A Brief Overview of Some Environmental Problems in India

K.T. Padmapriya[1] and Dr. Vivekanada Kandarpa[2]
[1] CVR College of Engineering, Department of H&S, Ibrahimpatan, R.R.District, A.P., India
Email:ktpadmapriya@gmail.com
[2] Professor, University of Phoenix, USA.
Email: kandarpav@gmail.com

Abstract- **The current article is a brief discussion of the enormity of environmental problems facing India. The problems are in the form of pollution of air, water, and land resources. High concentrations of pollutants of various kinds are directly linked with the health of the people, and in some cases they result in premature deaths. It is extremely important for engineers of the current and next generation to be cognizant of this situation in their future developments. Environmental laws exist, and every effort should be made to keep this in mind in all new developments.**

Index Terms- **Environment, Atmospheric pollution, pollutant, Environmental laws.**

I. INTRODUCTION

There is a preponderance of evidence that the majority of the respiratory and cardiovascular maladies, cancer and other serious diseases, and even premature death of millions of infants are due to very high level of the pollution of the air, water, and land. The sources for the pollution are many, and they include various industries, electric power plants, different modes of transportation, and waste disposal of various kinds (medical, industrial, radioactive, etc.,). In spite of the promulgation of many government regulations to combat the degradation of the environment, very little progress is being made and even the little progress made to date is too slow, especially in the developing countries. This is in spite of the global alarm expressed in the United Nations sponsored GEO-4 [1]: "Tipping points occur when the cumulative effects of steady environmental changes reach the thresholds that result in dramatic and often rapid changes. There is a concern that a number of environmental systems may be heading towards tipping points."

Most of the well developed countries are making much better progress at the local level in reducing harmful pollution, but many of them are reluctant to take full measures to reduce green house gas (GHG) emissions. Their main reasons expressed by the developed countries for the resistance to fully implement any reduction in GHG emissions are: (1) economic impact of such measures on the industry and (2) the lack of general belief on the GHG impact on global warming. On the other hand, the developing countries are reluctant to do anything regarding GHG emissions for a different set of reasons. They include: (1) the current urgent need of energy and other resource needs to support large populations, (2) a general lack of clean energy resources, and (3) the economic impact of importing advanced technologies to implement these reductions.

The purpose of this article is to educate the current generation of Engineers on the seriousness of the environmental problems currently facing India.

II. BRIEF HISTORICAL BACKGROUND

Historically speaking, the general concerns for the environment were expressed in Indian literature as far back as 300 BC in Kautilya's Arthasastra, where economic importance of forest administration is emphasized [2]. Following the ideas expressed in this document, Ashoka, in the early part of 1st Century implemented some concrete measures, as evident on the Ashoka Pillar, which expresses the necessity for biodiversity [3]:

"- - - - - Beloved-of-the-Gods, King PIYADASI (ASHOKA), speaks thus: Animals were declared to be protected – parrots, bats, - - - - and all four-footed creatures that are neither useful nor edible. Also protected were nanny goats, ewes and sows which are with young or giving milk to their young, and so are young ones less than six months old. Cocks are not to be caponized, husks hiding living beings are not to be burnt, and forests are not to be burnt either without reason or to kill creatures."

Additional evidence for the Indian society concern for environment can be found in the 5th Century document named "YAGNAVALKYA SMRITHI", which prohibited the cutting of trees and prescribed punishment for such acts.

These historical documents clearly demonstrated that the Indian society was implicitly conscious of the adverse environmental effects caused by deforestation and extinction of animal species (i.e. harmful effects of bio diversity). The latest GEO-4 [1] stresses the importance of biodiversity in preserving human and ecosystem welfare. However, over a period of several centuries, India lost this ideology and substantially deviated from its historic ethical philosophy and started embracing western utilitarian ethical philosophy. From the advent of industrial revolution, the utilitarian western ethical philosophy essentially dictated indiscriminate use of natural resources,

DOI: 10.32377/cvrjst0415

in the beginning in the western countries, and subsequently propagated throughout the world. According to utilitarian ethics, the right action is "the action that produces maximum happiness to man". It is generally accepted that "the main strands of Judeo-Christian thinking had encouraged the overexploitation of nature by maintaining the superiority of humans over all other forms of life on earth, and by depicting that all of nature as created for the use of humans"[4][5]. However, in the mid to late 20th century, many U.S. naturalists began to rethink some of these ethical viewpoints and started to voice concerns on the overuse of natural resources. They promoted the idea of conserving natural resources and eventually forced the legislative actions of the U.S. administration. The public awareness about the pollution and the degradation of the resource quality began to increase, in large part because of the publication of the book, *Silent Spring* by Rachel Carson [6]. Her book emphasized the harmful effects of DDT (dichlorodiphenyltrichloroethane) and other pesticides on birds as well as the contamination of human food supplies. Subsequently, further environmental movements followed throughout the U.S. and finally by 1970, the voices of the environmentalists were heard with the establishment of the first Earth Day by Gaylord Nelson, a former U.S. senator. Soon after, the US government formed Environmental Protection Agency (EPA) and established National Environmental Policy Act (NEPA). Now, most of the countries around the world have incorporated some form of environmental legislation to protect the environment. The EPA passed many environmental laws and regulations aimed at protecting the environment. However, it is not an easy task to implement the laws, especially when it comes to retrofitting changes to the already well established industries in the U.S. In spite of these difficulties, U.S. and many of the developed countries have been making substantial progress.

The developing countries, such as India, China, and other countries are facing similar environmental problems, but with more enhanced intensities due to relatively large populations using technologies. Before the problems get too severe, these developing countries should pay attention to the "lessons already learned" by the developed countries and implement the proper preventive measures at the inception of any new industrial developments. One of the crucial steps in this process is a general awareness of how natural environment functions.

III. WHAT IS ENVIRONMENTAL SCIENCE?

Environmental Science is the application of different sciences and non-sciences in understanding and managing or mismanaging the environment around us. It is not like other pure sciences. The goal of pure sciences is "to find how world works, to seek what regularities there may be, to penetrate to the connection of things – from sub-nuclear particles, which may be the constituents of all matter, to living organisms, the human social community, and thence to the cosmos as a whole" [7]. Science, especially physics attempts to understand the functioning of the universe, simply because it is there. In spite of the esoteric nature of sciences and its focus on fundamental research, humans benefited from the technologies they produced. However, some of the technological developments resulted in several unexpected consequences, such as "damages of various kinds" to the environment around us. There are many historical examples related to the "unexpected negative consequences" of useful technological products. Let us look at a recent example of a widely used pesticide which is banned subsequently because of the unexpected consequences.

NEONICOTINOID pesticides, a group of nicotine based chemicals, have been successfully helping in the control of pests of various kinds. Different research organizations, including the most recent work, hailed these pesticides to "have outstanding potency and systemic action for crop protection against piercing-sucking pests, and they are highly effective for flea control on cats and dogs. They generally have low toxicity to mammals (acute and chronic), birds, and fish."[8]. Since their registration in 1990's, these pesticides have been in use throughout the world. In recent research activities, a possible link between the use of NEONICOTINOID pesticides and drastic reduction in honey bees has been established. As the honey bees are considered the prime pollinators in agriculture, a majority of the countries in the European Union banned the use of NEONICTONOID pesticides. It is definite win for the bees and the environmentalists [9]. Further studies, probably, will ban the use of these pesticides in other countries. This example illustrates the relation among sciences, technologies, environmentalists, and government. Thus environmental science, unlike pure sciences is driven by humans for their need. Environmental Scientists are like "watchdogs" for the people and government agencies in proposing and implementing various environmental laws.

By its complex nature, environmental science handles many interconnected local as well as global issues involving human population, natural resources, and environmental pollution. It recognizes that whatever we do, that is going to alter the world's environment outside humans. The goal of environmental science is to encourage various governments, industries and people of the world to operate in an environmentally sustainable manner. Here, the environmental sustainability is defined as the ability to meet the current human needs for natural resources without compromising the ability of future generations to meet their needs, including minimum to the environment.

IV. ENVIRONMENT AS A SYSTEM: Natural Environment

As in Science and Engineering disciplines, it is convenient and useful to treat the environment as a system. The environmental system may be considered as made up four segments or individual sub-systems: Atmosphere, Hydrosphere, Geo-sphere or Lithosphere, and Biosphere. Fig.1 illustrates a schematic of natural environmental

system. Four segments or subsystems, namely, atmosphere, hydrosphere, lithosphere (or geo-sphere), and biosphere interact with one another. These interactions consist of energy and material transport among the segments, and ultimately they reach a dynamic equilibrium.

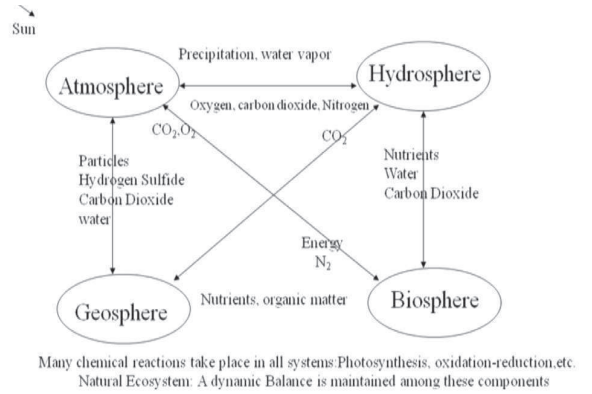

Figure 1: Schematic Representation of Natural Environment

Sun is the main source of energy in supporting life on earth. Earth's atmosphere provides radiation protection and molecular exchange needed to support life. Very high energy radiation from the sun is protected by the stratosphere (between about 11 km – 50 km above the earth's surface), where photochemical reaction creates a constant Ozone (O_3) content by an equilibrium reaction between oxygen and ozone. The ozone layer absorbs the majority of harmful ultraviolet radiation from the sun and prevents it from reaching the surface of the earth. The region from the surface of earth to about 11 km is called troposphere and is the most important zone for sustaining life on earth. The region is made up of nitrogen and oxygen, with minor amounts of carbon dioxide (about 0.03 percent of the atmosphere), and argon. Since the atmosphere is in equilibrium with the hydrosphere, varying concentrations of water vapor are also present in the atmosphere depending upon its location. The troposphere region provides the necessary molecular exchange between atmosphere and other subsystems of the environment needed. For example, the plants absorb radiation from the sun and the atmospheric carbon dioxide (CO_2) in utilizing the sun's energy through photosynthesis, and give off oxygen (O_2) as byproduct in respiration process. Humans and some animals breathe O_2 and give off CO_2. In addition to providing photosynthesis, CO_2 and water vapor help maintain a relatively comfortable temperature of earth around 15^{o}C by means of the greenhouse effect. Thus, life on earth is made possible by the energy from the sun and exchange of life supporting materials from atmosphere to other segments of the earth system.

In the hydrosphere (ocean and other surface waters), carbon dioxide dissolves in water. Carbonate minerals in the geo-sphere or lithosphere (land) also contain carbon. On land, carbon occurs as carbohydrates, proteins, and molecules essential for life in the biota, as fossil fuels from dead animals, and as carbonates in rocks. In ocean and other surface waters, carbon occurs as carbohydrates in the biota, as several forms of dissolved carbon dioxide, and as carbonates in the sediments. A schematic representation of a sustainable carbon cycle is shown Fig.2,. Through nitrogen cycle, the global circulation of nitrogen from the environment to living organisms and back to the environment are maintained. Similarly, hydrological cycle is maintained by global circulation of water from the environment to living organisms and back to the environment. A standard book on environmental science should be consulted for additional details on various cycles [10]. A dynamic balance of carbon, nitrogen, water, and other constituents are maintained in the natural environment, through carbon, nitrogen, phosphorus, sulfur, and water cycles.

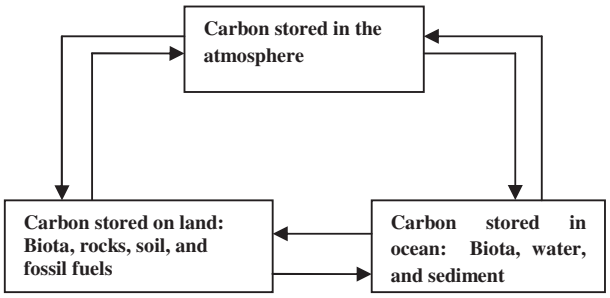

Figure 2: A schematic representation of Carbon Exchange in the Environment

V. TECHNOLOGICAL IMPACT ONNATURAL ENVIRONMENT

The dynamic equilibrium of the natural environment is impacted substantially by modern technological developments. Fig.3 schematically illustrates the impact of technology "currently" being used worldwide on the natural environment. All sub-systems of the environment see the impact of technology, either directly or indirectly through interaction among the sub-systems. Benign atmosphere becomes hostile due to harmful pollutant species, including especially dangerous particulate matter. These unnatural chemical pollutants and "their long-term exposure have serious health impacts for humans, ranging from minor eye irritation, respiratory symptoms to decreased lung and heart function, hospitalization, and even premature death." [11].

DOI: 10.32377/cvrjst0415

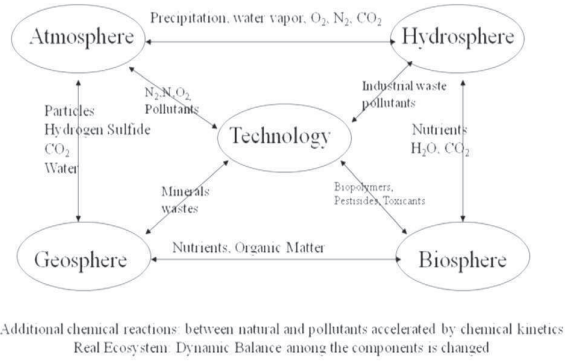

Figure 3: IMPACT OF TECHNOLOGY ON THE NATURAL ENVIRONMENT

The introduction of technology imparts additional constituents in all subsystems of the natural environment. Some of the technologies which directly impacted the natural environment include,

1) Energy production and utilization industries (fossil fuels including coal)
2) Transportation industries and private transportation (fossil fuels use)
3) Agriculture practices
4) Manufacture and utilization pesticides and insecticides
5) Manufacture of industrial products and various chemicals (Most of the Chlorine based chemicals)
6) Extraction and processing of mineral extraction (various acids, surfactants, etc.,)
7) Waste disposal (medical, radioactive, etc.)

These and many more modern developments contribute to the degradation of the environment. For example, coal mining industry and the burning of coal in the power generation industry cause serious environmental problems. Mining destroys existing vegetation and topsoil; the effluents in the mining operation generate pollutants in water and in the air (arsenic, lead, cadmium, particulate matter, etc.). Combustion of carbon produces several pollutants (CO_2, SO_2, etc). The GEO-4 of the UNEP emphasized that the energy, climate-change, industrial developments and environmental pollution are the main environmental concerns [1]. The report further reiterated that twenty years after the first report (UNEPT, 1998), factors such as population growth, and economic activities as well as consumption patterns have placed increased pressure on the environment. The population growth and increase in economic activities affect the environment negatively. The result is greater consumption of resources and higher pollution. However, by implementing improvement in technology, the negative effects of technology can be minimized or even eliminated.

VI. ATMOSPHERIC POLLUTION

The atmosphere, its pollutants and their associated issues are very complex. Here atmospheric pollution is defined as chemicals added to the "natural environment" in high enough concentrations to be harmful. The addition of these chemicals could occur by natural events (volcanic activity) or human activities (emissions from transportation and various industries). A given pollutant can have local or global effect depending upon the residence time of the pollutant in the atmosphere. The residence time of a pollutant is a measure of how long it stays in the atmosphere. The pollutants with short residence times affect local air quality. The pollutants that affect local air quality include particular matter (PM), gases such as SO_2, NO_2, NO, NH_3 and their ionic forms. All the gaseous species mentioned are called primary pollutants (emitted directly into atmosphere). The pollutants with residence time of days to weeks cause local and regional problems. The pollutants that belong to this category include, SO_4^{-2}, NO_3^-, NH_4^+, and particular matter having $PM_{2.5}$ (particulate matter with diameters less than or equal to 2.5 microns). The pollutants with residence time of weeks to months cause continental problems. The presence of Ozone in the troposphere belongs to this category. Ozone in the troposphere is formed as a result of secondary conversion of nitrogen oxides and some hydrocarbons in the presence of UV radiation. The pollutants with residence time from month to years result in global problems, including global warming. Pollutants that belong to this category are CO_2, CH_4, N_2, SF_6, HFCs, and PFCs.

The immediate effect of air pollution is its impact on human health. Evidence shows that many air pollutants suppress the immune system, cause respiratory illnesses, chronic respiratory diseases and premature death. The World Health Organization (WHO) uses six atmospheric pollutants in evaluating air quality. These include, Suspended Particular matter (SPM), Sulfur dioxide, Carbon monoxide, Ozone (troposphere), and lead. The particulate pollution in the atmosphere alone seems to be the leading cause of premature deaths in India and other Asian countries. In year 2000, over 500,000 premature deaths were reported as due to outdoor exposure to PM_{10} particulate materials. TABLE 1 lists the health effects of the WHO pollutants. If remedial effects are not implemented, the premature deaths could reach millions in future.

In addition to the atmospheric pollution, the land and water resources are also being degraded by various industries and people by improper discharge of harmful chemicals with consequences to the human and ecosystem health.

TABLE 1
HEALTH EFFECTS AND ATMOSPHERIC POLLUTION

POLLUTANT	SOURCE	HEALTH EFFECTS
Particulate	Motor vehicles, power plants, various industries, and construction	Respiratory illnesses, heart disease, suppresses immune system, some specific species may cause cancer.
Nitrogen Oxides	Motor vehicles, various industries, and fertilizer usage	Respiratory conditions
Sulfur Dioxide	Power plants and various industries	Same effects as particulate matter
Carbon Monoxide	Motor vehicles and various industries	Headache, fatigue and death when exposed to high level
Ozone	Secondary pollution in the troposphere	Aggravates respiratory conditions, irritation of eyes
Carbon dioxide	Fossil fuel use in power plants and various industries, transportation, and deforestation	Global warming and associated ill effects.

VII. ENVIRONMENTAL ISSUES IN INDIA

For the past fifty years, India has seen tremendous industrial and technological progress. This rapid growth is accompanied by innumerable environmental consequences. There is clear visible evidence of the pollution in many parts of India. A recent article in Slate Magazine reported that the air pollution in New Delhi is worse than the air pollution in Beijing, which itself made headlines around the world for its appalling air quality (Upton, 2013). The constituents of the pollution include particular matter, nitrogen oxides (NO_x), Carbon dioxide (CO_2), Ozone molecules, and many other hazardous chemicals. This is substantiated by a recent article on Delhi's particulate (PM) pollution in the Environmental Development magazine [11]. Other Indian cities have similar air pollution problems. Another news item reports pollution by high concentration of $PM_{2.5}$ [12]. The main sources of the pollutants are the vehicle exhaust, industries, waste burning, and construction. The paper reported that between 2008 and 2011, the particular pollution averaged $123 \pm 87\ \mu g/m^3$ for $PM_{2.5}$ and $208 \pm 137\ \mu g/m^3$, both exceeding the national standards of $40\ \mu g/m^3$ and $60\ \mu g/m^3$, respectively. Here, the $PM_{2.5}$ refers to the particular matter with diameters less than or equal to 2.5 microns and $\mu g/m^3$ refers to concentration in micrograms per cubic meter. Worldwide studies have consistently demonstrated that exposure to PM, NO_x, and Ozone pollution cause serious damage to respiratory and cardiovascular diseases, in some cases resulted in premature deaths [13] [14] [15] [16] [17].

A similar state of affairs exists in the case of water pollution. A recent study on the status of water quality in Delhi concluded that its surface water is highly polluted and groundwater is not fit for domestic and drinking purpose [18]. Other major cities in India face similar pollution problems, as evidenced by a brief stay in any of the larger cities. Besides air pollution and water pollution, India faces other major environmental issues on solid waste pollution, noise pollution, and land or soil pollution.

In 1997, the United National Environment program (UNEP) report published a report on global environmental outlook [19]. The report recognizes that Environmental problems are extremely complex as a result of interaction among the various components of the environment. For example, the emissions of greenhouse gases (CO_2, CH_4, etc.) and acidifying gases (SO_2, NO_2) have been shown to worsen the problem of ozone layer thinning.

VIII. GLOBAL ENVIRONMENTAL ISSUES

Various environmental problems exist in every corner of the world and most of them are attributed to the continuing progress or technological developments in different countries. Just from the point view of air pollution, based on the air monitoring data between 2003 and 2010, the world's worst pollution floats over Ahwaz, Iran followed by Ulaanbaatar, Mongolia [20]. Besides air pollution, other forms of environmental degradation exist throughout the world. According to a 1998 report by Canadian Scientists, the entire world is now polluted and even the most remote Polar Regions have substantial levels of toxic waste presence [21].

It is generally recognized that the environmental problems are extremely complex as a result of interaction among the various components of the environment. For example, the emissions of greenhouse gases (CO_2, CH_4, etc.) and acidifying gases (SO_2, NO_2) have been shown to worsen the problem of ozone layer thinning. However, the report issued specific recommendations for India (see Table 2). All these issues are associated with human health and natural ecological risks. To mitigate the problems listed in Table 1, a general understanding of some aspects of Environment Science is essential.

DOI: 10.32377/cvrjst0415

TABLE 2
RESOURCE AND ENVIRONMENTAL ISSUES

HIGH PRIORITY	MEDIUM PRIORITY	LOW PRIORITY
Land and Soil Resource	Pesticide and Fertilizer	Sea Level Rise
Deforestation	Acid Rain	Waste Disposal
Water Resources	Marine and Costal Degradation	
Industrial Pollution		
Urban Congestion and Pollution		

IX. CONCLUSION

The present article briefly describes the impact of technology on the natural environment. The impact is in the form of (1) pollution of the atmospheric air with toxic chemicals and particulate matter, (2) pollution of water resources with toxic chemicals, affluent disposals from industries, and sediments, and (3) pollution of land by waste disposals and spills. In the earth system, all the subsystems are interconnected and interact with one another, and as a result the pollution in one system goes to contaminate other systems. The effect of pollution of all systems contributes to millions of cases of pulmonary and other diseases. In many cases, they result in premature death, especially of infants.

The sources of pollutants are transportation, chemical, and power plant industries. It is extremely important to minimize the pollution through technological innovation of all industries. All nations have environmental regulations, and new generation of engineers should implement methods to follow these regulations in all future designs.

REFERENCES

[1]. UNEP, GEO -4, 2007. Global Environmental Outlook. http://www.unep.org/geo/geo4/report/GEO-4

[2]. Gosh Ray, R., 1996. The attitude of Kautilya to Aranya. Environment and History 2, no. 2, 221-229, http://www.environmentandsociety.org/node/2885.

[3]. Buddhist Publication Society, 1994. The Edicts of King ASHOKA.

[4]. White, 1967. White, L., 1967. "The Historical Roots of Our Ecological Crisis", *Science*, 155:1203-1207.

[5]. Bible, 2001.Genesis1:26. http://biblehub.com/genesis/1-26.htm

[6]. Rachel Carson, Author- Silent Spring, published by Houghton Mifflin on September 27, 1962.

[7]. Sagan, C. *Broca's Brain*. , Random House, Inc. See Ch.1 Can we know the Universe? Reflections on a Grain of Salt.

[8]. Motohiro Tomizawa and John E. Casida, Annual Review of Pharmacology and Toxicology, Vol. 45: 247-268 (Volume publication date February 2005).

[9]. Victory for the Bees, 2013. http://www.independent.co.uk/environment/nature/victory-for-bees-as-european-union-bans-neonicotinoid-pesticides-blamed-for-destroying-bee-population-8595408.html

[10]. Ahluwalia, V.K. and Malhotra, S., 2008. *Environmental Science.* Ane Books India, New Delhi, India.

[11]. Guttikunda, S.K. and Goel, R, 2013. Health impacts of particulate pollution in a megacity – Delhi, India, Environmental Development, Environmental Development, Volume 6, April 2013, Pages 8–20 Also see: http://dx.doi.org/10.1016/j.envdev.2012.12.002

[12]. Mascarenhas, A. Pune Air is more polluted now: New data shows. http://www.indianexpress.com/news/pune-air-more-polluted-now-new-data-shows/1082087/

[13]. Chhabra, S.K., Chhapra, P, Rajpal, S., Gupta, R., 2001. K. Ambient air pollution and chronic respiratory morbidity in Delhi. Archives of Environmental Health 56, 8.

[14]. Pande, J.N., Bhatta, N., Biswas, D., Pandey, R.M. Ahluwalia, G., Siddaramiah, N.H., et al., 2002. Outdoor air pollution and emergency room visits at a hospital in Delhi. The Indian Journal of Chest Diseases and Allied Sciences 44, 9.

[15]. Gupta, S.K., Gupta, S.C., Agarwal, R., Sushma, S., Agrawal, S.S., Saxena, R., 2007. A multicentric case-control study on the impact of air pollution on eyes in a metropolitan city of India. Indian Journal of Occupational Environmental Medicine 11, 37-40.

[16]. Siddique, S., Banerjee, M., Ray, M., Lahiri, T., 2010. Air pollution and its impact on lung function of children in Delhi, the capital city of India. Water, Air, and Soil Pollution 212, 89-100.

[17]. Balakrishnan, K., Ganguli, B., Ghosh, S., Sambandam, S., Roy, S., Chatterjee, A., 2011. A spatially disaggregated time-series analysis of the short-term effects of particular matter exposure on mortality in Chennai, India. Air Quality, Atmosphere and Health, 1-11Jones, J. "Entire World Polluted, Canadian Scientist Report." October 12, 1998, Reuters News Agency.

[18]. Abhay, R.K. Status of water quality and pollution aspect in Delhi. International Journal of Social Science Tomorrow, vol. 1, no. 5. Also see http://www.ijsst.com.

[19]. UNEP, GEO-1., 1997. Global Environmental Outlook. http://www.unep.org/geo/geo1

[20]. Upton, J., 2013. Slate Magazine article: Which City has the Worst Air Pollution in the World? http://www.slate.com/articles/health_and_science/medcal_examiner/2013/03/worst_air_pollution_in_the_world_beijing_delhi_ahwaz_and_ulaanbaatar.html

[21]. Jones, J. "Entire World Polluted, Canadian Scientist Report." October 12, 1998, Reuters News Agency.