

A Comprehensive Study on Impacts of Air Pollution on Environment and Human Health

Garima Singh, Rakshit Jakhar, Ravi Raj, Preeti Sachar



Abstract: *One of the biggest challenges for our society is air pollution because it is not only impacting our climate, but it affects the environment as well as human health badly. There are various pollutants present in the air nowadays that are the main reasons for disease in human beings. One of the major pollutants is Particulate Matter (PM), which is particles of very small diameter and variable, impale the respiratory system through breath, causing cardiovascular and respiratory diseases, dysfunction of the central and reproductive nervous system, and cancer. Although the ozone layer in the troposphere plays an important and protective role against irradiation of ultraviolet, it is dangerous when in extreme concentrations near the level of the ground, also impacting the cardiovascular and respiratory systems. Lastly, changes in climate resulting from environmental pollution impact the distribution of various infectious diseases, like natural disasters. The best way to overcome these issues is through awareness in public integrated with an approach multidisciplinary by scientific experts; organizations of international and national levels must study the emergence of this problem and provide sustainable solutions. This paper presents a comprehensive study on the impacts of air pollution on human health and the environment. Also, we are discussing the role of artificial intelligence to overcome these problems.*

Keywords: *Air Pollution, Artificial Intelligence (Ai), Diseases, Environment, Greenhouse Gases (Ghg), Policy.*

I. INTRODUCTION

The interconnections between human beings and their substantial surroundings have been widely studied, as various activities of human being influence the environment. Pollution is abbreviated as the insertion into the substances of the environment harmful to living organisms and humans. Pollutants are dangerous gases, solids, or liquids produced in better than regular concentrations that decrease the environmental qualities. Activities of human beings have an unfortunate impact on the environment by infecting; the air we inhale, the soil where plants grow, and the drinking water.

Although the revolution in industries was an exceptional achievement in terms of society, technology, and the facilities of various services, it also originated the generation of enormous amounts of pollutants emitted into the environment that are dangerous to the health of human beings. Environmental pollution at the global level is taken as a global public health problem with different facets. Economic, legislative, and social problems and habits of lifestyle are connected to this big issue. Industrialization and urbanization are reaching exceptional and destabilizing proportions globally in our society. Anthropogenic air pollution is the major and biggest hazard to public health globally, it is proved that it is the reason for 9 million death every year [1]. Climate changes and the impacts of increasing temperature significantly affect various ecosystems, causing issues such as the melting of ice and iceberg, damage to plants, food safety issues, and animal extinction. Air pollution has several effects on human health. The human health of sensitive and susceptible individuals might be affected even at a decreased level of air pollution. Some major diseases such as asthma, wheezing, shortness of breath, respiratory disease, chronic obstructive pulmonary disease (COPD), and an increased rate of hospitalization are short-term exposure to air pollution. Also, long-term exposure to air pollution is cardiovascular diseases, chronic asthma, pulmonary insufficiency, and mortality of cardiovascular. Moreover, air pollution is considered as the cause of several malign health issues in children, such as cardiovascular, perinatal disorder, mental, respiratory, leading to chronic disease in younger and infant mortality [2]. Air pollution mostly affects the people living in big cities, where fume emissions from vehicles contribute mainly to the reduction of air quality. There are also higher chances of industrial accidents because where the toxic fog is spread might be fatal to the people of corresponding areas. This type of pollutant is estimated by various parameters, mainly significantly atmospheric wind, and stability. Sometimes this air pollution can also badly affect the power system by creating islanding in the system [3]. The problem associated with air pollution in developing countries is more dangerous due to uncontrolled urbanization together with industrialization and overpopulation. This tends to bad air quality, especially in countries, where the environmental management system is not properly well designed and lacks an information system. The utilization of fuels such as solid fuel or wood fuel for making foods or other domestic uses due to very low income exposes the population to low quality, even polluted air at the house.

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Fig. 1 appropriately explains the climate system, which has all the required studies or parts of the climate change problems. This Figure illustrates all the major factors

associated with climate change such as changes in ice area, changes in water level, different types of radiation, etc.

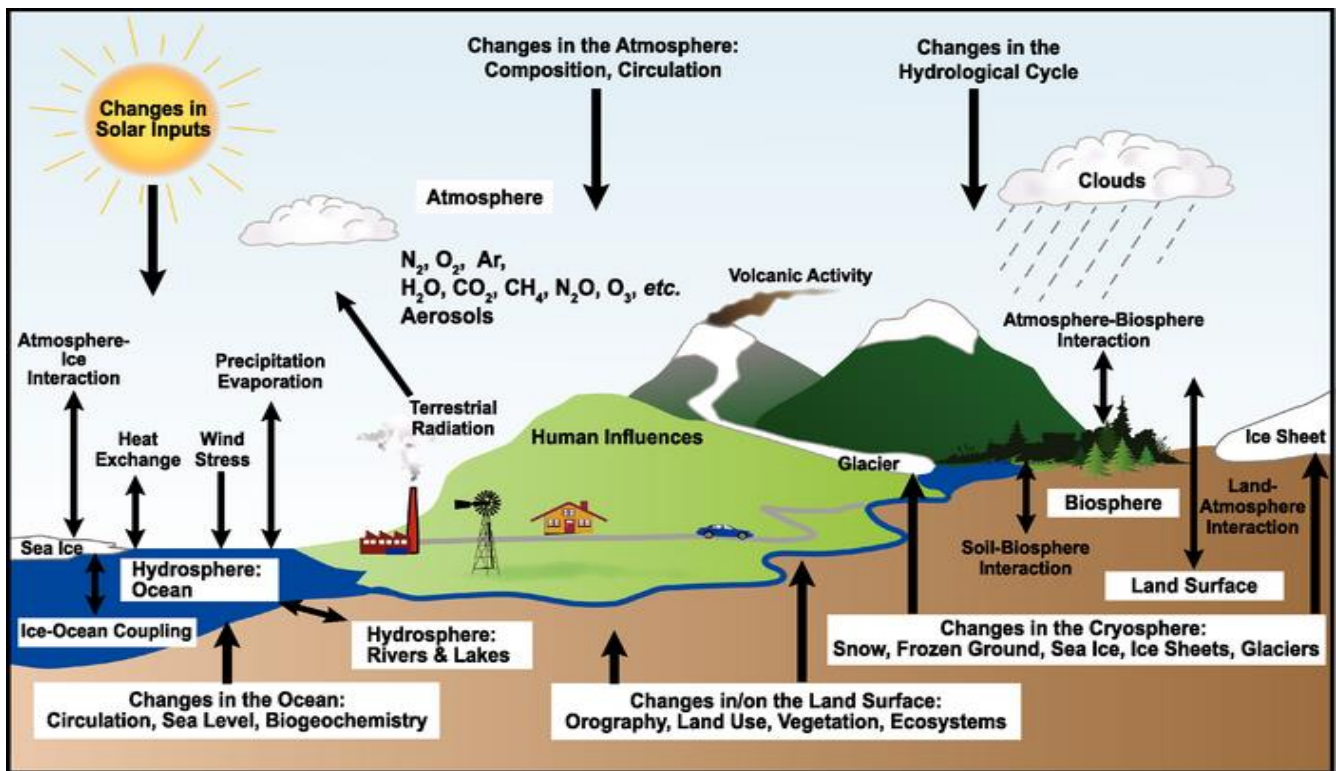


Fig. 1. A complete climate system with almost all activities [4]

Effectiveness and success in air pollution control especially in the small area, have been seen. Significant techniques are applied to estimating the resources and type of the emission together with its impact on the environment and health. Government and private authorities and entities implement works to ensure the quality of air [5]. Assessment of the controlling methods and policies is generalized from the surroundings to the local and finally to the global level. Air pollution might be transported and dispersed from one area to another region localized far away. Management of air pollution means the deduction to the levels of acceptance or elimination of possible air pollutants whose availability in the impacts of air on our health or the environment. This paper presents a study of air pollution's impacts on the environment and public health. Also, we are discussing some better solutions and future research prospects in this field.

II. SOURCES OF EXPOSURE

It is better known that most of the pollutants of air are emitted through activities of humans at a large-scale such as the utilization of machinery in the industries, power plants, combustion engines, and vehicles. Because these types of activities are exploited at a very large level, they are the biggest reasons for air pollution. Cars are mainly around 80% contributors of responsible for today's air pollution [6]. Some other activities of human beings are also impacting our environment to a smaller extent, such as fuel tanks heaters, procedures of cleaning, techniques of field cultivation, and gas stations, as well as various natural resources, such as forest fires, and eruptions of soil and volcanoes. GHG is the major reason for the evolution of air pollution in the

environment. It is a very dangerous gas for the vulnerable people in our society.

Air pollutants are classified based on the resources of the production of pollution. Therefore, the air pollutants are classified into four parts Mobile sources, Major sources, Natural Sources, and Indoor sources.

A. Mobile Sources

Sources of air pollution such as airways, buses, trucks, cranes, railways, cars, automobiles, and many more, are considered mobile sources. These types of sources are mainly effective in the large cities for the generation of air pollution. These are not effective in rural areas, because in rural areas vehicles are very few.

B. Major Sources

Sources of air pollution such as refineries, power plants, fertilizer industries, chemical industries, petrochemicals industries, metallurgical industrial plants, and other types of these industries are considered major sources. These types of sources are mainly available in industrial areas in any country.

C. Natural Sources

There are some natural sources of air pollution that are also available such as dust storms, volcanic erosion, agricultural burnings, and forest fire. These types of sources can be found anywhere in the world.

D. Indoor Sources

Sources of air pollution such as printing shops, cleaning activities, petrol stations, and dry cleaners are considered indoor area sources.

If some major pollutants such as CO, NO, SO₃, NO₂, CO₂, hydrocarbons, dispersed particles, etc. are present in the air at more than the minimum acceptable value then that situation is called air pollution. Air pollution can impact the quality of water and soil by polluting precipitation and mixing into soil and water environments [7]. Moreover, air pollution occurs if there are any changes in the biological, physical, or chemical constituents of nature. Pollutants harm our health and environment either by adding or increasing the number of substances harmful toxic to the environment.

III. CLIMATE AND POLLUTION

Fig. 2 demonstrates the complete relationship between air pollution and climate change on human health. It provides the complete possible health risks due to climate change. Air pollution is responsible for most of the critical disease evolution in human beings. GHG is playing a vital role in climate change occurrence. Thus, the emission of GHG must be controlled and forecasting the future problems due to this issue, by the application of some advanced technologies such as artificial intelligence, machine learning, etc. [8].

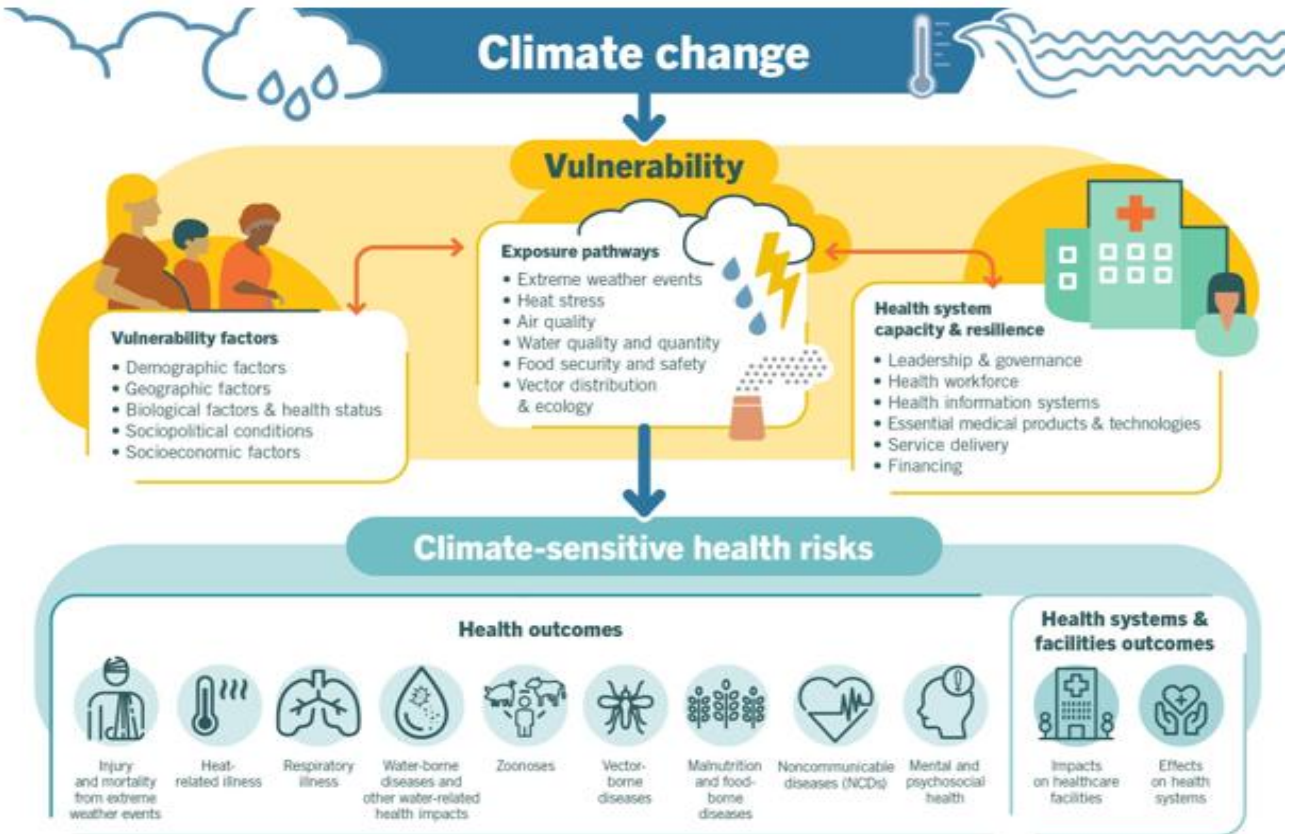


Fig. 2. A complete relation between climate change and its corresponding impacts [9]

IV. AIR POLLUTANTS

According to World Health Organization (WHO) reports on six major pollutants of air, namely sulfur dioxides, lead, particle pollution, carbon monoxides, nitrogen oxides, and ground-level ozone. Air pollution might have a harmful impact on all parts of the environment, including air, soil, and groundwater. As well as it contains a major threat to human beings. Global warming, acid rain, GHG, and climate changes have a vital impact on the ecology of air pollution [10]. Some major gases responsible for health issues associated with air pollution have been discussed below:

A. Sulfur Dioxide (SO₂)

SO₂ emitted from fossil fuel emissions or other industries is a very harmful gas for human beings. It affects the plant, human, and animal life. Susceptible human beings such as those with children, lung disease, and old people, who give a very high risk of damage. The main problems of health

associated with emissions of sulfur dioxide in the industrial field are irritation of respiratory, bronchospasm, bronchitis, and production of mucus, as it is an irritant of sensory and deep penetrates the lung transformed into bisulfite and connecting with receptors of sensory, causing bronchoconstriction.

B. Leads

Lead is a very heavy metal utilized in various industries and emitted from vehicles running with petrol, waste incinerators, batteries, wastewaters, and radiators [11]. Although, some major resources of lead pollution are metals, piston-engine, and ore of the aircraft in the air. Poisoning of lead is a major threat to lives due to its dangerous effects on the environment, humans, and animals, particularly in developing areas.

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C. Carbon Monoxide (CO)

CO is generated during the combustion of fossil fuels if they are not completely burned. The symptoms such as nausea, headache, loss of consciousness, vomiting, weakness, and dizziness are created due to this gas when it enters the body through inhaling. It also affects the GHG that is strongly connected to climate and global warming. The rapport of CO to hemoglobin is much more than that of O₂ (oxygen).

D. Nitrogen Dioxide (NO₂)

NO₂ is a type of pollutant emitted from the engines of an automobile motor. It is very harmful because it penetrates deeper into the lungs, inducing diseases related to the respiratory system such as wheezing, coughing, bronchospasm, pulmonary edema, and dyspnea. However, some other diseases such as irritation in the nose, eye, and throat have been seen also.

V. IMPACTS OF AIR POLLUTION ON THE ENVIRONMENT

Air pollution is impacting not only the health of humans but also our environment. Acid rain is dry or wet precipitation having toxic amounts of sulfuric and nitric acids. Acid rain has the capability to acidify the soil and water environments, damage plantations and trees, and even affect constructions, outdoor sculptures, and statues. Haze is generated when small and fine particles are mixed in the air and decrease the atmospheric transparency. It is generated by the emissions of gases in the air emitted from automobiles, trucks, power plants, and industrial facilities.

Changes in climate are an important problem that concerns human beings. The GHG effect protects the temperature of the earth's stability. People living in bad quality buildings in hot climate countries can be badly affected hot climate from heat stroke-related problems [12]. Wildlife is also badly infected by the air pollution impacts on the environment. Wildlife animals are suffering from the birth effects and reproductive failure. Therefore, we can say that air pollution has mostly effects on water and soil, and these effects significantly create health issues for animals as well as human beings.

VI. APPLICATION OF ARTIFICIAL INTELLIGENCE TO COMBAT AIR POLLUTION

AI has the capacity of improving qualitative and collective measurement data. AI can be implemented for better analysis by finding accurate patterns. AI technique might discover resources of air pollution accurately and quickly. Artificial intelligence can be useful to predict and track the reduction and growth of air pollution. We can monitor the gases emitted from vehicles and industries. Forecasting accurate air quality is a significant impact on controlling pollution as well as wellness and public health. Generally, the usual forecasting methodology has shown lower accuracy due to the complex and non-linear dynamic nature of air pollutants [13]. Artificial intelligence techniques such as support vector machines (SVM), deep neural networks (DNN), fuzzy logic, and artificial neural networks (ANN) for forecasting air pollution can be used extensively. Thus, AI has become the most advanced technology to combat air pollution by

forecasting the issues related to human health and the environment.



Fig. 3. Algorithm of AI for clean air

Predicting the quality of air is a complex task because it is dynamic in nature, highly variable, and volatile with time, and space of particulates and pollutants. Thus, we need a better technology to monitor, predict, and model a system for the air quality index. AI can play an important and better role to provide an accurate prediction of air quality index. Fig. 3 presents a complete scenario for the role of AI to combat air pollution from our environment. Recent technologies such as deep learning can be also utilized to combat air pollution, which can be used to analyze data on pollution in a better way to identify the pattern of air pollution.

VII. DISCUSSION

World health organization organized a global conference on air pollution and health in 2018, the general director of the world health organization termed air pollution an “emergency of silent public health” and “the new tobacco” [14]. Diseases related to air pollution have significant impacts on the economy and health. Therefore, a global policy for the prevention of air pollution must be designed to reduce the harmful air pollution as a complement to getting data about adverse effects on health-related to air pollution. International cooperation is required to do research, monitoring, administration policy, politics, and development is necessary for better control of pollution [15]. This article presents a comprehensive idea of air pollution background and its adverse impacts on human health and the environment. We provide a detailed report on factors responsible for air pollution. Finally, the main important purpose of this article is to provide a better insight into air pollution's adverse impacts on health and the environment, to the early-stage researchers who are going to start their research in the field of environmental studies.

VIII. CONCLUSION

Air pollution is the major problem for human being and environment nowadays because it is responsible for most of the severe diseases in the human lives. Thus, it is required to solve this major problem by applying various techniques.

This paper provides an overview of the causes for the air pollution and their corresponding affects on the human beings and environment. This article is very helpful for the early-stage researchers starting their career or research in this area of study. In the near future a greater number of article is required to give better insights related to this major issue.

REFERENCES

1. Air Pollution, WHO, Available online: <https://www.who.int/health-topics/air-pollution> (accessed on April 18, 2022).
2. R. Kelishadi, P. Poursafa, "Air pollution and non-respiratory health hazards for children", Archives of Medical Science (AMS), vol. 6, pp. 483–95, 2010, doi: 10.5114/aoms.2010.14458.
3. R. Raj, and M. Praveen, "Survey of Islanding Detection Techniques for Grid-connected Photovoltaic Inverters", International Journal of Computer Science and Network (IJCSN), Vol. 6, Issue 1, pp.14-23, February 2017.
4. The Climate System, Available online: <https://scied.ucar.edu/learning-zone/earth-system/climate-system> (accessed on April 18, 2022).
5. M. Newlands, "Environmental Activism, Environmental Politics, and Representation: The Framing of the British Environmental Activist Movement", Ph.D. thesis, University of East London, United Kingdom (2015).
6. L. Möller, D. Schuetzle, and H. Autrup, "Future research needs associated with the assessment of potential human health risks from exposure to toxic ambient air pollutants", Environ Health Perspect., vol. 102(Suppl. 4), pp. 193–210, 1994, doi: 10.1289/ehp.94102s4193.
7. V. Maipa, Y. Alamanos, and E. Bezirtzoglou, "Seasonal fluctuation of bacterial indicators in coastal waters", Microbial Ecology in Health and Disease, vol. 13, no. 3, pp. 143-146, 2001, doi: 10.1080/089106001750462687.
8. R. Jakhar, G. Singh, R. Raj, K. Kumari, P. Sachar, and P. S. Prasad, "Different Applications of Artificial Intelligence to Combat Climate Change Issue", International Journal of Advanced Trends in Computer Science and Engineering, vol. 11, no. 2, March-April 2022, pp. 58-61.
9. Climate change and health, World Health Organization, October 30, 2021, available online: <https://www.who.int/news-room/fact-sheets/detail/climate-change-and-health> (accessed on April 21, 2022).
10. W. E. Wilson, and H. H. Suh, "Fine Particles and Coarse Particles: Concentration Relationships Relevant to Epidemiologic Studies", Journal of the Air and Waste Management Association, vol. 47, no. 12, pp. 1238-1249, 1997, doi: 10.1080/10473289.1997.10464074.
11. A. Pruss-Ustun, L. Fewrell, P. J. Landrigan, J. L. Ayuso-Mateos, "Lead exposure. Comparative Quantification of Health Risks", World Health Organization, pp. 1495–1542. Available online: <https://www.who.int/publications/cra/chapters/volume2/1495-1542.pdf?ua=1> (accessed on April 21, 2022).
12. L. Manderson, "How global warming is adding to the health risks of poor people", January, 27, 2019, available online: <https://theconversation.com/how-global-warming-is-adding-to-the-health-risks-of-poor-people-109520> (accessed on April 21, 2022).
13. A. Masood, and K. Ahmad, "A review on emerging artificial intelligence (AI) techniques for air pollution forecasting: Fundamentals, application, and performance", Journal of Cleaner Production, vol 322, no. 129072, November 2021, doi: 10.1016/j.jclepro.2021.129072.
14. WHO, First WHO Global Conference on Air Pollution and Health, 2018, Available online: <https://www.who.int/news-room/events/detail/2018/10/30/default-calendar/air-pollution-conference> (accessed on April 22, 2022).
15. I. Manisalidis, E. Stavropoulou, A. Stavropoulos, and E. Bezirtzoglou, "Environmental and Health Impacts of Air Pollution: A Review", Frontiers in Public Health, 2020, doi: 10.3389/fpubh.2020.00014.

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