20

Managing Air Pollution: How Does Education Help?

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1. Introduction

We aware since Tbilisi Declaration (UNESCO, 1977) that, science and technology can no doubt provide solutions to environmental problems, which probably helped to cause, nevertheless, solutions sought should not be short-term ones nor too narrowly conceived. Solutions, on the other hand, have to take into account social and cultural factors which are so often at the root of environmental problems. What is necessary is a close examination of the complex relationships between people and their environment. The equilibrium in the flow of matter and energy through natural ecosystems as well as ecosystems already modified by humanity must be re-established. In addition, models of economic growth, development, environment and culture must be reconsidered. It has become essential to look-over the lifestyles to distinguish between the essentials and luxuries for both the environment and development. This is one of the basis to advocate a holistic approach to the management of environmental problems. Therefore, the recognition of reasons, results and implications of environmental problems must be coupled with an increasing awareness of solidarity among nations. Improved management of the environment should aim reducing existed disparities as pertaining a sustainable use of natural resources and at bringing about international relations based on equity. Environmental Education (EE), therefore, has an evident role to play if the issues are to be grasped and if all concerned are to be provided with the knowledge, skills, and attitudes to modify the existing situation for the better. Building on more than 30 years of experience in environmental education, education for sustainable development (ESD) continues to highlight the importance of addressing the issues of natural resources as part of the broader agenda of sustainable development. In December 2002, the United Nations General Assembly (UNGA) adopted resolution (57/254) to put in place a United Nations Decade of Education for Sustainable Development (DESD), spanning from 2005 to 2014. Teaching society how to behave responsibly towards the environment lies at the core of ESD; the founding value of ESD is respect: for others and respect for the planet and what is provides us with. ESD wants to challenge us all to adopt new behaviours and practices to secure our future, seeks to integrate the principles, values, and practices of sustainable development into all aspects of education, in order to address the social, economic, cultural and environmental problems we face in the 21st century. Air pollution is one of the themes of environmental perspectives of the ESD. Educating about air pollution builds the skills and attitudes needed to question the way we think, the values we hold and the decisions we make in the context of sustainable development. Improving

awareness about the sustainability involves issues like the impact of human activities on earth systems, control of green house gases, land and energy use, consumption patterns, pollution and transport. ESD for air pollution can be appreciated as one of the powered tools for air pollution management since it offers innovative ways of framing to make sense in people's daily lives and of translating passive awareness into active concern and behaviour change. EE and ESD for air pollution has been covered in several researches all over the world the major areas of focus being, problems on the implementation of EE, misconceptions of both teachers and students especially related to global warming and ozone layer depletion issues , attitudes towards air pollution problems and solutions and environmental literacy components and environmental responsible behaviour (Cutter, 2002; Michail et al., 2007; Dove, 1996; Gayford, 2000; Özdemir & Çobanoğlu, 2008; Summers, et al., 2000; Michail et al.,2007). The researchers also interested in the regional differences in students' and citizens' attitudes and behaviours toward air pollution issues. All this research have shown that people of all ages has positive attitudes toward air pollution issues; that is to say we all are aware of the threats of population increase, industrialization and consumption patterns on the air pollution problems but, almost none of us can make connections between these threats and individual contributions. Therefore, through ESD, we seek for ways to help people to touch the reality, so to make sustainable decisions. The main idea of this chapter therefore, is to present both reasons and results of air pollution in a wider perspective, i.e. through the point of view of EE and ESD, as well as to present education as a component for air pollution management.

2. Action and response

Hunter-gatherers live in the forest, agriculturalists live adjacent to but within striking distance of the forest, and urban-industrial men live away from the forest. Paradoxically, the more the spatial separation from the forest the greater the impact on its ecology, and the further removed the actors from the consequences of this impact! (Gadgil & Guha, 1992, p.67)

Earliest probable evidence of fire used deliberately to clear forests in the Kalambo Falls site in Tanzania points out 60,000 years before present. (Grove, 1995). Air pollution is concurred with the appearance of humans, continues to grow and as we stand still unconsciously, it will continue to intrude the life on Erath. Signals are clear and actually there are number of evidences for air pollution beginning from ancient civilizations that should not be disregarded:

When Homo sapiens first lighted fire, its smoke provided the first medium of environmental pollution. The burning of fuels for heating and cooking has contributed to indoor air pollution. The walls of caves, inhabited several thousands of years ago, are covered with thick layers of soot. The presence of smoke must have made breathing difficult and must have irritated the eyes in the confined space as well. Most of the lungs of mummified bodies from the Palaeolithic have a black tone. In the first inhabited areas smoke was not driven away (one of the practical reasons might have been protection against mosquitoes) and the people dwelling in these inner areas found shelter in the smoke (McNeill, 2001). Humans, on the other hand, seem to have been living together with this unhealthy form of air pollution for many thousands of years. Following section presents the brief history of air pollution beginning from 13th century till today, based mainly on the "Environmental History Timeline, which originally appeared in Mass Media and Environmental Conflict, a book written by Mark Neuzil and William Kovarik published by

Sage in 1996. The first web publication of the timeline was on 6/18/96, and it was expanded in 1998 and 2001 (www.radford.edu/~wkovarik/envhist).

The Roman Senate introduced a law about 2000 years ago, according to which: 'Polluting air is not allowed'. The Institutes issued under the Roman emperor Justinian in 535 AD were used as a text in law schools. Under the section Law of Things, our right to the air is clear: 'By the law of nature these things are common to mankind – the air, running water, the sea, and consequently the shores of the sea.' (Makra & Brimblecombe, 2004).

In 1257, Queen Eleanor of Provence was forced to leave Nottingham Castle for Tutbury Castle because heavy coal smoke fouls the air.

In 1306, Edward I forbidden coal burning in London, but like many attempts to regulate coal burning, it has little effect.

Between 1560 and1600, rapid industrialization in England leaded to heavy deforestation and increasing substitution of coal for wood. In 1590, Queen Elizabeth was "greatly grieved and annoyed" by coal smoke in Westminster Palace.

In 1661 John Evelyn wrote "Fumifugium, or the Inconvenience of the Air and Smoke of London Dissipated" to propose solutions for London's air pollution problem. These include large public parks and lots of flowers:

"*The immoderate use of, and indulgence to, sea-coal in the city of London exposes it to one of the foulest inconveniences and reproaches that can possibly befall so noble and otherwise incomparable City... Whilst they are belching it forth their sooty jaws, the City of London resembles the face rather of Mount Aetna, the Court of Vulcan... or the suburbs of Hell [rather] than an assembly of rational creatures...*"

In his diary, Evelyn wrote in 1684 that smoke was so severe "hardly could one see across the street, and this filling the lungs with its gross particles exceedingly obstructed the breast, so as one would scarce breathe."

Abraham Darby of Coalbrookdale, England used coal instead of wood in 1709 for manufacturing iron. British coal production around this time was 3 million tons per year, or five times more than the rest of the world combined.

In 1775 English scientist Percival Pott found that coal was causing an unusually high incidence of cancer among chimney sweeps.

Benjamin Franklin noted in 1784 that the switch from wood to coal had saved what remained of England's forests and he urged France and Germany to do the same.

In 1795 Sir Thomas Percival, a UK physician, leaded group of doctors to supervise textile mills and recommended hours and working conditions, children were only permitted to work 12 hours per day.

Philippe Lebon became the first to illuminate a public building with gas. The hotel Seignelay in Paris was lit using wood gas, not coal. Project was restricted and then Lebon's untimely death by robbery 1804 ended the experiments.

In 1804, impacts of smoke had begun to be felt in Pittsburgh. The smoke affected the "comfort, health and peace and harmony" of the new city. As in most other cities, the solution was to build higher chimneys.

First gas light introduced in 1812 in London. This "town gas" or manufactured gas would be used in every major US and European city, but residual coal tar would remain an environmental problem well into the 21st century.

In 1819 British Parliamentary committee expressed concern that steam engines and furnaces "could work in a manner less harmful to public health."

James Fenimore Cooper wrote “The Pioneers” in 1823, which contains the idea that humans should "govern the resources of nature by certain principles in order to conserve them.
Jean Baptiste Joseph Fourier wrote the first scientific reference to global warming in 1824, "Remarks on the Temperature of the Terrestrial Globe and Planetary Spaces", in which he proposed the theory that the sun's heat is partially trapped in the earth's atmosphere like a giant glass jar.
In 1835 Alexis de Tocqueville published Journey to England and described the industrial city of Manchester:
"*Thirty or forty factories rise on the tops of the hills...six stories (high). The wretched dwellings of the poor are scattered haphazard around them. Round them stretches land uncultivated but without the charm of rustic nature.,, the fetid, muddy waters stained with a thousand colours by the factories ... Look up and all around this place and you will see the huge palaces of industry. You will hear the noise of furnaces, the whistle of steam. These vast structures keep air and light out of the human habitations which they dominate; they envelope them in perpetual fog; here is the slave, there the master; there is the wealth of some, here the poverty of most.*"
In 1843 House of Commons Select Committee on the Smoke Nuisance recommended all manufacturers be removed to a distance of 5 to 6 miles from city centre.
In 1848, Andrew Jackson Downing, a landscape architect, proposed creation of a 500 acre People's Park in New York, which is now known as Central Park.
Novelist Charles Dickens published his novel **“**Bleak House” in 1853, with an image of London as a twisted, twilight world of smoke, shadows and wraiths. Dickens wrote:
"*Smoke lowering down from chimney-pots, making a soft black drizzle, with flakes of soot in it as big as full-grown snowflakes -- gone into mourning, one might imagine, for the death of the sun.*"
In 1860, Prof. Augustine Mouchot of Lycee de Tours, France, said: "*One cannot help coming to the conclusion that it would be prudent and wise not to fall asleep regarding this quasi security. Eventually industry will no longer find in Europe the resources to satisfy its prodigious expansion Coal will undoubtedly be used up. What will industry do then?*" Mouchot's answer was to build solar energy machines. In 1874 he built a collector with 54 square feet of reflecting surface for alcohol distillation which worked at the rate of 5 gallons a minute. The machine could also power a 1/2 hp motor and develop 75 psi of steam.
John Tyndall explained the **"**greenhouse effect**"** in 1863 in a lecture to the British Royal Society entitled "On Radiation through the Earth's Atmosphere." It was the first confirmation and extension of Joseph Fourier's idea that the earth would be much colder without its atmosphere.
First of a series of "killer fogs" in London occurred in December 1873. Over 1,150 died in three days. Similar incidents happened in 1880, 1882, 1891, 1892 and later.
In 1874 German graduate student Othmar Zeider discovered chemical formula for the insecticide DDT.
Inversions lead to another "killer fog" in London with 700 deaths in January 1880.
In 1881, Chicago became the first American city to create a local ordinance regulating smoke discharges, followed that same year by Cincinnati.
In the same year, in 1881, Norway tracked first signs of acid rain on its western coast.
English writer Edward Carpenter published "**Civilization: Its Cause and Cure**" in 1889, which later had a great influence on Mahatma Ghandi. The following is what Carpenter wrote about the town of Sheffield:
"*Only a vast dense cloud, so thick that I wondered how any human being could support life in it, that went up to heaven like the smoke from a great altar. An altar, indeed, it seemed to me, wherein*

thousands of lives were being yearly sacrificed. Beside me on the hills the sun was shining, the larks were singing; but down there a hundred thousand grown people, let alone children, were struggling for a little sun and air, toiling, moiling, living a life of suffocation, dying (as the sanitary reports only too clearly show) of diseases caused by foul air and want of light -- all for what? To make a few people rich!"

Clarence Kemp, "the father of solar energy in the U.S.", patented first commercial Climax Solar Water Heater in1891. By 1910, the Climax had competition, especially from the Night and Day solar hot water company, which used a secondary loop from the collector to a water tank. By 1920, over 5,000 Night and Day heaters had been sold in California. At the same time, a boom in solar hot water heaters started in Florida, where electricity was a very expensive competitor. About 15,000 units were sold by 1937.

In April, 1896, Swedish chemist Svante August Arrhenius summarized scientific opinion about the effect of carbon dioxide in the atmosphere, predicting a global temperature increase of 8 or 9 degrees Fahrenheit for a doubling of CO_2 in the atmosphere; "On the Influence of Carbonic Acid in the Air upon the Temperature of the Ground".

In 1898, Coal Smoke Abatement Society formed to pressure government agencies to enforce pollution laws in England.

In 1900, the world's leading scientists gathered in Paris to consider new elements with unusual powers discovered by Pierre and Marie Curie. Minerals like thorium, uranium and radium emitted a new kind of light, the Curies had found. A year later, Ernest Rutherford and Frederick Soddy found that thorium was turning itself into radium -- evidence of long-sought transmutation of metals. Tapping the energy within atoms would mean that a future awaited that "would bear as little relationship to the past as a dragonfly does to that of its aquatic prototype." Indeed, he said, the power would allow mankind to "transform a desert continent, thaw the frozen poles, and make the whole world one smiling garden of Eden." (Weart, 1988, p. 6).

Smoke Prevention Association of America founded in Chicago in 1907.

Air pollution lawsuit begun in Supreme Court in 1907. In various decisions through 1915, the Court decided to limit the amount of sulphur and other noxious fumes that can emerge from the Tennessee Copper Co. following a suit by the State of Georgia. The suit involved sulphur dioxide fumes from Copper Basin smelters in Tennessee that were killing forests and orchards and making people sick over the Georgia border. The state of Tennessee refused to move against the copper companies and disputed Georgia's right to interfere. Georgia sued in 1907 and won in 1915 after investigation and attempts to reduce the pollution, including a court-mandated reduction and mandatory inspections by a university professor. The majority opinion was delivered by the Chief Justice:

"*It is a fair and reasonable demand on the part of a sovereign that the air over its territory should not be polluted on a great scale by sulphurous acid gas, that the forests on its mountains should not be further destroyed or threatened by the act of persons beyond its control, that the crops and orchards on its hills should not be endangered.*" - Georgia v. Tennessee Copper Co. and Ducktown Sulphur, Copper & Iron Co, 206 U.S. 230 (1907)

In 1908, Swedish chemist Svante Arrhenius argued that the greenhouse effect from coal and petroleum use is warming the globe. According to his calculations, doubling CO_2 would lead to average temperature increase of 5 to 6 degrees Celsius. Rather than being alarmed, Arrhenius was pleased that people in the future would "*live under a warmer sky and a less harsh environment than we were granted.*" In his book World in the Making, he says that with increased CO_2 "*we may hope to enjoy ages with more equable and better climates, especially as*

regards the colder regions of the earth, ages when the Earth will bring forth much more abundant crops than at present for the benefit of rapidly propagating mankind."

Glasgow, Scotland, winter inversions and smoke accumulations kill over 1,000 in 1909.

In October 1921, General Motors demonstrated car powered by 30 percent alcohol-gasoline blend.

In December 1921, General Motors researchers discovered tetraethyl lead as an anti-knock gasoline additive. Despite strong private warnings about its danger and a secret Public Health Service inquiry, the new gasoline went on sale without safety tests 14 months after it was invented, with disastrous consequences.

Leaded gasoline went on sale in February 1923 in Dayton, Ohio at a gas station.

In 1926, the first large scale survey of air pollution occurred in U.S., in Salt Lake City.

Air pollution control begun in 1928 in eastern US cities, reporting sunlight cut by 20 to 50 percent in New York City.

In 1930, Meuse River Valley killer smog incident occurred in Belgium. Three day weather inversion in this industrial valley killed 63, with 6,000 made ill.

The date 1939, October 11 was recorded as St. Louis smog episode**.** Smog was so thick that lamps were needed during daylight for a week.

Donora, Pennsylvania smog incident occurred in October 30-31, 1948. Twenty people died, 600 hospitalized and thousands stickered in this nationally publicized environmental disaster.

In 1948 a "killer fog" in London caused 600 deaths.

First US conference on air pollution held in 1949.

Four thousand people died in the worst of the London "killer fogs" in Dec. 4-8, 1952. Vehicles used lamps in broad daylight, but smog was so thick that busses run only with a guide walking ahead. By Dec. 8 all transportation except the subway had stopped.

In May 4, 1953, Gilbert N. Plass presented paper on global warming at American Geophysical Union. The Washington Post story (May 5) says:

*World Industry**, pouring its exhausts into the air, may be making the earth's climate warmer,** a Johns Hopkins physicist, reported here yesterday. Releases of carbon dioxide from burning coals and oils, said Dr. Gilbert N. Plass, blanket the earth's surface 'like glass in a greenhouse.' So much carbon dioxide has been released in this industrial century that the earth's average temperature is rising 1 1/2 degrees (F) a century, he said. Similar but more naturally caused changes in the air's carbon dioxide content may account for the ice ages and warm intervals in geologic time, he added... Latest experimental and theoretical calculations, he reported, show that **doubling the carbon dioxide content of the atmosphere causes surface temperatures to rise four degrees (F)** if no other changes occur. But, he added, still other earth warming factors may also be triggered by increased carbon dioxide in the air. It could cause less rainfall by its effect on the clouds and less cloud cover for the earth,' both tending to make the climate warmer and drier,' he said. Dr Plass said the newer calculations bolster the theory first proposed in 1861 that decreases in the carbon dioxide content of the earth's atmosphere caused the ice ages in geologic history. The theory, he said, has not generally been accepted because the effects 'appeared to be too small.' It appears now, he said, that **even the physicists supporting the theory underestimated the climate-changing effects of the carbon dioxide** content in the earth's atmosphere.* ("Industrial Gasses Warming Up Earth, Physicist Notes Here," Washington Post, May 5, p. 5, probably by Nate Haseltine).

New York smog incident killed between 170 and 260 in November, 1953.

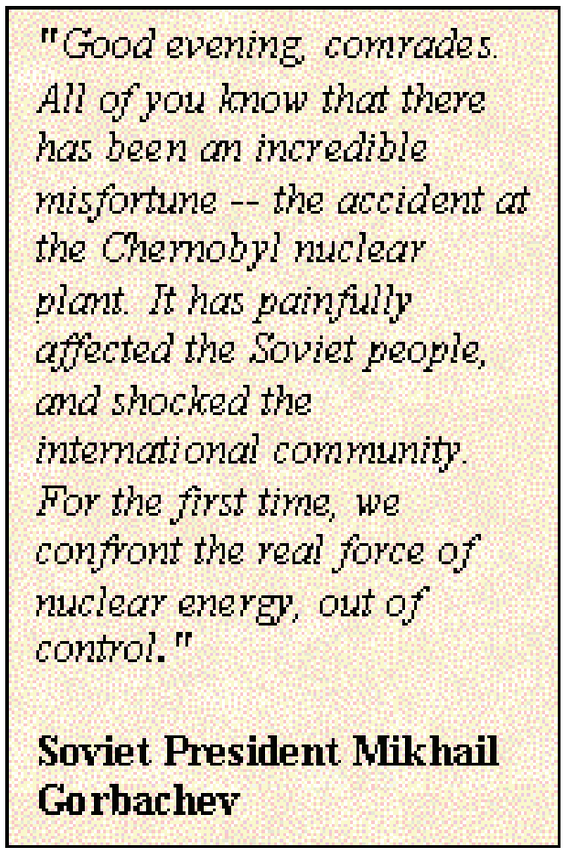
Heavy smog conditions shut down industry and schools in Los Angeles for most of October in 1954.

In 1955 International Air Pollution Congress held in New York City.
Another killer smog occurred in London in 1956; 1,000 died.
British Parliament passed Clean Air Act in 1956.
World's first commercial nuclear electric power plant was opened at Sellafield in the United Kingdom in March 31, 1956.
Chelyabinsk nuclear waste explosion occurred in Kyshtym in Russia in 1957-58. Two million curies spread throughout the region, exposing to radiation over a quarter million people.
Another smog phenomenon in London caused 750 die in 1962.
A reaction took place in 1962 to Silent Spring by Rachel Carson. Some agronomists asked whether Carson is intending to starve people by banning pesticides. By 1970 DDT was banned, but other more toxic chemicals were not. Silent Spring was often seen as a turning point in environmental history because it opened a much stronger national dialogue about the relationship between people and nature.
In January 1970, General Motors president promised "pollution free" cars by 1980 and urged the elimination of lead additives from gasoline in order to allow the use of catalytic converters.
In the seventies, air pollution was cut back dramatically through use of catalytic converters on new cars that use only unleaded gasoline. But the predicted "pollution free car" proved to be imaginary.
Disasters showed the weak and fragile side of industrial technology in 1980's:
Bhopal Disaster was recorded as one, 2 decades after the "Silent Spring": Bhopal is a town in India, was similar to many others, before that night in December 3, 1984. Union Carbide Co. fertilizer plant leaked methyl isocyanide at 5 past midnight in Bhopal. 2000 dead, another 8,000 die of chronic effects, estimated 2000 casualties, 100,000 injuries, and significant damage to livestock and crops. The International Medical Commission on Bhopal estimated that as of 1994 upwards of 50,000 people remained partially or totally disabled.
"India's night of death: (Brelis, 1984).
"The first sign that something was wrong came at 11 p.m. A worker at the Union Carbide pesticide plant on the outskirts of Bhopal (pop. 672,000), an industrial city 466 miles south of New Delhi, noticed that pressure was building up in a tank containing 45 tons of methyl isocyanate, a deadly chemical used to make pesticides. At 56 minutes past midnight, the substance began escaping into the air from a faulty valve. For almost an hour, the gas formed a vast, dense fog of death that drifted toward Bhopal.
The vapour passed first over the shantytowns of Jaiprakash and Chhola, just outside the walls of the plant, leaving hundreds dead as they slept. The gas quickly enveloped the city's railway station, where beggars were huddled against the chill. In minutes, a score had died and 200 others were gravely ill. Through temples and shops, over streets and lakes, across a 25-sq.-mi. quadrant of the city, the cloud continued to spread, noiselessly and lethally. The night air was fairly cool (about 60° F), the wind was almost calm, and a heavy mist clung to the earth; those conditions prevented the gas from dissipating, as it would have done during the day.
A few hundred yards from the chemical plant, M.A. Khan, a farmer, was lying in bed when he heard several thumps at a nearby dairy farm and sensed that his own cows were milling about restlessly. He arose and went outside. Two cows were dead on the ground. A third gave out a loud groan and collapsed as Khan watched. Then the farmer's eyes began to smart painfully. He ran into the darkness. The day after, at Bhopal's Hamidia Hospital, his eyes shut tightly and tears streaming down his cheeks, Khan described his fear: "I thought it was a plague."

Fig. 1. Bhopal Disaster; cover in Time Magazine

By week's end more than 2,500 people were dead in the worst industrial disaster the world has known. At least 1,000 more were expected to die from the fumes in the next two weeks; some 3,000 remained critically ill. In all, 150,000 people were treated at hospitals and clinics in Bhopal and surrounding communities. Most of the dead had succumbed because their lungs had filled with fluid, causing the equivalent of death by drowning. Others had suffered heart attacks. The disaster struck hardest at children and old people, whose lungs were either too small or too weak to withstand the poison. A number of the survivors were permanently blinded; others suffered serious lesions in their nasal and bronchial passages…

Another disaster showing the weak and fragile side of industrial technology happened in 1986: On April 26, 1986, at 1:23 a.m. an explosion and fire occurred in Reactor Number 4 of the Chernobyl Nuclear Power Plant in the former USSR (now Ukraine), located 80 miles north of Kiev. Before engineers and scientists could get it under control, 190 tons of highly radioactive material was released into the atmosphere. The radioactive particles rained down not only on Chernobyl, but all over Ukraine, as well as the neighbouring countries of Belarus and Russia, and drifted over to other European countries such as Poland. Scientists estimate that the amount of particles released was equivalent to the effect of 20 nuclear bombs. The Chernobyl accident remains the largest peacetime nuclear disaster ever. The massive radiation killed 31 people within a short time, mostly plant workers and people close to the accident site who died of radiation sickness. As time passed it became clear that



(http://www.megaessays.com/viewpaper/99365.html)

Fig. 2. Announcement for Chernobyl Disaster

the accident had left a number of serious long-term health problems for the people who lived in the area. These health problems were made worse by the poverty, poor nutrition, and lack of medical care in the region.

In the wake of the Chernobyl disaster, in 1988 Russian scientists form the Ecology and Peace Association, electing as president S.P. Zalyghin, whose astonishing statement -- "Only the people can save nature" -- implied that the government had failed.

At the time when Zalyghin pointed out the people as the saver of the nature, UNEP was working on public awareness raising activities to reduce ozone layer lose. The story of success in ozone layer protection is presented by Stephen O. et al. (2002) and education is dedicated as one of the major contributors.

In 1985, British scientist Joe Farman published discovery of, so called, ozone hole over Antarctica and it was confirmed by US NASA satellite monitoring. Meanwhile, US EPA had begun reconsidering CFC regulations. And the United Nations Environment Program had begun negotiations under the Vienna Convention for the Protection of Ozone which leads to the 1987 Montreal Protocol. The Montreal Protocol international agreement to phase out ozone-depleting chemicals signed by 24 countries, including the US, Japan, Canada and EEC nations in the same year. The treaty calls for phasing out production and consumption of

ozone depleting substances. Accordingly, beginning from March 1989, European nations begun ban on ozone - depleting chemicals.

A new report released in September 2010 by the UN, says international efforts to protect the ozone layer are a success and have stopped additional ozone losses. The joint World Meteorological Organization and U.N Environment Program report is the first comprehensive update in four years. World Meteorological Organization Research Department Director Len Barrie says the treaty is working: "It has protected us from severe ozone depletion over the past decade, global ozone, including ozone in the Polar Regions," Barrie said. "It is no longer decreasing, but not yet increasing. One phase for the ozone layer protection work realized by UNEP is related to public awareness raising activities. Apart from the technical reports, UNEP has published myriad of booklets, brochures, posters aimed at the public and the General Assembly of the United Nations designated 16 September as the International Day for the Preservation of Ozone Layer. In most countries, improved servicing was the source of early and substantial emissions reductions. One of the components of the improved servicing, on the other hand, was training. Trade and professional associations, labor unions and private companies primarily undertook training. The objective of the ozone treaties was certainly a difficult one: to persuade the entire world to give up the use of many profitable chemicals. To be persuaded were not only the governments, but also the producers of these chemicals, all major multi- national giants of industrialized countries, and thousands of industries. Behind them were the billions of consumers who wanted and needed the products that contained ozone-depleting chemicals. (Stephen, O et al., 2002).

Therefore, an important role of the success in ozone layer protection can be dedicated to education and training, believing that, re-establishment efforts of the equilibrium of natural systems that have already been distorted by human activities can be satisfactory on the condition that, they include the human itself. Any innovative technology produced to handle an air pollution problem should consider human being who will get the advantage of it.

In the book titled "Earth in Mind", Orr (1994, p.6) wrote, "*If one listens carefully, it may even be possible to hear the Creation groan every year in May when another batch of smart, degree-holding but ecologically illiterate, Homo sapiens who are eager to succeed are launched into the biosphere.*" The things on which our future health and prosperity depend are in dire danger and according to Orr (1994) this is not the work of ignorant people, rather it is largely the results of work by people with degrees. Because what was wrong in their education is, it emphasized theories instead of values, concepts rather than human beings, abstraction rather than consciousness, answers instead of questions, ideology and efficiency rather than conscience. And he added (page 8), "*It is not education but education of a certain kind that will save us.*" And so, he reported several myths for this kind of education: First one is about the myth that, ignorance is a solvable problem. According to him, ignorance is not a solvable problem; it is rather an inescapable part of the human condition. The advance of knowledge always carried with it the advance of some form of ignorance. As for the case of chlorofluorocarbons (CFCs); *in 1929 the knowledge of what a substance like CFCs would do to the stratospheric ozone and climate stability was a piece of trivial ignorance as the compound had not yet been invented. But in 1930, after the compound discovered, what had been a piece of trivial ignorance became a critical life threatening gap in human understanding of the biosphere. Not until the early 1970's no one did ask "What does this substance to do what? In 1986 we discovered that CFCs had created a hole in the ozone over the South Pole the size of the lower 48 U.S. states; by the early 1990's*

CFCs had created a worldwide reduction of ozone. With the discovery of CFCs, knowledge increased, but like the circumference of an expanding circle, ignorance grew as well (Orr, 1994, p.9). Likewise, one can refer to the above mentioned history of London fog; it was 1257 when Queen Eleanor left Nottingham Castle because heavy coal smoke fouls the air, a series of "killer fogs" occurred in London in 1873, similar incidents happened in 1880, 1882, 1891, 1892 in London, in 1948 another "killer fog" in London caused 600 deaths, New York smog incident killed almost 260 in 1953 and another smog phenomenon in London caused 750 die in 1962 and 4000 people died in the worst of the London "killer fogs" in 1952, 7 centuries later then the first sign. What's more, the disaster caused by a pesticide factory caused unavoidable impacts on the people in 1984, although Rachel Carson's Silent Spring was seen as a turning point in environmental history because it opened a much stronger national dialogue about the relationship between people and nature in 1962. Besides, according to J.Russell (2007), in 2006, coal accounted for 25 percent of world primary energy supply. Due to its high carbon content, coal was responsible for approximately 40 percent of the carbon dioxide emissions from fossil fuels, despite supplying only 32 percent of fossil fuel energy. Management of this plentiful but heavily polluting energy resource has tremendous implications for human welfare, the health of ecosystems, and the stability of the global climate. World coal consumption reached a record 3,090 million tons of oil equivalent (Mtoe) in 2006, an increase of 4.5 percent over 2005. China led world coal use with 39 percent of the total. The United States followed with 18 percent. The European Union and India accounted for 10 percent and 8 percent, respectively.

Another myth Orr (1994) wrote is that, with enough knowledge and technology, we can "manage planet earth". According to Orr, however, what might be managed is us, human desires, economies, politics and communities. But, our attention is caught by those things that avoid the hard choices implied by politics, morality, ethics, and common sense. It makes far better sense to reshape ourselves to fit a finite planet than to attempt to reshape the planet to fit our infinite wants (Orr, 1994, p.9). The global trend on the use of materials, on the other hand, reveals that, we are, in the year 2011, still trying to reshape the planet: Yet, as Gardner (2010), global use of materials (the food, feed, forest products, metals, and minerals that constitute the foundation of modern economies) was up 2.7 percent in 2007, reminding that, materials use is a proxy indicator for environmental impact: the greater the tonnage of virgin materials extracted, processed, consumed, and disposed of, the greater an economy's environmental footprint.

One other myth Orr (1994) presented is related to knowledge, and by implication human goodness, is increasing. According to Orr, rapid increase in data, words and paper, that is an information explosion, should not be mistaken for an increase in knowledge and wisdom, which is not easy to measure. What can be said, as he states, is that some knowledge is increasing while other kinds of knowledge are being lost. As Lopez, B.(1989) says, "*[I am] forced to the realization that something strange, if not dangerous, is afoot. Year by year the number of people with firsthand experience in the land dwindles. Rural populations continue to shift to the cities…. In the wake of this loss of personal and local knowledge, the knowledge from which a real geography is derived, the knowledge on which a country must ultimately stand, has come something hard to define but I think sinister and unsettling*."

All in all, the message is that, we are becoming more ignorant of the things we must know to live well and sustainably on the Earth.

In an Environmental Impact Assessment study, for example, we ask public opinion on the investment. But, how public will assess the investment without having related evaluation

skills on the causes and effects? Without having knowledge, positive attitudes, responsibility, skills on the environmental issue, public will act under the influence of economical and cultural pressures and cannot make sustainable choices. An investment even with a very efficient technology on environmental protection has no meaning if the people, who will use and be served by, do not share the responsibility, and responsibility comes with education. Similarly, that efficient technology on environmental protection has no meaning if manager, engineer, technician of the plant, governmental authority responsible for controlling the plant do not feel and share the responsibility. Didn't Chernobyl disaster happen because of such a reason, or what was the reason for the dispersion of the fatal gas in Bhopal? Or how items in the Kyoto Protocol will be effective if people do not understand and feel them? Therefore, education should be a part of any investment. Moreover, we don't need to look for investment proposals for educating people. We can create environmentally literate citizens through several means like integrating EE and ESD into the curriculum of preschools, high schools and universities, offering seminars for women, young, teachers, managers, decision makers, workers etc.

Because, helpless poor in Philippines who has to destroy their own values to survive children living in Africa, people of Bangladesh who do not have any idea about the threat of the global warming, citizens of the developed nations who consume to be happy; decision makers who sign world's biggest investments that discard environmental issues, managers who decide to build new highways instead of constructing new bicycle routes, teachers, students, politicians, women, ….Everybody shall take the responsibility.

Education for Sustainable Development (ESD) may be an answer: It was a quarter of a century ago, that education was described as the "greatest resource" for achieving a just and ecological society. Since then, a series of major international reports have emphasized the critical role education can play in the search for sustainable living. The Brundtland Report, (WCED 1987) argued that teachers had "a crucial role to play in helping to bring about the extensive social changes" (p. xiv) necessary for sustainable development. This message was reiterated by *Caring for the Earth* which identified education's vital role in ensuring that people learn, accept and live by the principle of living sustainably (IUCN, 2002).

> Sustainable living must be the new pattern for all levels: individuals, communities, nations and the world. To adopt the new pattern will require a significant change in the attitudes and practices of many people. We will need to ensure that education programs reflect the importance of an ethic for living sustainably.
> (IUCN, UNEP & WWF 1991 p. 5)

Unlike most education movements, the inception of ESD was not created by the education community. One major outside thrust for ESD came from international political and economic forums. From the time sustainable development was endorsed in the UN General Assembly in 1987, the parallel concept of education supporting sustainable development was being explored. From 1987 to 1992, the concept of sustainable development matured as committees discussed, negotiated, and wrote the 40 chapters of *Agenda 21*. The initial thoughts concerning ESD were captured in Chapter 36 of *Agenda 21*, "Promoting Education, Public Awareness, and Training" (UNESCO 1992).

> Education, including formal education, public awareness and training should be recognized as a process by which human beings and societies can reach their

fullest potential. Education is critical for promoting sustainable development and improving the capacity of the people to address environment and development issues. (*Agenda 21*, Chapter 36, p. 3)

3. Millennium goals and hopes for a sustainable air pollution solutions

Does it make a change if people know and feel deeply the difference they make - for their carbon footprint - by choosing to buy locally grown potatoes instead of imported ones?
Does it make a change if people know and deeply feel how an American meal – hamburger, fries and coke –pays for global warming?
Does it make a change if people can realise that we live the lives that "assigned" to us, and as we continue to do so, we'll continue to face with worse problems of air pollution?
It is our choice to make a change…
Former President of Ireland, Mary Robinson (Robinson, 2011) wrote about her visit to Bangladesh in The Hoffington Post: "Travelling by seaplane to Koyra, in the delta area of Bangladesh, was the equivalent of a journey some years into the future, when the devastating effects of climate change will be an accepted reality worldwide. We landed in an area still devastated by cyclone "Aila" which hit Bangladesh in 2009. A huge amount of once cultivated land was still under water, because of daily tidal fluctuations and the fact that some embankments had not been mended in the nearly two years since Aila… A memorable stop on my visit was to a local primary school run by BRAC (a development organization dedicated to alleviating poverty by empowering the poor to bring about change in their own lives). It was organized on the same principles as a BRAC school I had visited the day before in Korail slum, the largest slum in Dhaka. The schools have 30 plus pupils and one teacher, who teaches these children the five year curriculum in four years, .. In the school in Koyra the children enacted with great gusto -- and acting skills -- how climate change may happen. One of the taller boys acted as the tree which the others cut down, even though warned not to. The winds came, and the consequences were played out -- they all knew where the climate shelter was! As I watched with a grandmother's eye, it struck me that every primary school around the world should be beginning to bring home to children what we must all do to change our habits. Reminding that, Bangladesh is a least developed country (LDC) which has become the leading LDC negotiator on climate change issues. Its contribution to the problem of green house gas emissions is negligible, but the additional burden of climate change is already being felt. It is predicted by the officials in Dhaka that 20 million people may have to leave this region if the global temperature increases by more than 2° Celsius and sea levels rise as predicted. There is nothing theoretical about the climate change issue from this local viewpoint. The injustice of a poor LDC country having to bear huge additional costs from climate impacts it did not contribute to be self evident. Every school needs to be a "green school", so that children can educate their parents. For some it will be knowing where the nearest climate shelter is. For others -- in the developed world -- it will be learning to reuse, reduce, recycle, eat less meat, and travel by public transport, among other ideas".
One of the choices to make a change, eating less meat is investigated by Eshel and Martin (2006). Authors compared the energy consumption of animal- and plant-based diets and the range of energetic planetary footprints spanned by reasonable dietary choices. As a result it was demonstrated that the greenhouse gas emissions of various diets vary by as much as the

difference between owning an average sedan versus a sport-utility vehicle under typical driving conditions. Therefore, authors concluded with a brief review of the safety of plant-based diets, and find no reasons for concern. As Walsh (2008) wrote in his article titled "Meat : Making global warming worse", in 2008 the head of the U.N.'s Nobel Prize–winning Intergovernmental Panel on Climate Change, Pachauri advised people around the world to cut back on meat in order to combat climate change. Pachauri is absolutely right, considering the numbers. In a 2006 report, the U.N. Food and Agriculture Organization (FAO) concluded that worldwide livestock farming generates 18% of the planet's greenhouse gas emissions, by comparison, the entire world's cars, trains, planes and boats account for a combined 13% of greenhouse gas emissions. Much of livestock's contribution to global warming come from deforestation, as the growing demand for meat results in trees being cut down to make space for pasture or farmland to grow animal feed. Livestock takes up a lot of space, nearly one-third of the earth's entire landmass. And, there's manure, all that animal waste generates nitrous oxide, a greenhouse gas that has 296 times the warming effect of CO_2. And of course, there is cow flatulence: as cattle digest grass or grain, they produce methane gas, of which they expel up to 200 L a day (full). And as Tung (2010) reported, global meat production increased by 0.8 percent in 2009 to 281.5 million tons, a slowdown from the 2.4 percent growth rate of 2008. But, as he wrote, the increase continued the steady growth of the past decade. Since 2000, global meat production has risen by 20 percent. So, what if people have aware that, giving up average 176 lb. of meat a year is one of the greenest lifestyle changes one can make as an individual. One can drive a more fuel-efficient car, or install compact fluorescent light bulbs or improve insulation, really no green way to get meat — although organic, locally farmed beef or chicken is better than its factory-raised equivalents. If every American reduced meat consumption by just 20%, the greenhouse gas savings would be the same as if we all switched from a normal sedan to a hybrid Prius. Likewise, if a portion of French fries is preferred with meat one shall need to be sure if the potatoes are locally grown or not.

It's a lesser known fact that up to 1/3 of all greenhouse gas emissions (GHGs) can be attributed to the food we eat. Many people think of transportation of food as the big contributor to climate change. But, although transporting food over great distances does contribute to climate change, how food is produced matters just as much. In fact, growing and harvesting, heating and cooling, processing and packing, transportation and storage ALL contribute to the GHGs emitted by our food system. Focusing on the potatoes and a coke accompanying, yet, just simply try to imagine what it takes to consume a favourite American meal (apart from the meat); the potato was dug with a diesel-powered harvester and then trucked to a processing plant where it was dehydrated, sliced, and frozen. The freezing was done by a cooling unit containing hydrofluorocarbons, some of which escaped into the atmosphere and likely contributed to global climate change. The frozen fries were then trucked to a distribution centre, then on to a fast-food restaurant where they were stored in a freezer and then fried in corn oil heated by electricity generated by hydropower. The meal was served in a fast-food restaurant built on what once was originally forest, then farmland, and then converted to commercial/industrial uses as the city expanded. The ketchup in aluminium- foil packets came from Pittsburgh and was made from Florida tomatoes. The salt came from Louisiana River. The high-fructose corn syrup came from Iowa, as did the carbon dioxide used to produce the fizz, which is produced by fermenting corn. The caffeine came from a processing plant that makes decaffeinated coffee. The cola

can was made from one-third recycled aluminium and two-thirds bauxite ore strip-mined in Australia. It came to Washington State on a Korean freighter, and was processed into aluminium using an amount of energy equivalent to a quart of gasoline. The energy came from some of the same dams mentioned earlier that have contributed to a 97 percent decrease in the salmon runs of the Columbia Basin. The cola came from a Seattle processing plant. It is made of 90 percent water from the Cedar River. The high-fructose corn syrup came from Iowa, as did the carbon dioxide used to produce the fizz, which is produced by fermenting corn (Ryan & Durning, 1997).

Knowing the theory of global warming, acid rains, photochemical smog is not enough to construct the links, knowledge should be accompanied by feeling the links deep inside and human being has this potential. ESD is the way to take out the potential and help individuals to feel how their presence is connected with nature, the way we arrange our lives in harmony with nature and to respect nature as well as respecting ourselves. The way each individual shape their living styles, on the other hand, is unique. ESD does not mean to outline the styles, but shows the human and environment interdependence considering environmental, economical, social aspects together. Therefore, having environmentally literate citizens promise to take a step in managing air pollution issues. Disinger & Roth (1992) provide a generally accepted 'definition' of environmental literacy pointed out that, Environmental literacy is essentially the capacity to perceive and interpret the relative health of environmental systems and take appropriate action to maintain, restore, or improve the health of those systems (p.2). They go on to explain that environmental literacy draws upon six major components: environmental sensitivity, knowledge, skills, attitudes and values, personal investment and responsibility, and active involvement (Disinger & Roth, 1992). This definition is in line with a growing literature that sees pro-environmental behaviour as a function of environmental literacy and the literature that views environmental behaviour as something that may be learned through increased environmental knowledge (Wilke 2005; Hines et al., 1986)

4. How can education help? How education can be integrated in managing air pollution?

Education is how we live our lives and how you live with everything around you. Everything in existence teaches us something about life... everything around us educates, how we interact with the land, minerals, trees, sky, animals everything, even our thoughts. Our thoughts too can become a force, for we are in charge of them. (Profeit-Le Blanc 1996, p. 14)

The Intergovernmental Panel on Climate Change (IPCC, 2007) concluded in 2007 that, global warming is inevitable and that human activity is likely to be the main cause. However, according to a survey of the American public in the same year (ABC News 2007), while 33% cited climate change as the world's top environmental issue, and 84% thought it was probably happening today, only 41% of the American public believed that global warming was caused by human activity. Furthermore, while 86% believed global warming would become a serious environmental problem if not corrected, 63% thought it could be reduced, with 62% claiming they knew a moderate amount about global warming. However, reported that, only 18% of the US public agree that every time we use coal or oil or gas, we contribute to the greenhouse effect (Nisbet and Myers, 2007). What these findings imply is

the importance of women, young, decision makers, teachers, … learning about the greenhouse effect in order to understand the arguments and debates about the science of global warming and climate change to promote that is knowledgeable about global warming and climate change, and one which can assume informed responsibility for the management and policymaking decisions facing our planet (Brown 1992; Bybee 1993 quoted in Shepardson et.al. 2011).

Accordingly, ESD for air pollution issues have been covered in several researches all over the world and the major areas of focus are; implementations, cultural differences in attitudes, misconceptions, factors effecting satisfactory results, problems for an effective ESD. And although there are a number of recommendations made by researchers, the targets for ESD still have not been satisfied. But, it is reality that, although research in developing ESD is the task of the education society, increasing environmental literacy is the task for all sectors, including universities, governmental authorities, NGOs, private sector, etc. The following section, therefore, highlights the recent research, focusing on the results, on ESD implementations related to air pollution issues, global warming being the focus of almost all researchers, major challenges and the driving force.

Although air pollution has been a problem since 17th century (please refer to the 1st section of this chapter), it has just become more complex and difficult to manage and control, requiring a growing need for improvement in public understanding of environmental science and policy. Thus, comprehensive and meaningful education is decided to be a promising avenue for equipping members of society in identifying potential solutions to environmental problems in order to protect valuable natural resources. ESD can produce an environmentally literate citizenry able to actively address environmental challenges and problems (Hungerford and Peyton, 1976; UNESCO, 1980; Roth, 1992). Therefore, comprehensive environmental education may be an important mean for societies to meet the increasing need for improved public understanding of environmental issues, trade-offs and other alternatives. The 1972 United Nations-Stockholm Conference (UNEP, 1972) helped articulate a shared outlook and set of principles for inspiring and guiding efforts focused on helping the public learn to pre-serve and enhance healthcare and environment. In 1977, an international assembly of environmental educators developed a set of definitions and principles for environmental literacy and education at the Inter-governmental Conference on Environmental Education in Tbilisi (UNESCO, 1977). A decade later, Hines et al. (1986/87) pointed out that environmental education efforts must go beyond providing simplistic information and move towards providing: knowledge of complex environmental issues, specific knowledge about approaches for addressing such issues and decision-making skills. Hines et al. also called for efforts to change certain effective qualities (attitudes) that result in people caring about and paying more attention to environmental conditions. It seems axiomatic to observe that the current global environmental and natural resources conditions are worse today, the world over than in the past. Therefore, it is imperative that the goals of 21st century educational systems should include environmental education and the formation of an environmentally literate citizenry able to actively participate in solving environmental problems. Disinger and Roth (1992) provide a generally accepted 'definition' of environmental literacy and have pointed out that: Environmental literacy is essentially the capacity to perceive and interpret the relative health of environmental systems and take appropriate action to maintain, restore or improve the health of those systems (p. 2).

Individuals (adults and children) may change their environmental behaviour when their values, beliefs, and pro-environmental norms change (Dietz et al., 2005). Improved environmental education as well as increased environmental literacy may result in such changes. As Clair (2003) pointed out: Environmental literacy for adults means developing and participating in the social practices likely to change the way our societies think about and act upon ecological issues. Literacy is a powerful metaphor that contributes a great deal to thinking through the question of what each of us can contribute for a more just and sustainable way of life for the planetary community (p. 77).

Coyle (2005), in reviewing 10 years of NEETF/Roper research on environmental literacy in the United States, points out that creating more widespread environmental literacy depends on (1) bringing sound environmental education programming into the education realm, and (2) channelling public environmental literacy efforts to focus more on depth rather than accuracy. Thus, environmental literacy is distinct from simple awareness or personal conduct knowledge because of its depth of information and the actual skills (thinking and doing) imparted. Knowledge and attitudes are essential components of environmental literacy, especially if the goal of environmental education is to change behaviour. Individuals' environmental behaviours may change as a result of changes in their values, beliefs, and pro-environmental norms (Dietz et al., 2005).

A research on the environmental literacy of pre-service teachers in Turkey (Tuncer et.al, 2009) revealed that, the least percent (34%) of correct answer for environmental knowledge items were concerned about motor vehicles as the major contributor to carbon monoxide while more than 60% of respondents incorrectly identified factories and businesses as the major source of carbon monoxide. 77% of the teachers correctly answered the item that the ozone layer serves as a protective layer from cancer-causing sunlight. The most frequently answer received for the types of pollution "very concerned', on the other hand, was related to ''indoor air pollution'' (42%), ''ozone depletion and global warming'' (38%), while 42% of respondents indicated that they were very concerned about ''ozone depletion and global warming,'' only 19% of them were 'very concerned' about automobile emission. Therefore, the conclusion was that, preservice teachers in this study either do not understand the cause - effect relationship between automobiles and global warming or that their fear of more restrictions on their automobiles motivated them to answer strategically. Besides, gender appeared to play a role in elucidating the variation in the two components of environmental literacy variables along with environmental attitude and uses. Female pre-service teachers tended to have more positive attitudes and have more responsible actions toward the environment than male pre-service teachers, which is in line with other studies (Alp et al., 2006; Berberoglu and Tosunoglu, 1995; Huang and Yore, 2003; Chu et al., 2007; Tikka et al., 2000; Yilmaz et al., 2004; Worsley and Skrzypiec, 1998; Zelezny et al., 2000). For example, according to Tikka et al. (2000), whereas males are more likely to emphasize mastering nature and taking benefits from natural resources, females obtain a more emotional attitude toward nature. Since females, as indicated by the authors, have traditionally been responsible for looking after the home and children, such behaviours could be perceived as a way of taking care of their offspring. Indeed parallel to this explanation, there are two theories, namely socialization-based theories and structural theories proposed in the literature to clarify the gender difference in environmental variables: Socialization-based theory posits (sets) that females are more likely than males to associate themselves with

'caregiver' roles. It is argued that this leadswomen to be more in tune with their locality and the world at large and, consequently, to turn their compassion toward the ecological environment. Women's close affinity with nature is viewed as a result of socialization due to cultural and social-structural forces rather than resulting from biological differences. Structural theories suggest that it is the gendered segmentation of the economy and workplace that frames the perspective of women and men toward the environment. It is argued that although women may be knowledgeable and accepting of the aims of economic growth, they are more prone than men to question the consequences of such growth. The reasoning behind this argument lies in the combination of women's role as caregivers for children and their role in the household, where they do most of the house work, in addition to working in the paid labor force. This role is in direct contrast to men's historical ''breadwinner'' role. (Weaver, 2002;p.83).

Referring to the above mentioned definition of environmental literacy, it seems to rest on an assumption that individuals have a competent level of environmental knowledge. It is concluded in one of the recent studies realised in Turkey, to determine environmental literacy of preservice teachers (Tuncer et.al, 2009), that, a majority of Turkish pre-service teachers do not possess enough knowledge to be classified as having an acceptable level of environmental knowledge (NEETF and Roper, 2005). Slightly less than half of the pre-service teachers of this study (49%) received a passing grade, based on the NEETF and Roper Starch grading scale. Yet, 66% of the students from Michigan State University [MSU] (Kaplowitz and Levine, 2005) reported to receiving a ''passing grade'' based on the same grading scale. Interestingly, in that same university, MSU College of Education students had one of the lowest mean correct scores compared with students from other MSU colleges such as agriculture and natural resources (8.84 of 11) and Natural Science (8.48 of 11). One possible explanation for the low level of passing grades for Turkish respondents' environmental knowledge, on the other hand, was explained be the absence of course works, relevant to environmental education in the current teacher education programs in Turkey. Of course, there may be demographic characteristics of students that relate to differences in academic level and environmental knowledge. Despite their low levels of environmental knowledge, Turkish respondents expressed positive attitudes toward the environment as well as high degree of concern about environmental problems. The respondents also expressed feelings of responsibility for environmental problems; expressed the view that environmental problems are one of the most important problems of their lives; and shared their feeling that they are comfortable with their background on environmental issues. Such results beg the question of what it would take to create a critical mass for increased environmental learning throughout the educational system.

In service elementary teachers' knowledge about air pollution in Turkey was the subject of another study (Tuzun et.al, 2008). The study pointed out specific results. One of the questions related to teachers' general knowledge about air pollution sources was that, "Which human activities contributed to air pollution?" The answers for this question were categorized as, individual, societal, and industrial contribution. Approximately 24% of the teachers reported exhaust gases as the main cause of the air pollution. Which, was not a surprising result for the authors, reminding that the study area is one of the crowded cities in Turkey with a number of cars has been increasing and traffic is getting more and more challenging every day. Use of sprays and deodorants was considered as the second main

individual source of air pollution by the participants. The reason was explained in relation with not the content of textbooks but with the effect of media. Use of coal at home for heating was declared as the third most important individual source of air pollution by the teachers of the study. Teachers seemed to have knowledge about importance of improper use of other energy sources. Moreover, cigarette, forest fires, education, and trash were found as the other important sources of air pollution declared by the teachers. Contribution of community to air pollution was declared by Turkish teachers as exhaust gases, as the main source, unconscious use of energy especially at homes and forest fires. Besides, awareness toward environmental pollution, trash, and industrial emissions were also considered as the sources of the air pollution by the teachers. When industrial contribution was in consideration, more than 70% of the teachers were stated industrial emissions as the main contributor to air pollution. Whereas, they also indicated that lack of control mechanism is an important aspect for air pollution in Turkey. According to the teachers of this study, emissions from solid waste disposal areas also cause air pollution. Therefore, it was decided by the authors that, teachers participated the study have a considerable knowledge about the reasons of air pollution. However, teachers were asked further questions to get the nature of their knowledge. As a result, teachers reported that, global warming was caused mainly by carbon dioxide (44.3%), methane (28.4 %), chlorofluorocarbons (19.7 %) and ozone (10.4 %). But at the same time, 34.9 % of them declared CO as one of the gases causes global warming, while 18.1 % declared SO2 as so. Teachers declared CFCs (31.7%), spray deodorants (61.7%) and air conditioners and refrigerators (38 %) as the reasons for the ozone layer depletion problem. The interesting result at this point was that, although about 32 % of the teachers indicated CFCs as a reason for the ozone layer depletion, spray deodorants were indicated by 62 %. This result explained with the media effect as; teachers were more familiar with the term rather than the chemical formula. Because, ozone layer depletion has always coincided with the use of spray deodorants in media; especially by the phrase "ozone friendly" in the deodorant advertisements. Moreover, sulphur and nitrogen compounds were stated as the pollutants for acid rain problem by relatively higher percentages. It was inferred as a result that, teachers' knowledge about global warming, ozone layer and acid rain cannot go beyond just defining the concepts. Misconceptions of the teachers of this study about global warming and ozone layer were also obvious by their answers for the multiple choice question (*Which characteristic of the green house gases make them cause green house effect*?): Although 61% of the teachers answered this question correctly, as they absorb *the sunlight emitted from the Earth surface,* 15 % of them answered as they are *found in the upper layers of the atmosphere relative to other gases.* This result points out a common misconception observed in the literature. As was declared by Michail, Stamou and Stamou (2007), Cutter (2002) and Summers, Kruger, and Childs (2000), for example, teachers had confusion about green house effect and ozone layer depletion and they had misconception on these issues. In general terms, the location of ozone layer was confused with that of the greenhouse gases and stratospheric ozone with tropospheric ozone. Teachers in Turkey were also asked about renewable energy question, emphasizing that teachers need to teach renewable energy sources to allow their students to show appropriate actions to prevent air pollution. Just having knowledge about causes of the air pollution will not help them prevent air pollution, they can help prevent air pollution if they know the ways for sustainable use of the sources. As a result, majority of the teachers

knew that wind, sun light, wave, and geothermal are renewable energy sources and some of them also indicated that biogas, hydrogen, and biodiesel as renewable energy sources. Similar research conducted with Greek, Australian, and English teachers had also revealed that they did not had enough understanding about air pollutants, green house gases and ozone layer (Cutter, 2002; Michail, Stamou, & Stamou, 2007; Summers et al., 2000).

Shepardson et. Al. (2011) derived five distinct mental models of the greenhouse effect from an inductive analysis of the content of the drawings and explanations of 225 students' from three different schools in the Midwest in the US. Based on the mental models identified it was apparent that students lacked a clear understanding of the greenhouse effect. At best 48% of the students realized that greenhouse gases, whatever they may be, cause the greenhouse effect and that the sun's energy is either 'trapped' by or 'bounced' back to the Earth by the greenhouse gas layer. On the other end of the spectrum, 29% of the students lacked an understanding of the greenhouse effect.

Investigation on the regional differences in 15 year old Turkish students' awareness, perception, optimism and responsibility development toward environmental pollution issues carried out, with 4942 fifteen year-old-students attending 160 schools across 78 provinces and 7 geographical regions (Teksoz, Tekkaya, Erbas, 2009). Results indicated that a minority of students, across seven regions reported as they aware of the increase of greenhouse gases in the atmosphere (9.7%). The percent of students who stated that they never heard about these issues were 26.5% in average. As far as the acid rain issue has been considered, 18.2% stated that they were familiar and 9.2% stated that they never heard about the acid rain issue. Furthermore, while 63.7% of the participants believed that they were familiar with the consequences of clearing forests for other land use, 3.9% declared that they never heard about the issue. The mean scores calculated for environmental perception, environmental awareness and responsibility development components show almost the same trend among the regions. Those for the regions in the West part of the country are higher than those for the Eastern regions. Whereas, mean values for the environmental optimism component show a different pattern between the regions: students living in the Eastern regions seem more optimistic than those in other regions. In the first place, the results of the study provided some evidence that the place where students live had an effect on their environmental awareness, concern, optimism and responsibility for sustainable development. For example, the most noticeable characteristic was that; although the students of the two of the least industrialized regions (Southeast Anatolia and East Anatolia) displayed lower awareness and concern toward environmental issues, they displayed highest degree of optimism concerning the development over the next 20 years of the problems associated with air pollution, clearing of forests for other land use. In fact, the results reflect the transcontinental feature of Turkey. Among the 7 geographical provinces, Marmara having students with comparably higher environmental concern, responsibility but low degree of optimism, distinguishes from the others with its being heavily advanced in industry, commerce, tourism and transportation because of its close location to Europe. Thus the children living in such circumstances are more aware of air pollution problems, are concerned about them and pessimistic about the future state of the problems. The significant feature of Aegean, which has the students with very high environmental awareness, concern, responsibility and comparably higher optimism, is that, most of the population and cities are concentrated on the coast line because of its convenience for sea transportation and

tourism and it's also being both industrialized and agriculturalized. Students from one of the most important trading and tourism centre and the rapidly growing port, the Mediterranean region, on the other hand revealed high awareness and concern but lowest optimism toward environmental issues. The students from the Black Sea region, one of the most heavily forested regions with very rich fauna and flora, revealed a similar trend with the former regions. The students from plateau-like heartland of the country, Central Anatolia, revealed comparably higher perception, responsibility and optimism toward environmental issues are considered. The students showing a distinguished feature, lowest awareness, perception, responsibility but highest optimism toward environmental issues, in the current study come from the Eastern Anatolia, where the population and habitat not dense because of the harsh climate and high mountains and has the highest unemployment rate in Turkey and South-eastern Anatolia where a special atmosphere exists throughout, uniquely different from other parts of the country, thus, reflecting a specific life style over its land. Thus, referring the very well known phrase of the environmental studies, *think globally act locally* (UNEP, 1972), efforts to explain environmental perceptions and concern as a function of social structure and socio-demographic characteristics can be combined with the regional features of a country and such a relationship, if any, is valuable for strategy development for developing air pollution perceptions. Thus, as Matthews (1995) reviewed in his study, regional features and culture affect children's behaviour in large-scale environments and it follows that as the life worlds of children from different socio cultural backgrounds differ, the way in which children encounter place and make sense of their everyday worlds are also likely to be at variance. Therefore, it may be concluded that, "area of residence is a silent predictor of responsible environmental behaviour". Therefore, efforts for creating environmentally literate generations need to consider regional socio-economical features as well as the people's perceptions towards environmental issues. Such an evaluation will be very valuable leading the education specialists to establish a national strategy for and will help to make the strategy regional, as suggested in Chapter 36 of Agenda 21 (UNCED, 1992).

Efforts for developing EE and ESD as a tool for managing air pollution therefore continues under the light of the research, several examples of which are summarised above. Although there is are international conventions leading such efforts, regional, national and local strategies are needed to get more effective outputs. Efforts, although concentrated in teachers' education, shall diffuse to all areas, engineering being one of the vital one. Ashford (2004) pointed out the concern as follows: "Scholars and professionals committed to fostering sustainable development have urged a re-examination of the curriculum and the restructuring of research in engineering-focused institutions of higher learning. The focus is on engineering, more than on the natural and physical sciences or on social science, because the activities that drive the industrial state – the activities that implement scientific advance – are generally rooted in engineering. Moreover, engineers are known as 'problem solvers' and if economies are becoming unsustainable because of engineering, it is natural to ask whether engineering as an activity and as a profession can be re-directed toward achieving sustainable transformations. Of course, engineering cannot do it alone; scientific as well as social and legal changes must occur as well" (p.239).

Nevertheless, results of research investigating people awareness, attitudes, behaviour on the air pollution issues have a single common result that, most of the people from different

countries with different socio-demographic features and life styles, aware of the natural resources, like air, are vulnerable resources and deserve conservation for the sake of supporting human life or just for the health of itself. Most of the people have an eco-centric approach to the natural sources. But beyond this point, when it comes to individual responsibilities, i.e. making changes in living styles for natural protection, such as preferring public transport instead of private cars or using less energy at home, the approach slides through anthropocentrism. Or, citizens both in the developing and developed world cannot make a relation between, for example the way we eat and the global warming, or the way we shop and acid rain, or the way we consume, we produce and ozone layer depletion, etc, which as a result makes it difficult to make a change. Education is a powerful tool to make people aware of such relations and get rid of the ignorance we have been carrying since 17th century.

> Living sustainably depends on a duty to seek harmony with other people and with nature. The guiding rules are that people must share with each other and care for the Earth. Humanity must take no more from nature than nature can replenish. This in turn means adopting lifestyles and development paths that respect and work within nature's limits. It can be done without rejecting the many benefits that modern technology has brought, provided that technology also works within those limits. (IUCN, UNEP and WWF 1991, p. 8)

> Knowledge, learning, information, and skilled intelligence are the new raw materials of international commerce and are today spreading throughout the world as vigorously as miracle drugs, synthetic fertilizers, and blue jeans earlier... Learning is the indispensable investment required for success in the "information age" we are now entering. (National Commission for Excellence in Education, 1983, p. 7)

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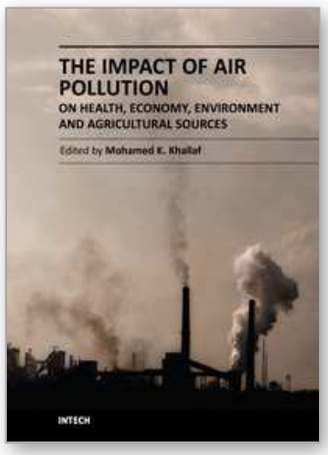

The Impact of Air Pollution on Health, Economy, Environment and Agricultural Sources

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This book aims to strengthen the knowledge base dealing with Air Pollution. The book consists of 21 chapters dealing with Air Pollution and its effects in the fields of Health, Environment, Economy and Agricultural Sources. It is divided into four sections. The first one deals with effect of air pollution on health and human body organs. The second section includes the Impact of air pollution on plants and agricultural sources and methods of resistance. The third section includes environmental changes, geographic and climatic conditions due to air pollution. The fourth section includes case studies concerning of the impact of air pollution in the economy and development goals, such as, indoor air pollution in México, indoor air pollution and millennium development goals in Bangladesh, epidemiologic and economic impact of natural gas on indoor air pollution in Colombia and economic growth and air pollution in Iran during development programs. In this book the authors explain the definition of air pollution, the most important pollutants and their different sources and effects on humans and various fields of life. The authors offer different solutions to the problems resulting from air pollution.

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