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INDUSTRIAL EXPANSION AND GLOBAL WARMING

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ABSTRACT

Over the past few years, there has been lot of concern about the global warming and one of the main causes of the same is attributed to the rapid increase in industrial development that took place in the world over last some decades. Understanding the causes of and responses to global warming requires interdisciplinary cooperation between social, business and natural scientists. The theory behind global warming has been understood by climatologists since at least the 1980s, but the impact of huge industrial establishments has caused concern only recently and there has been the mounting empirical evidence to this effect which has convinced most of us as also the business scientists, politicians, and the general public as well as growing sections of our business community that the industrial expansion is responsible for global warming to a larger extent. With this in view, an attempt is made in this paper to know as to what extent our industrialization has contributed in global warming.

KEYWORDS

Carbon Footprint, Climate change, Global warming, Greenhouse Effect, Industrialization, Kyoto Protocol, Sustainable Environment and Ecosystem.

INTRODUCTION

Global warming is understood to result from an overall, long-term increase in the retention of the sun's heat around earth due to blanketing by "greenhouse gases," especially Carbon dioxide (CO_2), methane, nitrous oxide and fluorocarbons. Emissions of CO_2 have been rising at a speed unprecedented in human history, due to accelerating fossil fuel burning and biomass that began especially with the advent of Industrial Revolution. Industrial revolution was a period from 1750 AD to 1850 AD when changes in agriculture, manufacturing, mining, transportation and technology had a profound effect on social, economic and cultural conditions of the times. It began in the UK and then subsequently spread throughout Western Europe, North America, Japan and eventually the rest of the world. Thus, we the human race have substantially altered the earth's atmosphere. It is reported (Mehta, 2007) that in 2005 the concentration of Carbon dioxide exceeded the natural range that has existed over 650,000 years. Eleven of the warmest years since instrumental records have been kept occurred during the last 16 years and therefore climate change is accelerating. In the 20th century the increase in average temperature was 0.74 degrees centigrade; sea increased by 17cm and a large part of the Northern Hemisphere snow cover vanished. Particularly worrisome is the reduction in the mass balance of the glaciers and this has serious implications for the availability of the water. It is reported that melting of glaciers has contributed as much as 30 per cent of change in sea level in the 20th century. Melting of ice at Antarctica has caused growth of grass for the first time there. The total size of glaciers worldwide has decreased by 50 per cent since the end of the 19th century; something like 500 million people in South Asia and 250 million in China are likely to be affected as a result. The change in climate due to rise in global temperature is causing migration of species of wild animals towards polar and high altitudes. In general, in temperate regions there is an increase in precipitation, rainfall and snow. But in the tropical, sub-tropical and mediterranean regions there is a decline (Pachauri, 2007). A recent scientific survey carried out by the Chinese Academy of Science (2006) has revealed that the world's highest peak Mount Everest is shrinking and is gradually losing its height by nearly 0.1 meter annually due to global warming. The highest mountain in Africa, the Mount Kilimanjaro, has lost most of its snow cover since 1970 due to global warming. Global warming is depleting the fish stocks of African lakes. A rise in sea temperature killed off 90 per cent of coral reef near the surface of the Indian Ocean in only one year while the remaining 10 per cent could die in next 20 years. In the context of our country, the Parbati Glacier in Himachal Pradesh is melting fast. Satellite images taken between 1990 and 2001 indicate that the glacier has retreated 578 meters, the average shrink being 52 meters a year (Roy & Ashtt, 2007). The Gangotri glacier has shrunk more than 850 meters from 1996 to 1999.The Amarnath Shrine Board acknowledged, in May 2006, that the Ice Lingam at the Himalayan Cave was much smaller that year owing to global warming. In the elysian valley of Kashmir, most of the health resorts are experiencing less snow, in winters, during the past two decades for which the cause is attributed to global warming. Owing to environmental changes the Siachen glacier, in Ladakh region of J&K state, has also got affected to a considerable extent. It noteworthy that with the depletion of ozone layer there are obvious climate, atmospheric, ecological and environmental changes the protection of which have received worldwide attention during last two decades. Despite warning signals most countries have not put in required measures to avoid ill effects of climate change. The world has experienced devastating natural disasters on a level that has not been seen for decades due to global climate change brought about by increasing level of CO_2 and GHGs in atmosphere.

INDUSTRIAL EXPANSION AND CLIMATE CHANGE

Global warming has been a pertinent topic of discussion amongst earth scientists, geographers, climatologists, social scientists, economists, commercists, management experts, academicians, planners and administrators. Population, increasing industrialization and sustainable environment (which refers to maintaining environment overtime) are intertwined inseparably. Any increase in global warming will invariably deplete the resources in some proportion resulting in ecological imbalance of high magnitude to adversely affect sustainable development of the world. As stated earlier, global warming is the cause for enhancing the extreme environment temperature. It is responsible for rising sea water level by 0.5ft to 5.0ft due to melting of mountain glaciers and expansion of the oceans (Bhattacharjee, 2010). It may be recalled here that the greenhouse gases are the main culprits of the global climate/ecological change. The greenhouse gases like water vapour, carbon dioxide, methane, nitrous oxide and chlorofluorocarbon are playing hazards in the present times. Over the past 200 years, emissions of these gases due to human activities have accumulated in the atmosphere. As a result, especially since the Industrial revolution, concentration of carbon dioxide has increased by 30 per cent, methane by 145 per cent and nitrous oxide by 15 per cent (Ratkalle, 2007). More or less all specialists of earth/earth scientists have the same opinion now that human actions mainly the discharge of greenhouse gases from smokestacks, vehicles, burning forests/deforestation and rapid industrialization are perhaps the leading power driving the fashion. An atmosphere containing gases that absorb and emit infrared radiation causes the greenhouse effect which regulates temperature on Earth. Just as glass in a greenhouse keeps heat in, our atmosphere traps the sun's heat near earth's surface, primarily through heat-trapping properties of certain "greenhouse gases". Earth is heated by sunlight. Most of the sun's energy passes through the atmosphere, to warm the earth's surface, oceans and atmosphere. However, in order to keep the atmosphere's energy budget in balance, the warmed earth also emits heat energy back to space as infrared radiation. As this energy radiates upward, most is absorbed by clouds and molecules of greenhouse gases in the lower atmosphere. These re-radiate the energy in all directions, some back towards the surface and some upward, where other molecules higher up can absorb the energy again. This process of absorption and re-emission is repeated until finally, the energy does escape from the atmosphere to space. However, because much of the energy has been recycled downward, surface temperatures become much warmer than if the greenhouse gases were absent from the atmosphere. This natural process is known as the greenhouse effect. It may be stated here that climate changes is said to be caused when there is a statistically significant variation in either the mean state of the climate or its variability, persisting for an extended period due to increasing emissions of greenhouse gages such as carbon dioxide , methane, nitrous oxide and chlorofluorocarbons. In simple terms, as these gases trap the solar heat within the earth's atmosphere, the earth's surface temperature increases, leading to change in weather patterns and the earth's ecological balances. The major sources of greenhouse gases are:

- Fuel combustion;
- Energy industries;
- Manufacturing industries and construction;
- Transportation;
- Solid fuels;
- Oil and natural gas;
- Industrial process involving mineral products, chemical industries, metal production of halo carbons and sulphur hexafluoride;
- Agricultural processes such as enteric fermentation, manure management, rice cultivation prescribed burning of savannas and field burning of agricultural residues; and
- Solid waste disposal on land, waste water handling and waste incineration.

It has been observed that the environment temperature is increasing year-after-year leading to climate change. Industries, refineries, excessive electromagnetic wave propagation through air, transport vehicles – road and airways, rapid growth of entertainment equipment like air conditioned machines, refrigerator, television, mobile phone, computer etc are said to be the agents also responsible for the increasing environment temperature. The existing ecological environmental has become highly polluted due to the establishment of different industries worldwide (heavy and light), oil-refineries, petrochemical, vehicles – air route and surface route etc. As is reported (Bhattacharjee, 2010) that in manufacturing industry, oil-refineries, petrochemical, chemical industries and heavy industries etc., most of the times residue of these industries, which is generally composed of different poisonous materials in gaseous form- (yielding greenhouse gases and causing global warming) - are either thrown out or burnt in open air after being exhausted through openings of a long heighten chimney. In case of burning residue gases in open air, some part of these residue gases are not completely (100%) burnt, some portion remains in their original condition. These remaining residue gases in unburnt condition/in original condition get mixed up with natural air in environment. These residue gases with the ashes of burnt residue gases with other greenhouse gases, because of their highly poisonous character spread numerous diseases in animals and botanic life including humans especially in the surroundings of these industrial plants (say 3~4 Km radius from the exposure of the residue gases or the burning residue gases) are responsible to raise environment temperature rapidly to a large extent.

The whole process of the global warming as influenced by the massive industrialization could be understood with the help of the concept of Carbon footprint as explained below:-

CONCEPT OF CARBON FOOTPRINT

Carbon footprint is a measure of the amount of CO_2 emitted through the combustion of fossil fuels; in case of an organization, business or enterprise/ industry as a part of their everyday operation; in the case of an individual or household as a part of their daily lives; or in case of a product or commodity in reaching the market. In other words, the total amount of GHG emission caused directly or indirectly by an individual, organization/ industry events or products is called "Carbon Footprint" of that entity. A carbon footprint is expressed as tons of carbon dioxide ($C0_2$) or tons of carbon emitted usually on yearly basis. A ton of carbon dioxide is released when we for example travel 5000 miles in an airplane or drive 2,500 miles in a medium - sized car, or cut down and burn a tree that was about 1 foot in diameter and 40 foot tall. It may be pointed out here that Carbon footprint consists of two parts – The Direct/ Primary footprint and Indirect/ Secondary footprint;

- The Primary footprint is a measure of direct emissions of CO_2 from the burning of fossil fuels including domestic energy consumption and transportation (e.g. car and Plane); and
- The secondary footprint is a measure of the indirect CO_2 emissions from the whole lifecycle of products that are used. These are associated with their manufacture and breakdown. For a country, the total amount of CO_2 release is associated with the carbon footprint of the individuals and business houses that belong to that country.

REMEDIAL MEASURES AT GLOBAL LEVEL

Periodic surveys and researches have proved that the global warming due to greenhouse gases causing changes in the world climates is increasing day-by-day. It is currently recognized as an important global issue. Representatives from over 160 countries have met regularly to discuss ways to reduce greenhouse gas emission. In December, 1997 a conference was organized in Kyoto Japan wherein world nations signed an agreement called as Kyoto Protocol. According to the protocol, the industrialized nations were required to cut their greenhouse gas emissions to an average of 5 per cent below 1990 levels by 2012. The protocol has been ratified by more than 126 countries. But Australia and the US did not support the protocol (Khokhar, 2010).

- Under Kyoto Protocol, United Nations Framework Convention on Climate Change (UNFCCC) members are divided into two groups: Annex 1 countries include mainly the OECD and Eastern European industrialized countries and the Non Annex-I countries are the developing economies;
- Three emission trading based 'flexibility mechanisms' were adopted to help in minimizing the global economic cost of achieving the agreed emission reductions. They are namely a) International emission trading that would involve the transfer of the Assigned Amounts Units (AAU) among the Annex 1 countries; b) Joint Implementation (JI) involves project based activities undertaken between Annex 1 countries; and c) Clean Development Mechanism (CDM) involves emission reduction projects undertaken in non-Annex- 1 countries.

Recently in December 2009, in Copenhagen, important steps towards reducing emission of CO_2 were taken which are expected to go a long way in keeping our environment sustainable. It is pertinent to note that for each tone of CO_2 that an industry in the developing world save by adopting cleaner technology or energy efficiency or shifting to non-conventional sources of energy generation, the United Nation's body on climate change gives a certificate called Certified Emission Reduction (CER) to the concerned industry. The company receiving the CER can sell the surplus credits (collected by surpassing the emission reduction targets) if any, to entities in the developed countries either immediately or through a future market at a price that is mutually agreed upon by both the parties involved in the deal. In the process the entities in the developed countries find it cheaper to buy "offsetting" certificates rather than achieving emission reductions in their own backyard. The following table reveals the carbon dioxide emissions from fossil fuels in ten countries:-

CARBON DIOXIDE EMISSIONS FROM FOSSIL FUELS BURNING

(Top Ten Countries- 2006)

Country Emissions	Total Million Tons of Carbon	Share of Global Per cent
United States	**1,656**	**19.8**
China	**1,480**	**17.7**
Russia	**437**	**5.2**
India	**391**	**4.7**
Japan	**342**	**4.1**
Germany	**221**	**2.6**
Canada	**177**	**2.1**
United Kingdom	**171**	**2.0**
South Korea	**130**	**1.6**
Mexico	**123**	**1.5**
All Other Countries	**3,249**	**38.8**
Global Total	**8,379**	**100.0**

Source: Various studies and Carbonyatra.com, India's first carbon footprint calculator.

It may be stated here that in 2005, an eight-year European study drilling Antarctic ice cores to measure the past composition of the atmosphere reported that CO_2 levels were at least 30 per cent higher than at any time in the last 65,000 years. The speed of the rise in CO_2 was unprecedented, from 280 parts per million (ppm) before the Industrial Revolution to 388 ppm in 2006. Early in 2007, the Norwegian Polar Institute reported acceleration to a new level of 390 ppm. In January 2006, a British Antarctic Survey, analyzing CO_2 in crevasse ice in the Antarctic Peninsula, found levels of CO_2 higher than at any time in the previous 800,000 years. In April 2005, a NASA Goddard Institute Oceanic Study reported that the earth was holding on to more solar energy than it was emitting into space. The Institute's director said: "This energy imbalance is the 'smoking gun' that we have been looking for" (Columbia, 2005).

It is now an admitted fact that climate change affects the entire globe. And therefore, developed and developing countries alike are working together to find solutions to climate change. Towards this end, the initiatives began in June 1992 when the United Nations Framework Convention on Climate Change (UNFCC) was signed by 154 countries that agreed to stabilize the amount of greenhouse gases in the atmosphere at levels that would not cause harm, the efforts are going on and shall continue for all times to come.

It may be indicated here that Canada and the world will continue to warm, but there are many variables that can affect the speed and magnitude of the changes. Staying informed about climate change, and supporting efforts to slow its progress are things everyone can do. Taking action on climate change can also make our economy more internationally competitive by creating growth and jobs while producing less waste, pollution and greenhouse gases. Our climate may already be changing because of the existing buildup of greenhouse gases in the atmosphere, and we must be prepared to adapt to those changes. While action now to reduce emissions is critical, the existing build-up of GHG concentrations means that some climate change in the coming decades is inevitable and planning must start now on adapting our economy and society to these changes. Adaptation involves taking action to minimize the negative impacts of climate change and taking advantage of new opportunities that may arise. The types of adaptation measures adopted will depend on the impact of climate change on particular regions and economic sectors. Increasing our capacity to adapt reduces our vulnerability to the effects of climate change. However, we must start planning our adaptive responses now and by doing so, we may help to lessen some of the environmental, economic and social costs of climate change.

THE END NOTE

Global warming means increase in world's surface and environment temperature due to greenhouse effect. The greenhouse gas is composed of carbon dioxide and monoxide (CO_2, CO), Chlorofluorocarbons (CFC), sulphuric fluoride, methane, hydrocarbons, water vapor, etc. The impact of global warming has sensitized all the nations. It is as such obligatory on us all to see that we can contribute at individual as well as at group levels to reduce global warming by producing less and less of gases in whatever way we can so as to keep our environment sustainable and live a healthy life. Safeguarding is the way of management of global warming and environment of man's surroundings to prevent its destruction. The aim of safeguarding is to ensure the preservation of ecosystem and quality environment in which human can live in harmony with nature. Without plants and animals we cannot maintain the ecosystem. Detonation of environment is mainly due to indiscriminate development, population explosion, unplanned urbanization and increasing industrialization. The following major areas should be immediately developed to mitigate global warming and reduce the greenhouse gases:

- **Energy:** conversion from coal to gas and renewable power sources including hydro, nuclear, solar and wind is strongly recommended;
- **Transport:** More fuel-efficient vehicles including hybrids and cleaner diesel vehicles should be used. More extensive use of rail and other public transport systems is also recommended.
- **Agriculture:** Improved crop and grazing land management to increase soil carbon storage. Better rice cultivation techniques, livestock and manure management to reduce methane emission;
- **Building/Industry:** More efficient electrical gadgets, better insulation and active solar design for heating and cooling is needed. Architects are experimenting with architectural designs now, so that structures are energy efficient;
- **Reduce, Re-use and Recycle:** Recycle paper, newspaper, beverage containers, electrical equipment and batteries, etc. Reducing, reusing and recycling help to save money, conserve energy, reduce pollution and greenhouse gases;
- **Educate People:** We need to educate people and ourselves about global climate change and its causes. Though the civil society does not respond at all well to moralistic scolding, so we need to use education to enlighten and not frighten;
- **Encourage:** We should encourage neighbors, supervisors, colleagues, and businesses to do recycle more by using recycling bins;
- **Local products**: Buy locally made and locally grown products;
- **Tracking Carbon consumption:** Keep track of your carbon consumption as a way of tracking your progress;
- **Discard Old Appliances**: Replace old appliances and reduce reliance on them;
- **Grow More Plants**: Plants and tree like bamboo grow faster and produce 35 per cent more oxygen than tree like oak or birch and require fewer chemicals and care;
- **Public Transport:** Use public transport. Reduces one's individual greenhouse gas emissions by an average of 1,600 pounds per year;
- **Using Traditional Transport:** Taking the bicycle instead of the car is a very simple solution;
- **Commonsense:** Use your commonsense as a tool against global climate change;
- **Fuel-Efficient Car:** Buy a fuel-efficient car and save upto 20,000 lbs. of carbon dioxide per year. Using a more fuel-efficient car and checking car's air filter monthly can save 800 pounds of carbon dioxide. Also find alternative sources of energy like renewable energy, manufacturing fuel or alternative fuel efficient vehicles etc; and last but not the least
- **Population Control, Planned urbanization and Industrialization**: are also badly needed, if we really want to avert the threats of global warming.

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