM

Raniab et al., (2008) in this research paper examines current disposal alternatives for APC (Air Pollution Control) wastes in the UK as well as alternative treatment technologies explored around the world. APC wastes are now landfilled in the UK, where they undergo in-situ solidification, but the future acceptability of this alternative is dubious because the EU waste acceptance standards (WAC) impose strict leaching limits that are difficult to meet. Other APC residue treatment techniques have been devised, with leaching reported to be below applicable regulatory limitations. The Ferrox process, the VKI process, the WES-PHix method, cementitious binder stabilisation/solidification, and a variety of thermal treatment processes are also discussed. Thermal treatment procedures transform APC leftovers and other pollutants into inert glass or glass-ceramics that enclose heavy metals. The waste management sector will eventually select the lowest available method for treating APC wastes, based on this paper, and stringent interpretation and enforcement of waste legislation is essential if new, potentially more sustainable solutions are to become commercially viable.

5)IRAN

Ghorani-Azam et al., (2016) in this study suggests realistic solutions for reducing air pollution in Iran. Firstly, there has been a significant interest in standardising vehicle fuel as much as possible, as well as developing a new source of energy for motor engines. Second, standardisation of motor engines and the development of engines with low fuel consumption is another technique for lowering air pollution levels. Motor vehicles will almost certainly no longer use fossil fuels and derivatives in the near future. Following that, public transportation networks will be improved by utilising more subways (metro), trams, and electrical bus lines. Reducing the expenses for people who use such devices is the best way to reduce air pollution. After that, increasing the cost of fuel in Iran could be a viable method to reducing the quantity of air pollution. With that, fines for polluting industries should be imposed, as will a low-tax programme for clean technologies. More fees are being levied on automobiles in Iran, particularly those older than 20 years, in order to distinguish between unclean and clean vehicles. Lastly Broad media effort to raise public awareness of air quality, environmental, and public health issues.

6)SWEDEN

According to (Lövgren, 1994), the traditional means of regulation have been mixed with economic mechanisms in Swedish air pollution control strategy in recent years. The sulphur tax, the nitrogen oxides charge, and the environmental classification of diesel fuels all provide significant economic incentives. Both economic instruments and administrative restrictions have contributed to emissions reductions, but the new economic instruments must be seen as the primary driving force behind the reductions. The average sulphur level of heavy fuel oil has dropped to around 0.4%, whereas practically all gas oil now contains less than 0.1%. Total nitrogen oxide emissions from nitrogen oxides-charged boilers have fallen by around 40%. Diesel fuel taxes are diversified in order to

encourage the use of environmentally better grades of fuel, which are taxed at a lower rate than the normal grade. As a result, diesel fuels with higher standards than the regular grade have seized a sizable portion of diesel sales — over 75% — in just a few years.

DISCUSSION

According to the outcomes of this review paper, the link between air pollution and climate change is highlighted, opening up new pathways for integrated research and action in China. Following that, In Japan a greater emphasis is placed on the successful implementation of cobenefit policies aiming at reducing both air pollutants and CO₂ emissions. It can also be analysed in terms of the relationships between low-carbon technological breakthroughs and policy measures that potentially encourage additional co-benefits. It can also be reviewed that in Finland, they are working on three major principles to reduce air pollution: first, greater involvement of industry and other stakeholders in the development of new legislation and the establishment of environmental targets; second, they work on the rigidly enforced but realistic and cost-effective implementation of regulations, standards, and permit provisions, in which operators can choose appropriate technical measures; and finally, they work on the implementation of regulations, standards, and permit provisions, in which operators can choose appropriate technical measures. As a result, this demonstrates a methodical approach to integrate environmental permits in Finland. It has also been noted that disposal alternatives for APC wastes are being investigated in the UK, as well as alternate treatment technologies around the world. APC wastes are now landfilled in the UK, where they undergo in-situ solidification, but the long-term viability of this option is uncertain because EU waste acceptance standards (WAC) demand strict leaching limits that are difficult to fulfil. This paper suggests that the waste management industry will finally choose the cheapest available way for processing APC wastes, and that strict interpretation and enforcement of

waste legislation is required if new, potentially more sustainable alternatives are to become financially viable. Furthermore, in Iran, practical measures for lowering air pollution are being implemented, such as standardising car fuel, developing engines with low fuel consumption, improving public transit networks, and increasing public awareness of air quality through media activities. Finally, it has been concluded that while both economic instruments and administrative constraints have contributed to emissions reductions in Sweden, the new economic instruments must be viewed as the fundamental driving force behind the reductions.

As a result of examining all of these studies, it can be concluded that air pollution has a significant impact on human health, causing and generating a variety of diseases that result in high morbidity and mortality, particularly in developing nations such as India. As a result, air pollution control is essential and should be at the top of the government's priority list. As in other countries, policymakers and lawmakers in India must update all air pollution laws and regulations. Coordination between several departments involved in air pollution in India must be led by a strong pollution control body. The development of new technologies is one of the most potential areas for improving the air quality which can take place in India as it has already taken place in many nations and provided them a lot of benefit. Lastly Research and innovation (R&I) is vital for fostering smart and long-term growth in job creation. Research is critical to developing new and creative goods, processes, and services that enable increased productivity, industrial competitiveness, and, ultimately, wealth, and this can result in reducing air pollution.

LIMITATIONS

“Most of the intuitions across the world seem to have “problem based” and not a “solution driven” approach to air quality deterioration.

“Heavy dependence on fossil fuels and conventional sources of energy often overpowers the efforts of air cleansing and purification.

“Developing and under-developed countries are the worst sufferers of air contamination and related morbidity because of obsolete technology, insufficient funds and lack of motivation.

FUTURE SCOPE

1. To reduce Air pollution, shifting to non-conventional sources of energy is a must. The energy generation sector contributes significantly to air contamination. Hence, solar power, winder energy and other green sources of energy should be used.
2. To curb excessive air pollution, Air Purification Towers are a great way to reduce environmental impact and ensure good health of people.
3. Standardization of fuel across the world can help magnificently in combating air pollution since vehicular pollution forms the lion share of toxic emissions in most countries.
4. Regulation of Industries and adaptation of strict environmental protocols in indicated in almost all success stories of environment conservation the world. Adherence to rules is the basic necessity to address air contamination.