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Research Paper

Conceptualizing Prevalent Approaches towards Environmental Sustainability

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ABSTRACT: *Environmental Sustainability is that what we have today will continue to have tomorrow means managing natural resources efficiently and maximizing the benefits we get from them so as not to overload the world's ecosystem. Population growth, industrialization, pollution, global warming and loss of biodiversity are various challenges to environmental sustainability. Each and every challenge has different reasons, causes and sources but they all are interlinked. A worldwide change is needed in order to avert their catastrophic effects. Although there are different approaches for a particular challenge to maintain sustainable environment like sustainable agricultural techniques, various measures to control pollution and population, use of green chemistry but the most important approach is value based Global Sharing to develop a sense of duty to care for the nature and its resources.*

Keywords: *Environment sustainability, global warming, green chemistry, genetic pollution, soil erosion.*

I. THE CONCEPT

The total developments of human activities with the future advancement of science and technology have been giving positive benefits since ages. However, these benefits have been coupled with resource depletion and ecological degradation as by products, thereby projecting gloomy prospects for future of man. In this context, sustainable environment is the need of this nature.
Sustainability is important to ensure that what we have today will continue to be there tomorrow. As "sustainability" word is derived from the Latin sustainers (tenure, to hold; sus, up). The term of Environmental Sustainability refers to the necessary balance between human necessities and the capacity of the earth's natural system. Therefore sustainable development for environment is managing natural resources efficiently and maximizing the benefits we get from them so as not to overload the world's ecosystem.

Environmental sustain ability is asset of four major activities i.e. the use of renewable and nonrenewable resources on the source side, pollution and waste assimilation on the sink side. As a well-managed environment requires vital resources, known as "ecosystem services" which fulfill the social, economic, environmental and other requirements of all present and future generations. In a sustainable environment the two fundamental environmental services; the source and the sink functions must be maintained unimpaired over the period of time.

Theoretically, sustainable environment depends upon the reconciliation of three pillars or triple bottom line[1]i.e. environmental, social and economic demands. Both economy of the world and society are constrained by environment. These three pillars are not only mutually exclusive but can be mutually reinforcing (supportive). This triple bottom line concept is also recognized by the ISEAL Alliance (International Social and Environmental Accrued it action and Labeling) –the global association for social and environmental standards. This chapter deals with the challenges to environmental sustainability and approaches to maintain it.

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II. THE CHALLENGES AND APPROACHES FOR ENVIRONMENTALSUSTAINABILITY

2.1Population Growth

The population puts considerable pressure on its natural resources and reduces the gains of development as it is the sumofhumans on earth. The human population has skyrocketed in recent times. 2000years ago, the Earth was home to just 300 million humans, roughly the population of the United States today. Two hundred years ago, 1 billion humans lived on ourplanet Earth. A soft day, it is estimated to number 7.012 billion by the United States Census Bureau (USCB). If current trends continue, we will add another one billion to the world population every13or 14years.Statistical data[2]revealthatthe currentrateofpopulationincreaseis1.2% every year[3]. Thus, the current world population of 7billion is projected to double to 14 billion in less than 60 years.

2.1.1World population trends: The world population is currently growing by approximately 74 million people per year according to the United Nations' World Population Prospects report [4]. Current United Nations predictions estimate that the world population will reach 9.0 billion around 2050, assuming a decrease in average fertility rate from 2.5 down to 2.0 [5]as given in Fig.1.

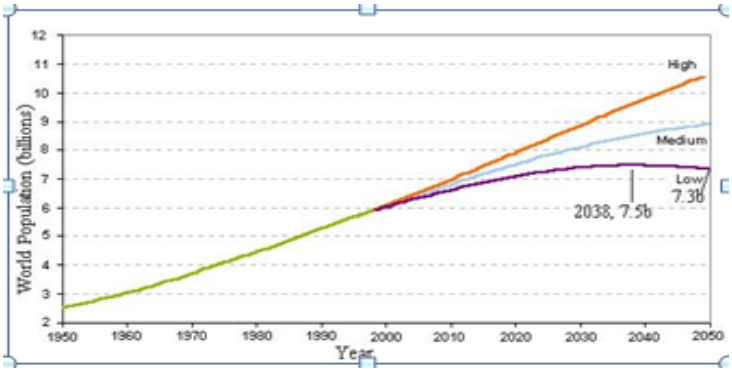


Figure1.World population size: past estimates and projection on medium-, high-and low fertility variants, 1950-2050

In this graph, there are three curves that reflecting the uncertainties involved in predicting fertility rates. According to the 'medium' projection, the human population will reach 8.9 billion in 2050. This approach assumes that all countries will eventually reduce their total fertility rate to 2.1 or lower. Using the 'low' projection, world population will peak at about 7.5 billion in 2040 and then drop. The low projection assumes TFR values everywhere will drop to 1.6. Under the 'high' projection, which assumes total fertility rates will stay at 2.1 to 2.6; human population will increase continuously, reaching 10.7 billion.

It is observed that almost all growth will take place in the less developed regions and is expected to increase by 9 billion in 2050 by comparing the growth chart of underdeveloped and developed countries. By contrast, the population of the more developed regions will remain mostly unchanged, at 1.2 billion as depicted in Fig.2 [6]. An exception is the United States population, which is expected to increase by 44% from 2008 to 2050 [7].

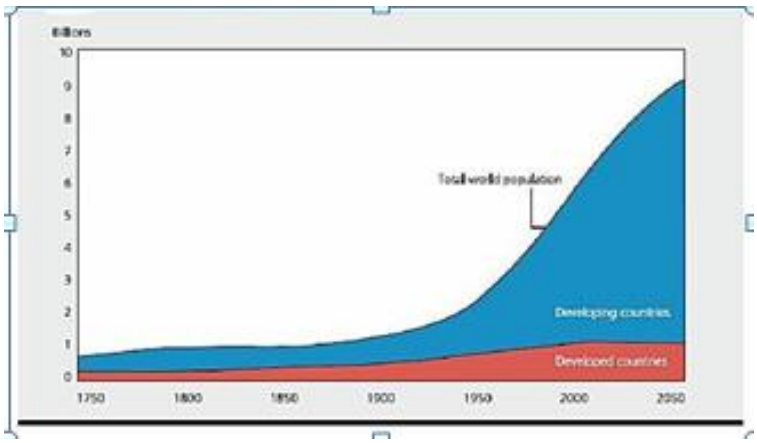


Figure 2. World Populations from 1750 to 2050

Table 1: India's Population 2015*[8]

Current Population of India in 2015	1,271,702,542 (1.27 billion)
Population of India in 2014	1,270,272,105
Total Male Population in India	656,659,592 (656.6 million) (2015)
Total Female Population in India	615,042,950 (615 million) (2015
Sex Ratio	943 females per 1,000 males
Age structure	
0 to 25 years	50% of India's current population
India's Population in 2013	1.26 billion
India's Population in 2012	1.22 billion
India's Population in 2011	1.21 billion

According to recent estimates, Population of India in 2015 is 1.27 billion. India, with 1,271,702,542 people is the second most populous country in the world, while China is on the top with over 1,360,044,605 (1.36 billion) people. Currently, there are about 51 births in India in a minute.

2.1.2 Reasons of Enhanced Growth: Some of the reasons for India's rapidly growing population are poverty, illiteracy, high fertility rate, rapid decline in death rates or mortality rates and immigration. Some reasons are described as:

Improved medical services - The availability of antibiotics, immunizations, clean water, and increased food production resulted in tremendous improvements in infant and child mortality and have been the reason of drop in death rate.

Fertility -It is the key to population growth over the long term. In order to maintain a stable population size, a total fertility rate (TFR) of 2.1 is needed. This represents the total number of children an average woman will bear over her lifetime also known as Replacement-level fertility. The worldwide average TFR is 2.9. The United States has a TFR of 2.1. Even with a TFR of 2.1, the United States and similar countries will still see its population increase, as children born in previous years reach adulthood and begin having offspring. Only after TFR values have remained low for a generation or longer population size will level off or decrease.

2.1.3 Consequences: Either rich or poor country both are affected by the population growth. In developed countries population is growing more slowly than developing one. At the present growth rates, the population of economically developed countries would double in 120 years. Some of the consequences of growing population are as follows:

Depletion of natural resources, especially fossil fuels[9], which can retard economic growth too.

World grain area per person reduced by 50% since 1950 due to rising population.
Changes in atmospheric composition and consequently increase in global warming[10,11].

Irreversible loss of arable land and increases in desertification.[12].

Mass species extinction [13] may also take place as a result of overpopulation especially in countries with rapidly expanding rural populations due to slash-and-burn techniques that sometimes are practiced by shifting cultivators. Present extinction rates may be as high as 140,000 species lost per year [14].

Inadequate fresh water [15]for drinking. Some countries, like Saudi Arabia, use energy-expensive desalination to solve the problem of water shortages.

The growing population put immense pressure on land extensification at the cost of forests and grazing lands because the demand of food could not increase substantially to population and lead to deforestation that sustain global atmospheric oxygen and carbon dioxide balance. As a result about eight million hectares of forest are lost each year [16].

Increased chances of the emergence of newepidemics and pandemics. [17].

Because of over population, horizontal extension of land has fewer scope and relies mostly on vertical improvement that is supported by technical development in the field of agriculture i.e. HYV seeds, Fertilizers, Pesticides, Herbicides, and agricultural implements. All these practices lead to environmental pollution with multiplying ratio.

Rapid population growth also led to an erosion and breakdown in customary laws and rules governing.

Rapid population growth continues to be a matter of great concern for the country as it has manifold effects, and the most important being environment degradation. Therefore, to save our environment there is a need of population control in the country.

2.1.4Strategies to check population growth

In fact 4.2 children are born every second in the world while only 1.7 people die this means there is an increase of 2.4 people per second and this population explosion is responsible for environmental degradation in various ways. Therefore, there is an immediate need to control population growth. The strategies which are being applied are as follows:

Abortion - Although it is inhuman yet developed countries like France, United States, Australia, Sweden and Canada which are looking for a growth rate of less than 1 percent need to obtain a rate of 200 to 500 abortions for every one thousand live births.

Educating girls and IEC activities - Special efforts should be made for educating the general mass and local leaders about the adverse effects of large population through specially designed IEC (Information, Education and Communication) activities. If women are given increased access to educational opportunities, birth rates declinee.g. India's literacy rate has gone up from 64.83 per cent in 2001 to 74.04 per cent in 2011, whereas, India's population growth rate has decelerated to 17.64 per cent in the decade 2001-11, which has been found to be the slowest rate of growth this past century, according to the first results of Census 2011 (put out by the registrar-general of census).

Family welfare programs: In India, 1965-2009, the contraceptive usage more than tripled and the fertility rate more than halved therefore, the family planning program, bringing down significantly the country's fertility rate. According to the United Nations Population Fund, there are 200 million women in the world who would like to delay or prevent their pregnancies, but have no access to birth control and family planning programs. The United Nations Population Fund found in a cost-benefit analysis that if 3.9 billion U.S dollars are spent on contraceptives for women in the poorest countries, it would prevent more than 50 million unintended pregnancies and more than 20 million abortions.

Government Incentives: Governments can further encourage the trend by funding education projects and ways to inform the populace about the costs of raising more than a set number of children.

2. 2 Global Warming &Ozone layer depletion

2.2.1Global Warming

Global warming is the rising average temperature of Earth's atmosphere and oceans. It begins when sunlight reaches Earth. Then about 30 % of it is reflected back by clouds, atmospheric particles, reflective ground surfaces and ocean surface, while the remaining is absorbed by oceans, lands and air. This in turn heats the planet's surface and atmosphere, making life possible. As Earth warmed up, this solar energy is radiated by thermal radiation or infrared heat, travelling directly out to space, thus cooling the Earth. However, some of the outgoing radiation is re-absorbed by carbon dioxide, methane, water vapor and other gases in the atmosphere and is radiated back to Earth's surface; these gases are known as greenhouse gases due to their heat-trapping capacity. This re-absorption process is naturally good; the Earth's average surface temperature would be very cold if not for the greenhouse gases.

The problem begins when the concentration of greenhouse gases in the atmosphere is artificially raised by humankind at an ever-increasing rate. As of 2004, over 8 billion tons of carbon dioxide was pumped out per year; natural carbon sinks such as forests and the ocean absorbed some of this, while the rest accumulated in the atmosphere. [18].

According to Intergovernmental Panel on Climate Change (IPCC) 4th Assessment Report on Climate Change, non-CO_2 greenhouse gases are also a significant contributor. Approximately 30 percent of the human-induced greenhouse effect can be attributed to the non-CO_2 greenhouse gases. e.g. Millions of pounds of methane are produced in landfills and upon agricultural decomposition of biomass and animal manure(Fig.3). Nitrous oxide is also released into the atmosphere by nitrogen-based fertilizers and other soil management practices.

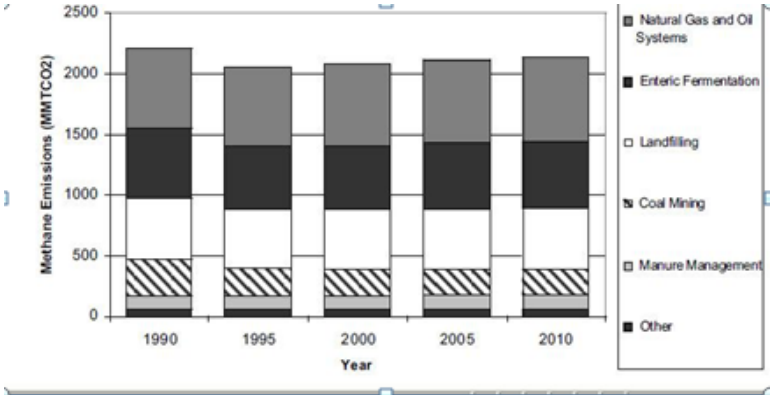


Figure 3. Evolution of non CO_2 GHG emissions of developed countries from 1990 to 2010 (MMT CO2)[19]

Once released, these greenhouse gases stay in the atmosphere for decades or longer. According to the Intergovernmental Panel on Climate Change (IPCC), carbon dioxide and methane levels have increased by 35 and 148 percent since the 1750 industrial revolution. Paleo climate readings taken from ice cores and fossil records dating back to 650 000 years show that both gases are at their highest levels. Thermal radiation is obstructed further by the increased concentrations of greenhouse gases, resulting in what is known as enhanced global warming.

2.2.2 Consequences: Though it appears to be a small change, still the consequences are devastating. Anincrease in global temperature is likely to affect the environment in the following ways:

Drought - A recent study by a group of British climatologists has come to find that global warming will lead to massive droughts in the next 100 years. It may cover half of the total land area that we have at the present, which will lead to large-scale migration. The Palmer Drought Severity Index (PDSI) has found that the global percentage of dry areas has increased by 1.74% between 1950 and 2008. If the temperature on the surface of the earth keeps getting warmer at the current rate, it is very likely to pose problems of feeding and accommodating the burgeoning population.

Climate change –It causes frequent occurrence of extreme-weather events including heat waves, severe hurricanes and heavy rainfall. Climate change has already led to an increase in the number of epidemics according to the Korea Institute of Health and Social Affairs (KIHASA), which states that "In extreme cases, a 1 degree rise in temperature resulted in as much as a 6 percent increase in the spread of diseases. Overall, high temperatures are seemingly responsible for more brisk activities of viruses." Future climate change is expected to particularly affect certain ecosystems, including tundra, mangroves, and coral reefs.

Floods - The thought that global warming can cause both droughts and floods can seem to be counterintuitive to some people, but the fact is that climate change has altered the weather pattern around the world. In the past couple of years itself; we have seen signs of how nature may have started the 'payback' proceedings. Pakistan witnessed one of the deadliest flash floods in May 2010, which killed about 1400 people and left another 3.5 million homeless. 35 people were reported to have died and property worth $30 billion was destroyed in Queensland,Australia, flash floods in December 2010. In January 2011, more than a thousand people died because of flash floods in Saudi Arabia. The Intergovernmental Panel on Climate Change (IPCC) has already warned that the frequency of flash floods would increase in this century.

Melting of polar ice caps and sea level rise - Global warming has led to the melting of the polar ice caps in the Arctic and the Antarctic regions. The temperatures in these areas have risen about two to three times as compared to the average temperatures on earth. The polar ice caps have their own important role in maintaining the environmental balance. If these ice caps were to melt, islands which are below sea level may be in danger. Cities like Shanghai and the island nation of Maldives are some places which would be at the highest risk in such a scenario.

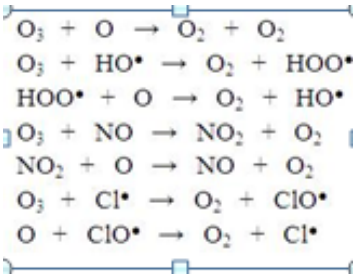
Smog - With the increase in the temperatures due to global warming, the concentration of smog in the atmosphere will increase. This increase in the level of smog will ultimately lead to illness and death. Smog will also intensify the severity of heat waves, which can take a further toll on us.

Wildfires - Over the past decade or so, a lot of research has been conducted to ascertain whether global warming leads to an increase in the frequency and intensity of wildfires. Wildfires, which soak up roughly $1.5 billion dollars from America's coffers, could become prolonged and intensive because of the effects of climate change. Wildfires cause destruction of life and property every year and release greenhouse gases, which further increase the temperature of the earth.

Reduction in biodiversity - Overall, it is expected that climate change will result in the extinction of many species and reduced diversity of ecosystems. It may cause changes in crop yields. Agriculture production may show positive as well as negative impact on various crops in different regions of world. Tropical and sub tropical regions will be more affected as the average temperature in these regions is high and even a 2^0C rise in temperature may be quite harmful to crops.
Human health - High temperature and humidity also help an increase in respiratory and skin diseases.

2.2.3 Facts and Figures
Earlier spring in American Ecosystem- A study observes 36 species in the central U.S. documented advances in flowering dates by an average of 7.3 days from 1936 to 1998.
Northward Shift – A study projecting responses to a doubling of atmospheric CO_2 found that tree habitats in the eastern U.S. may migrate northward more than 50 miles on average. However, the ability of trees to shift might be limited in regions where forests are only found in isolated patches.
Shifting Penguin Populations- Adélie penguin populations decreased 22% during the last 25 years in Antarctic coast, while Chinstrap penguins increased by 400%. The two species depend on different habitats for survival: Adélies inhabit the winter ice pack, whereas Chinstraps remain in close association with open water. A 7°–9°F rise in midwinter temperatures on the western Antarctic Peninsula during the past 50 years, and associated receding sea-ice pack, is reflected in their changing populations.
Coral Bleaching-Corals weakened by a variety of stresses are susceptible to "bleaching." This occurs when the microscopic algae that give corals their brilliant color die. In 1997 and 1998, a large El Niño event contributed to bleaching in tropical corals around the world. Over the next century, warming of the oceans, in combination with other stressors such as sea level rise and water pollution, could lead to an increase in bleaching events.
Therefore, this global warming seems to be a highly threatening risk to the global environment, which needs to be check to maintain the environmental sustainability.

2.2.4 Depletion of Ozone layer
The term ozone hole refers to recent depletion of this protective layer over Earth's polar regions.Ozone is an important species present in the stratosphere of the atmosphere, with maximum concentration of about 100 ppm at an altitude of 25- 30 km from the earth's surface. This layer acts as a protective shield for the life on earth, as it absorbs the harmful UV rays, which are supposed to be lethal to life and may cause DNA mutation and skin cancer.
Absence of this layer due to depletion may raise the temperature of the lower atmosphere to such an extent that the biosphere will turn into a blast furnace and may disturb the ecosystem.
Reactions involved in ozone depletion:
Ozone layer is believed to be depleted by reaction with atmospheric oxygen, reactive hydroxyl radical, nitric oxide and chlorine free radical as follows:



As long as Cl^S, HO^S, NO and atmospheric oxygen are regenerated, depletion reaction will continue

2.2.5 Sources: As such there are so many sources but the decrease in ozone concentration is mainly due to manmade compounds in the atmosphere.The most common and damaging of which the class of compounds is known as Chloroflurocarbons or CFCs (chlorofluoro carbons). Which are used as refrigerants and aerosol sprays and in plastic foams like thermocol.These molecules are inert in troposphere but in stratosphere they decompose to form Cl^S, which immediately react with ozone molecule and initiate ozone depletion.

$CFCl_3$ □ $CFCl_2$ + Cl^S

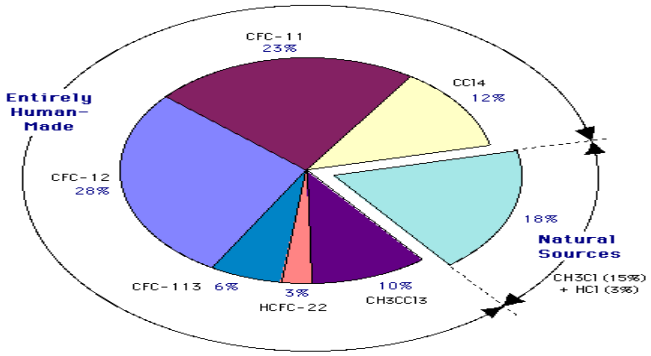


Figure 4.Primary Sources of Chlorine Entering the Stratosphere[20]

Volcanic eruptions inject Cl_2 and HCl directly into the atmosphere. Cl_2 on exposure to UV radiation forms Cl free radical while HCl reacts with OH free radical gives Cl free radical.

It is found to be more acute in Polar Regions particularly Antartica, leading to the formation of Ozone Hole. This may be either due to cold climatic conditions or absence of NO_2, which destroys ClO free radicals and checks ozone depletion. NO_2 at sub zero temperature freezes into ice droplets.

2.2.6 Consequences

Marine ecosystem - Reductions in stratospheric ozone are predicted to cause the greatest increase in the amount of UV-B(290-320 nm) radiation reaching the Earth's surface. This affects phytoplankton productivity. Marine phytoplanktons play a fundamental role both in the food chain as well as the oceanic carbon cycle by which atmospheric carbon dioxide is converted into oxygen.

Crop yield - Terrestrial plants vary considerably in their response to UV-B radiation between species and even between cultivars of the same species. Plants have several mechanisms to ameliorate or repair adverse effects from UV-B radiation, and may acclimate to a certain extent to increased UV-B radiation levels. In agriculture, reduction in stratospheric ozone will require the use of UV-B tolerant cultivars and the development of new ones. Scientific evidence indicates that there will be an adverse effect on crops, but the magnitude of these effects cannot be estimated given the current state of knowledge.

Human health - In addition to the above effects on the biosphere, increased UV-B can have direct effects on humans including increased skin cancer, cataracts, and suppression of the human immune response system.

Evaluations of impacts from increased ultraviolet radiation at a given location must consider the time of year and the latitude. Ultraviolet radiation naturally varies with time of year, latitude, and altitude. For example, four times as much ultraviolet radiation reaches the earth's surface at Philadelphia at 10 AM in the summer than in the winter. Southern latitudes receive more ultraviolet radiation than the northern latitudes.
However, it is clear that reductions in ozone levels will lead to higher levels of UVB reaching the Earth's surface. The sun's output of UVB does not change; rather, less ozone means less protection, hence more UVB reaches the Earth. In Antarctica, studies have shown that the amount of UVB measured at the surface can double during the annual ozone hole. A United Nations Environmental Program (UNEP) assessment estimates that for every 1 percent decrease in ozone, biologically damaging ultraviolet radiation will increase 1.3 percent. Another study recently confirmed the relationship between reduced ozone and increased UVB levels in Canada during the past several years.

The consequences show that discovery of the ozone depletion problem came as a great surprise and has become a great international issue. Now, action must be taken to ensure that the ozone layer is not destroyed.

2.2.7 Measures to control Global Warming & Depletion of Ozone layer

On an international scale, banning the use of CFC will slow down the destruction of ozone, which in turn can control global warming. This is being achieved through the Montreal Protocol, an international agreement to reduce the use of CFCs and eventually ban them completely and Hydrofluorocarbons (HFCs) have been recommended as a replacement of CFCs.

HFCs as alternative for CFCs

Hydrofluorocarbons (HFCs) are compounds containing carbon, hydrogen, and fluorine. Certain chemicals within this class of compounds are viewed by industry and the scientific community and accepted as an alternatives to CFCs. As HFCs contain no chlorine they do not directly affect stratospheric ozone. There are some common HFCs molecules which are being used in refrigeration [21].
For example: HFC-23 (CHF3), HFC-152a (CH3CHF2), HFC-32(CH2F2), HFC-143a (CF3CH3) and many more.

It is seen that atmospheric lifetimes of the most commonly used HFCs (HFC-134a and HFC-152a) are limited to <12 years because of their Oxidation by the hydroxyl radical. Also, a number of the HFCs, for example HFC-134a, are expected to decompose in the atmosphere and produce a long-lived chemical called trifluoroacetic acid (TFA) that is known to have adverse effects on certain biota.

Concern over these effects may make it necessary to regulate production and use of these compounds at some point in the future. Although there are a lot of substitutes for CFCs as refrigerants, scientists continue to research new substitutes, which are less expensive, less destructive for ozone layer and more practical for industry. [22].

2.3Industrialization and pollution

Pollution of the environment is one of the most serious ecological crises to which the whole world is subjected today. The three basic necessities for living organism are land, air and water. In the past these were pure, virgin, undisturbed and uncontaminated and very hospitable for living organism. But nowadays, situation is just reverse, because of progress in science and technology, which lead to pollution of environment and serious ecological imbalance.

Environmental pollution is the result of urban industrialization and speedy exploitation of natural resources. Rapid industrialization has left with us polluted rivers, contaminated soil, depleted wildlife and exhausted natural resources.Today India, which occupies 7^{th} position among the industrialized developing countries of the world has with good & large industrial infrastructure in several industries like chemicals, nuclear energy, food, petroleum, pesticides and plastics etc. As a result a number of toxic effluents and gases are spewed into the environment and becoming lethal to all organisms.

Various sources of pollutants which are affecting different spheres of the environment are categorized as follows:

2.3.1Anthropogenic sources:

Mining and Foundry activities –Which emit a variety of metals adsorbed on particulate matter that is suspended in the air due to processing of metallic raw materials (including the use of furnaces).
Transportation – It pollutes all spheres of environment like air, soil and water. It emits a series of air pollutants including oxides of carbon, sulfur, nitrogen as well as organic chemicals as PAHs and particulate matter that may end up in water bodies via deposition with precipitation water and may eventually contaminate ground water.

Construction activities and Demolition of old buildings contain a series of banned chemicals such as PCBs, PBDEs, asbestos and pollute the environment. Waste Incineration –emits various toxic gases and particulate matter into the atmosphere depending on waste composition.

Landfill disposal practices – usually generate methane due to intensification of natural microbial decaying activity in the disposal area, which may leak to groundwater or generate polluted vapors.

Agriculture practices and agriculture runoff– They pollute the environment usually through emissions of ammonia gas and the application of pesticides/herbicdes/insecticides which contain toxic volatile organic compounds. Whereas, agriculture runoff pollute the water bodies such as lakes, rivers, ponds by carrying fertilizers, pesticides/insecticides/herbicides and other pollutants.

Sewage and industrial waste: Sewage is a completely natural substance that contains about 90% water and should be broken down harmlessly in the environment. But, in practice, it contains all kinds of other substances like heavy metals, harmful chemicals, by-products, organic toxins and oils,effluents from factories, refineries etc. leading to water and soil pollutions.

Animal & Human Wastes– It contributes greatly to the biological pollution of water streams. The corporeal wastes produced by humans and farmed organisms generally pollute rivers, lakes, oceans and other surface waters.

Disposal of household chemicals – It includes mainly detergents and plastic materials which are non biodegradable and destroy the ecosystem.

Radioactive waste – Radioactive waste are generally produced by nuclear power plants and application of nuclear technology. In lower concentrations it can cause cancers and other illnesses but at higher concentrations it can be lethal.

2.3.2 Natural Sources:

Volcanic activities – They emit a series of toxic gases (including sulfur and chlorine) as well as particulate matter (ash particles) but are usually restricted to localized areas;

Winds and air currents – can mobilize pollutants from the ground and spread over large areas;

Wildfires – add to the atmosphere smoke, carbon monoxide as well as particulate matter (containing organic contaminants such as PAHs) and could affect significant areas although in general are restricted and may be contained;

Microbial decaying processes – Microorganisms are present in any environment have a major role in natural decaying processes of living organisms as well as environmental contaminants; this activity results in the natural release of gases especially methane gas;

Radioactive decay processes – For example radon gas is emitted due to natural decay of radioactive heavy metals which are dispersed throughout the earth crust has potential to accumulate in enclosed spaces such as basements.

Increase in temperatures – It contributes to an increase in the amounts of contaminants volatilizing from pollution in soil and water into air.

Natural accumulation of compounds in soil is due to imbalances between atmospheric deposition and leaching away with precipitation water (e.g., concentration and accumulation of perchlorate in soils in arid environments).

Natural production of chemicals in soil under certain environmental conditions – Natural formation of chemicals in soil such as perchlorates in the presence of a chlorine source, metallic object using the energy generated by a thunderstorm also contribute to soil pollution.

Leaks from sewer lines into subsurface – Leakage from sever lines sometimes add chlorine into soil which could generate trihalomethanes such as chloroform.

2.3.3 Consequences of pollutants

Lack of potable water and adequate sanitation.

Eutrophication- This kind of pollution is a result of excess concentration of plant nutrient in water, because of the release of sewage effluent and run-off water containing fertilizers. Eutrophication generally promotes excessive plant growth, and is likely to cause severe reductions in water quality. It causes decreased biodiversity, changes in species composition, dominance (algal boom), and toxicity effects. Eutrophication leads to hypoxia, i.e. decrease in concentration of dissolved oxygen between 1 to 25 % and causes the suffocation of fish and other aquatic organisms. [23]

In general, the biogeochemical impacts of pollutants like S and N, on ecosystems depend upon the mobility of these pollutants in the canopy and soils to which they are deposited. If the anions they form (sulfate and nitrate) are leached through the canopy and soils, rather than being retained, they can strip the valuable nutrient cations from the soil such as calcium and magnesium (Fig. 5). It results in acidification of soils and surface waters, and can be toxic to roots, and it can leach into surface waters where it is toxic to fish and other aquatic organisms.

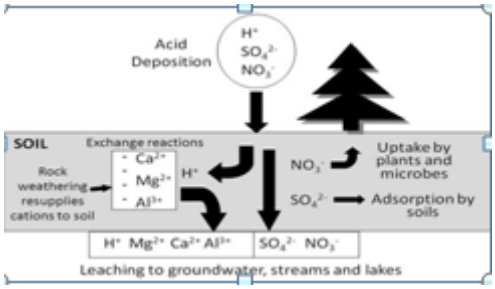


Figure 5.Schematic of key interactions of acidic deposition with soils. Biological (uptake),soil (exchange and adsorption) and geological (weathering) factors interact to determine the effects of the acidic deposition in the soil.

Accumulation of N may also lead to a condition known as N saturation, in which overabundance of these key nutrient results in a series of impacts on microbial and plant production and N cycling. In terrestrial ecosystems it can cause shifts in species composition as N-loving species outcompete those species better adapted to less fertile soils.

Heavy metals and toxins from industrial waste can accumulate in nearby lakes and rivers, and adversely affect thehealth of aquatic animals and those who eat them. And then in turn rest of the food chain. This means that entireanimal communities can be badly affected by this type of pollutant. Microbial pollutants from sewage often result in infectious diseases of aquatic life and terrestrial life through drinking water. This often increases the number of mortalities within an environment. Suspended particles can often reduce the amount of sunlight penetrating the water, disrupting the growth cycle of photosynthetic plants and microorganisms. This has subsequent effects on rest of the aquatic community that depends on these organisms to survive.
Air pollutants such as Carbon dioxide, ozone, nitrogen oxides, and sulfur dioxide also have harmful effects on natural ecosystems (Fig.6).

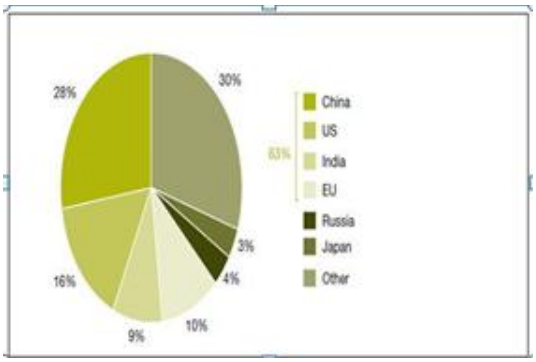


Figure 6. Cumulative Global CO_2 Budget for 2000 – 2050 [24]

Studies and data as depicted in Fig.8,show the continuous increase in level of CO_2 since year 1999 to 2012, except in year 2001, where there is no increase and in 2009, there is a dip.

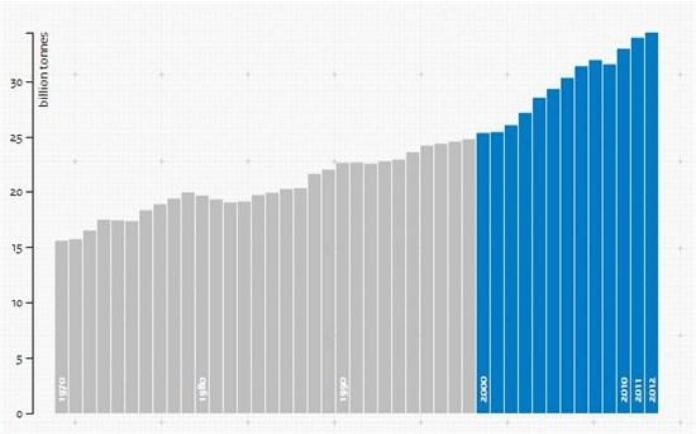


Figure 7. Shows CO_2 emissions (in Billion Tons) from year 1970 to 2012 [25]

Recent data show that the Global emissions of carbon dioxide (CO_2) have reached a historical maximum of 30.6 billion metric tons in 2010. The global levels of carbon dioxide emissions from fossil-fuel combustion reached a record highof 31.6 Giga tones (Gt) in 2011 as shown in Fig: 8.

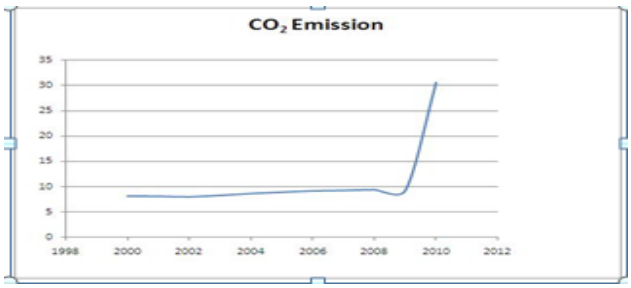


Figure 8. Global CO_2 emissions set record in 2011 – IEA

Pesticides used in an effort to control undesirable vegetation or insects can also damage crops and poison birds, animals, and fish. Most pesticides kill or damage life forms other than those intended.
Acid rain kills trees and vegetation that provides food and shelter. It can seriously disrupt the balance of nature, and, in extreme cases, can cause human fatalities.

Health consequences from exposure to pollution greatly depend on pollutant type, pathway of attack and vulnerability of the exposed population. Chronic exposure to chromium, lead and other metals, petroleum, solvents, and many pesticide and herbicide formulations can either be carcinogenic, or cause congenital disorders, or even cause other chronic health problems.

2.3.4 Facts and Figures

About 20% of the world's population lacks access to safe drinking water, and about 50% lacks adequate sanitation. In many developing countries, rivers downstream of large cities are little cleaner than open sewers. A study of 15 Japanese cities, for example, showed that 30 percent of all groundwater supplies are contaminated by chlorinated solvents from industry; in some cases, the solvents from spills traveled as far as 10 km from the source of pollution.[26]

Asian rivers are the most polluted in the world. They have three times as many bacteria from human waste as the global average, and 20 times more lead than rivers in industrialized countries.[27]
The river King is Australia's most polluted river, with a severe acidic condition related to mining operations. 100, 000 marine mammals, 1 million sea birds and other aquatic lives are killed due to plastic waste in water and coastal area.[28]

Pollution of freshwater (drinking water) is a problem for about half of the world's population. Each year there are about 250 million cases of water-related diseases, with roughly 5 to 10 million deaths.
Vehicle exhaust contributes roughly 60% of all carbon monoxide emissions nationwide, and up to 95% in cities.

Above facts and figures show the severe effects of pollution on environment in various aspects, which are required to control in order to maintain environmental sustainability.

2.3.5 Measure to Control Pollution

2.3.5.1 ForWaterconservation: Apart from general methods of water conservation there are some different, nontraditional and technical strategies of water management.

Meter/Measure/Manage:The process of metering, measuring, and managing laboratory facilities is essential for effective water management. Metering and measuring help in analyzing a facility's water usage and proper management of mechanical equipment results in greater water efficiency. [29]

Optimize Cooling Tower: Cooling towers that provide a vital source of cooling are also large consumers of water. Cooling tower operations can be optimized by carefully controlling the ratio of the quantity of water evaporated to the quantity of water discharged (blowdown). The quantity of water evaporated is a

function of the cooling demand. The quantity of blowdown should be controlled using an automated conductivity controller and by maintaining proper cooling tower water chemistry. The ratio of evaporation to blowdown is called the cycles of concentration. If possible, cooling towers should be operated at six or more cycles of concentration for maximum water-efficiency. In addition, metering the quantity of water put into and discharged from the cooling tower provides information that helps to better manage the efficiency of the tower. [29]

Upgrade Sanitary Fixtures (Waterless Urinals, Low-Flow Toilets, Faucet Flow Control): Prior to the 1990s, when the government established federal water-efficiency standards, most EPA facilities were outfitted with inefficient sanitary fixtures, such as toilets that used 3.5 gallons per flush (gpf). Several EPA laboratories have since received water-efficiency upgrades, including new toilets with efficient flow rates of 1.6 gpf, urinals with 1.0 gpf rates or below, and even waterless urinals in some men's bathrooms. If you have old sanitary fixtures, consider an upgrade. In addition, many lavatory faucets that flow at 2.0 gpm or more can be retrofitted with spout-end flow control devices that limit flow to 0.5 gpm. These devices provide a comfortable spray for washing and rinsing hands, and they save a significant amount of water. [29]

Upgrade Sanitary Fixtures (Waterless Urinals, Low-Flow Toilets, Faucet Flow Control)
Since April 2004, the Atlantic Ecology Division Laboratory in Narragansett, Rhode Island, has installed 11 new waterless urinals and one high efficiency urinal that flushes at 0.125 gpf. Lavatory faucets have been retrofit to flow at either 0.375 or 0.875 gpm, depending on faucet configuration. Showerheads have been replaced with ones rated at 1.25 gpm with superior results.

Eliminate Single-Pass Cooling: Single-pass cooling uses a continuous flow of water that is circulated once through the system for cooling purposes and is then disposed down the drain.E.g. In 2001, the National Vehicle and Fuel Emissions Laboratory (NVFEL) in Ann Arbor, Michigan, replaced its single-pass cooling system with an upgraded cooling plant involving a recirculated chilled water loop. This upgrade helped NVFEL reduce its water consumption by 80 percent, saving the laboratory 24.8 million gallons of water and $235,000 annually.[30]

In 2004, the Western Ecology Division Laboratory in Corvallis, Oregon, installed a closed-loop system that uses a recycled chilled glycol solution instead of water to cool air-conditioning equipment. As a result of this upgrade, the Corvallis laboratory reduced its yearly water consumption by 3.7 million gallons and saved approximately $21,000 annually. [31]

Incorporate Landscape Irrigation/Xeriscaping: Xeriscaping is a type of landscaping that conserves water by planting native, water-efficient plants rather than water-intensive ones, and utilizes techniques that minimize the need for irrigation. A laboratory can significantly reduce its total water consumption by incorporating xeriscaping techniques, which will help lower or eliminate the demand for irrigation water. Within an existing landscape, irrigation water use can be reduced by 10 to 20 percent by having an irrigation water audit performed and using a weather-based irrigation controller or soil moisture sensor to control landscape irrigation.

Control Water from Steam Sterilizers: Steam sterilizers use cooling water to temper steam condensate discharge from the sterilizer to the laboratory drain. Many older sterilizers discharge a continuous flow of tempering water to the drain, even when it is not needed. This can be prevented with improved operational controls, or by retrofitting the sterilizer with a tempering water control kit.

Reuse Culture Water: Several EPA laboratories require water for aquatic culture research. In some cases, culture water is pumped into laboratory specimen tanks from local bodies of water, such as lakes or bays, but then might be discharged into the sewer after use.The Mid-Continent Ecology Division Laboratory in Duluth, Minnesota, uses approximately 35 to 40 gallons per minute of Lake Superior water for its wet laboratory. The lab installed an aquatic culture water filtration system that diverts this water back into the lake instead of the sewer system.

Control Reverse Osmosis System Operation: Up to 10 percent of a laboratory's water consumption can be related to the multi-step process of generating deionized (DI) water through reverse osmosis (RO). Water savings can be achieved by carefully regulating DI generation rates to meet laboratory demand. Avoid producing excess DI water that overflows to drains.

Recover Rooftop Rainwater: Rooftop recovery systems capture rainwater from the roof and redirect it to a storage tank. This cache of water can then be used for various purposes throughout the facility, such as flushing toilets, supplying cooling towers, and irrigating the landscape.

Recover Air Handler Condensate: The normal operation of air conditioning equipment in warm, humid climates produces condensate water from the cooling coils. Rather than draining this water into the sewer system, some EPA laboratories are capturing this water for use in cooling towers and other various applications.

2.3.5.2 Green Chemistry: A revolutionary approach to control pollution

In efforts to move towards, sustainable development, green chemistry provides "green" path for different synthetic routes using nonhazardous solvents and eco-friendly chemicals."Green chemistry is the designing, development and implementation of process and chemical products in such a manner that can reduce the use and generation of substances hazardous to the environment and to maximize the use of safe and environment benign substances."

An evaluation of how green a chemical reaction or a chemical process is seems to be best done in terms of the following twelve principles formulated by Paul Anastas of U.S. Environmental Protection Agency in 1991.

i) Prevention: Prevent waste than to treat or clean up.
ii) Less hazardous chemical synthesis: Synthetic methods should be designed to use and generate substances that possess little orno toxicity.
iii) Designing Bafer chemicals: Chemical products should be designed to affect their desired function while minimizingtheir toxicity.
iv) Atom economy: Synthetic methods should be designed to minimize the incorporation of all materials used in theprocess into the final product.
v) Safer solvents and auxiliaries: The use of auxiliary substances should be minimized.
vi) Design for energy efficiency: Energy requirements of chemical processes should be recognized for their environmental andeconomic impacts and should be minimized
vii) Use renewable feed stocks: raw material or feed stock should be renewable rather than depleting.
viii) Reduce derivatives: Unnecessary derivatization should be minimized because such steps require additional reagents and can generate waste.
ix) Catalysis: Using catalytic reagents creates opportunities for increased selectivity, better yield, and feasibility of nonfeasible reaction.
x) Design for degradation: chemical products should be designed so that at the end of the function they breakdown into innocuous degradation products and do not persist in the environment
xi) Real-time analysis for pollution prevention: Analytical methodologies need to be further developed to allow forreal-time, in process monitoring and control prior to the formation of hazardous substances.
xii) Inherently safer chemistry for accident prevention: Substances and the form of a substance used in chemical process should be chosen to minimize the potential for chemical accidents including releases, explosions and fires.

The main advantages considering Green Chemistry are as follows:
Solvent free organic reactions, use of renewable feed stock: e.g. Production of biodiesel,waste minimization and management, Shortening of analysis time (from 16 hours to 10 minutes), savings of energy, decreasing exposure to solvents due to shortening of extraction time and to smaller amounts of applied solvents.Similar analytical characteristics for smaller sample.

2.4 Loss of biodiversity

The Global Convention on Biological Diversity, signed in 1992 at the Earth Summit, describes biodiversity as the "variability among all living organisms from all sources, including terrestrial, marine and other aquatic ecosystems and ecological complexes of which they are part, this includes diversity within species, between species and of ecosystems."
In current scenario, the number of species have become endangered by human activities and the number of natural or seminatural habitats being destroyed or fragmented, thus destabilizing the entire ecosystems, causing the loss of vital resources together with genetic and cultural impoverishment. There are four major reasons for the persistent loss of biodiversity:

2.4.1 Habitat loss- Habitat destruction has played a key role in extinctions, especially related to tropical forest destruction[32]. Factors contributing to habitat loss are: overpopulation, deforestation,[32] pollution (air pollution, water pollution, soil contamination) and global warming or climate change.

2.4.2 Invasive alien species – Although Natural Barriers such as large rivers, seas, oceans, mountains and deserts encourage diversity by enabling independent evolution on either side of the barrier, yet when these barriers are blurred, Invasive species occur and occupy new niches, substantially reducing diversity. Not all introduced species are invasive, nor all invasive species deliberately introduced.

2.4.3Facts and Figures

Invasive plants (weeds) affect biodiversity in many ways: they may outcompete native plants; they may reduce or alter the resources available to native animals.

For example - In 2007, more than 2800 of the 27 000 alien plant species that had been imported into Australia had become established in the wild, and that number was growing at around 10 species per year[33].The number is now much higher. As part of the National Land & Water Resources Audit phase II, the jurisdictions mapped 98 major weeds nationally. [34]. Of these 98 species, 20 are Weeds of National Significance (WoNS). The remaining 78 are either candidate WoNS, on the national environmental alert list, targets for biocontrol (control of an invasive species by other species, usually by the managed introduction of predators or pathogens), or a combination of these three categories.

The chytrid fungus [35] has been responsible for mass deaths of frogs worldwide and is widespread in Australia. A significant association between amphibian declines in upland rainforests of northern Queensland and three consecutive years of warm weather [36] suggests future warming could increase the vulnerability of frogs to the fungus.

The most significant invasive vertebrate animal species are the European fox (Vulpesvulpes), domestic cat (Feliscatus), European rabbit (Oryctolaguscuniculus), feral goat (Capri hircus), feral pig (Susscrofa) and cane toad (Bufomarinus). Significant invertebrate invasive species include the red fire ant (Solenopsisinvicta), the yellow crazy ant (Anoplolepisgracilipes) and a range of tramp ant species [37]. European wasps, bumble bees and European honey bees are also widely cited species of concern.

Many marine pests are introduced to Australian waters in ballast water discharged by commercial shipping, biofouling on hulls, aquaculture operations and aquarium imports, as well as marine debris and ocean currents.

2.4.4Genetic Pollution and hybridization: In agriculture and animal husbandry, the Green Revolution popularized the use of conventional hybridization to increase yield. Often hybridized breeds originated in developed countries and were further hybridized with local varieties in the developing world to create high yield strains resistant to local climate and diseases. Local governments and industry have been pushing hybridization. Formerly huge gene pools of various wild and indigenous breeds have collapsed causing widespread genetic erosion and genetic pollution. This has resulted in loss of genetic diversity and biodiversity as a whole.

The introduction of non-native species, hybrids and provenances into the range of a potentially interbreeding species may have a direct effect on the gene pool through genetic pollution as well as have indirect effects through impacts on other components of biodiversity.

Endemic species can be threatened with extinction [38] through the process of genetic pollution, i.e. uncontrolled hybridization, introgression and genetic swamping. Genetic pollution leads to homogenization or replacement of local genomes as a result of either a numerical and/or fitness advantage of an introduced species. [39]. Hybridization and introgression are side-effects of introduction and invasion. Some degree of gene flow is normal adaptation, and not all gene and genotype constellations can be preserved. However, hybridization with or without introgression may, nevertheless, threaten a rare species' existence.
Other examples include the succulent perennial *Carpobrotusedulis* which was introduced to California from South Africa for dune stabilization and has now extensively hybridized with a presumed native species *C. chilensis*. The Belgium riverbank species complex of the genus Scirpus(a fish) is also reported to be threatened from introgression from an introduced species. [40].

For example, fishes introduced into natural rivers and lakes accidentally, or for commercial and recreational fishing, have been reported to have caused genetic pollution by hybridization with native strains.Otherwell known examples involving species introductions include extensive hybridization of introduced mallard and ruddy ducks with endemic duck species (Anas spp.) in many countries (e.g. New Zealand, Hawaii, Australia, south Florida, eastern USA), feral house cats hybridizing with wild cat (Felis spp.) species and domestic dogs hybridising with wolves and jackals (*Canis spp.).*

2.4.5Over exploitation of natural resources – It occurs when a resource is consumed at an unsustainable rate.

This occurs on land in the form of overhunting, shifting cultivation, deforestation, commercialization, excessive logging, poor soil conservation in agriculture and the illegal wildlife trade. Joe Walston, director of the Wildlife Conservation Society's Asian programs, called the latter the "single largest threat" to biodiversity in Asia [41].international trade of endangered species in fact is second in size only to drug trafficking.

A substantial portion of the global illegal wildlife trade — possibly the largest in the world — takes place in Asia, where demand is driven by the need for specific animal parts to practice traditional Asian medicine, for human consumption, and as symbols of wealth. Demand for illegal wildlife is reportedly increasing in Southeast Asia due in part to the region's economic boom and resulting affluence. Southeast Asia is also a key supplier of wildlife products to the world.

China is the world's largest importer of wildlife products, including an insatiable demand for turtles, ivory, tigers, pangolins, and many other species used for food or medicine. India and Nepal feature as source and transit for the trade in body parts of tigers, rhinos, leopards, snow leopards, otters and musk deer for usages in traditional Chinese medicine, and for decorative use by the neo rich. Traders use land-routes via Sikkim, Ladakh and Tibet as borders are porous and customs lax [42] Skins and body parts of 783 tigers, 2766 leopards, and 777 otters were seized between 1994 to August 2006 in India alone, probably representing a tiny fraction of the actual trade bound for Tibet and China [43]. Among the many seizures of live and dead pangolins in Southeast Asian countries, these were the largest ready for export to China: in spring 2008, two shipments containing about 23 t of dead pangolins and scales were discovered in Vietnam originating in Indonesia; in July 2008, some 14 t of frozen Malayan pangolins and about 50 kg of scales were seized in Sumatra.

2.4.6 Nutrient Loading

Increased nutrient (nitrogen andphosphorus) loading [44]to the Coastal Bays leads to degraded water quality and ecosystem health. Nutrient inputs to the Coastal Bays are dominated by non-point sources (e.g., surface runoff, groundwater, atmospheric deposition and shoreline erosion). The amount of nutrients coming from an area is largely dependent on the predominant land use agriculture and developed land versus wetlands and forests. The most important nutrients affecting aquatic plant growth are nitrogen and phosphorus. Plant and animal matter (including animal and human waste), fertilizer, and even car and power plant exhaust, all contain nutrients. When these nutrient sources are not controlled, excess nutrients find their way into the groundwater, creeks, rivers and, eventually, the open bays. Nutrients can have detrimental effects on these tributary systems as well.

On the basis of facts and figures about loss of biodiversity, it is concluded that protection of nature is the utmost need of today's world.

2.4.7 Measures for biodiversity conservation: In today's world to save our life supporting systems, there is the utmost urgency of biodiversity conservation. In fact the maintenance of species and ecosystem is keystones to biodiversity conservation.There are mainly two basic approaches to conserve regional flora and fauna. Fig.10Keeping in view the loss of biodiversity, various attempts have been made on national and International levels.

National Biodiversity Strategy and Action plan(NBSAP): This plan had been prepared by the Ministry of Environment and Forest through consultative process in the year 1999. This plan envisages the assessment and stock taking of biodiversity related information at various levels, including distribution of endemic and endangered species and site specific threats and pressures.

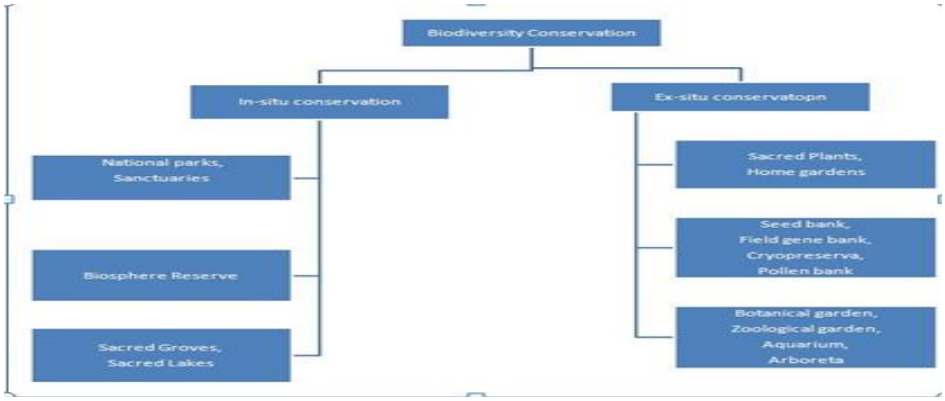


Figure 9. Methods of Biodiversity Conservation

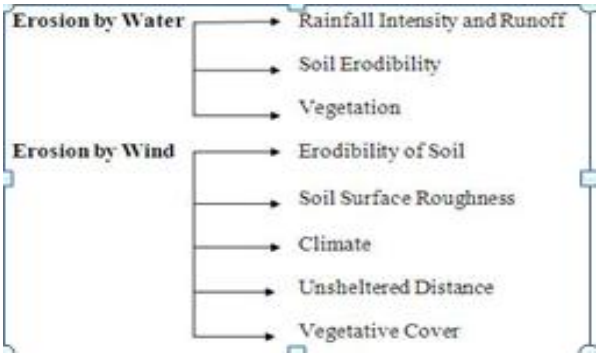
1992 "Habitats Directive" - listing 700 (by now 800) animal and plant species and 200 habitat types of EU importance. They are to be protected in "Special Areas of Conservation" (SAC), which Member States select together with the European Commission. The Habitats Directive also initiates the establishment of the Natura 2000 network, which is made up of SPAs and SACs.

1992 LIFE-Nature programme was launched to co-finance projects aimed at conserving the natural environment and supporting the implementation of the Birds and Habitats Directives.
1992 Convention of Biodiversity was adopted during the Earth Summit in Rio de Janeiro. The European Community is a signatory. The Convention's three main goals are: 1. The conservation of biodiversity, 2. The sustainable use of its components, and 3. The fair and equitable sharing of the benefits arising from the commercial and other utilization of genetic resources.
1998 EU Biodiversity Strategy – Sought to anticipate, prevent and fight the causes of biodiversity loss at source.
2000 EU Water Framework Directive - Aimed to protect the aquatic environment and ensure good quality of all water resources in the EU by 2015, based on sustainable cross-border water management.
2001 Four Biodiversity Action Plans - Set out the details for implementation of the Biodiversity Strategy and tackling conservation issues in the areas of agriculture, fisheries, natural resource use and economic and development co-operation. The objective is to ensure that policies in these sectors do not undermine conservation efforts.
2001 EU Sustainable Development Strategy launched by EU leaders meeting in Gothenburg - one of its four priorities was to halt biodiversity loss in the EU by 2010.
2002 Reform of the Common Fisheries Policies was to achieve sustainability of fish stocks, protect the marine environment and secure the future of the European fisheries sector.
2002 Strong EU participation in the World Summit on Sustainable Development ensured a number of concrete targets and timetables, including the goal to significantly reduce global biodiversity loss by 2010.
2003 Kiev Resolution on Biodiversity - at a meeting of pan-European Environment Ministers in Kiev, Ukraine, the EU committed to halting the loss of biodiversity in the pan-European region by 2010 by taking nine specific actions.
2003 Mid-term review of the Common Agricultural Policies cuts the link between subsidies and production levels and makes greater provisions for support to rural development and agri-environment schemes.
2003 In line with the provisions of the Biodiversity Convention on access to genetic resources and benefit sharing, the European Commission urges EU companies and research institutes not to take genetic resources from other countries without their consent and without offering them a fair share of the profits and research results arising from the use of their resources.
Nutrient budgets- It is a tool managers use to organize diverse nutrient data sets. The essential parts of simple budget include inputs (point, diffuse, atmospheric) and exports (denitrification, burial in sediment, oceanic exchange, fisheries harvest). Additional elements that should be included are nitrogen storages in the sediments, eroding marshes (a form of inputs) and nitrogen fixation (another potential input).[45]

2.5. Soil erosion
Soil erosion is one form of soil degradation along with soil compaction, low organic matter, loss of soil structure, poor internal drainage, salinisation, and soil acidity problems. These other forms of soil degradation, serious in themselves, usually contribute to accelerated soil erosion.Soil erosion is a naturally occurring process on all lands. The agents of soil erosion are water and wind, each contributing a significant amount of soil loss

each year in Ontario(a province of Canada). An intense form of erosion can make the land completely unproductive and devoid of natural vegetation.

2.5.1 Factors Responsible for soil erosion:



2.5.2 Consequences of Soil Erosion

Soil erosion leads to development of new topological changes due to deposition of soil particles.

The vegetation of the region is affected as a result of soil erosion. When soil gets weathered then the productivity and fertility of the land decrease. As land loses fertility, it reduces income of farmers.

Moisture content and mineral holding capacity of the soil are greatly reduced. Thus, the land becomes devoid of every kind of agricultural activity.

Since it is a gradual process, there is a marked reduction in the weight of the earth's mantle and surface layers after a certain period. This subsequently leads to tectonic shift in the earth's crust.

Barren lands and absence of rainfall due to severe erosion causes drought.

Excessive soil degradation will make people starve because of poor soil fertility. They will have no choice, but to migrate to another place.

The eroded top soil forms excessive amounts of sediments in rivers, causing rivers to overflow their banks. Moreover, flooding becomes more frequent. Lastly, it damages fish breeding areas.

Soil erosion decreases the moisture supply by soil to the plants for their growth. It also affects the activity of soil micro-organisms. Thus deteriorating the crop yeild.Soil erosion by wind cause sandy storms, which damage the crops. Further these sandy storms reduces the rainfall in particular area.

Therefore, in order to sustain and to increase agricultural growth and in turn to have sustainable environment suitable and appropriate approaches for soil conservation are required.

2.5.3 Measures for soil conservation and sustainable agricultural techniques

Soil conservation is one of the major concerns for today, as land is gradually eroding with time, which in turn is affecting agriculture.It refers to retain excessive vegetation on soil, which protect the soil from being washed or blown away by the force of wind and water, thus help in preserving physical and hydro – graphic balance of nature.

Here are some simple measures we can take to reduce soil erosion.

Plantation: It is a traditional method to prevent the soil from drying up and getting blown or washed away and keep the soil in place.

Soil Enrichment: This is an important step to prevent soil erosion. Use of fertilizers, manure or compost regularly make the soil rich in organic matter and binds soil particles together and helps in soil erosion.

Plant Wind Breakers: In areas prone to gusty winds, plant wind breakers in the form of trees, hedges and bushes or even put up a wooden/plastic fence.

Contour Farming: This method is very useful in preventing soil erosion by slowing down the flow of water down the slopes. It is done by following the natural contours of the land while planting.

Matting: One of the commonly used products in soil conservation is 'matting'. Readymade matting made of wood fiber is commonly used in household vegetable gardens and vacant plots. The matting which is placed on top of the soil prevents soil erosion while at the same time it allows plants and trees to grow through it.

Use of Retaining Walls: Very useful in areas where rains are heavy and water erosion affects the soil, one can prevent it by constructing small retaining walls around vegetable plots. One can use bricks and mortar or even pack in heaped soil in rows.

Use of Mulch/Fertilizer: Another useful method is applying a layer of mulch and fertilizer over the soil. This prevents the rain from beating down hard directly on the soil at the same time water slowly soaks through the soil and enriches it. The mulch and fertilizer layer helps the soil to regain its pH levels.

Avoid Excess Watering: While it is important to keep the soil moist which at times may be difficult, like in

summers, avoid over-watering as this washes away the top soil and degrades the land.
Salinity Management: Excessive collection of salts in the soil has harmful effects on the metabolism of plants. Salinity can lead to death of the vegetation and thus cause soil erosion, which is why salinity management is important.
Terracing: Terracing is one of the best soil conservation methods in hills, where cultivation is done on a terrace leveled section of land. In terracing, farming is done on a typical step like structure and the water runoff is slowed.
Bordering with Indigenous Crops: It is preferable to native plants, but when native plants are not planted then bordering with indigenous crops is necessary. This helps to prevent soil erosion, and this measure is opted much & effectively in poor rural areas.
No-tilling Farming: The process of soil being plowed for farming is called tilling, wherein the fertilizers are mixed and the rows for plantation are created. However, this method leads to death of beneficial soil organisms, loss of organic matter and compaction of soil. Due to these side effects, the no-tilling strategy is now recommended used to conserve soil health.
Soil Steaming: Soilsteaming can be used as an ecological alternative to chemicals for soil sterilization. Different methods are available to pump steam into the soil in order to kill pests and increase soil health.
For example steaming seems to significantly increase the growth of vine shoots. The region, where soil is both highly contaminated with diseases (such as fungus, bacteria, nematodes) and highly affected by soil fatigue, steaming could be developed to a profitable sanitation method for vine nurseries.
Inga alley cropping: Alley (a legume tree) cropping is the growing of crops between rows of trees. Inga alley cropping consists of growing crops between rows of Inga trees. This has been found to increase yields. It is sustainable as it enables the same plot to be cultivated over and over, thus eliminating the need for the continual burning of the rainforest to get new fertile plots (slash and burn or shifting cultivation). Rainforest Saver issupporting Inga projects in Honduras and Cameroon.

2.6 Poverty

Poverty is termed as deprivation, or a lack of access to food, shelter and safe drinking water. It is the state or condition of having little or no money, goods, or means of support.

It is said to be both cause and effect of environment degradation. Poorer people, who cannot meet their subsistence needs through purchase, are forced to use common property resources such as forests for food and fuel, pastures for fodder, and ponds and rivers for water. It also contributes to environmental degradation through over exploitation of natural resources like land, air and water. Population pressure driven over exploitation of the surface and underground water resources by the poor has resulted into contaminations and exhaustion of the water resources.

The poverty and rapid population growth are found to coexist and thus seems to reinforcing each other. Poverty also affects the demographic characteristics of the population and hinders the transition to slower population growth.

2.7 Role of IT in environment management

Global Information System (GIS) is a technique of superimposing various thematic maps using digital data on a large number of inter-related or inter-dependent aspects. It has proved to be a very effective tool in environmental management.Some of the areas in which IT is playing a vital role in environmental management include:
Biodiversity conservation: GIS and remote sensing can help in determining the rates, causes and scale of biodiversity loss.
Species Monitoring: GIS cannot only help in detecting the existing flora and fauna but even in counting of animals like elephant, tigers, etc.
Water Resources: Remote sensing data proved effective in inventorying, monitoring and managing both surface and ground water resources to help the water use efficiently.
Soil Resources: Satellites data provides valuable information on physiography, which helps map the special distribution of soil units with limited field work. These maps predict degree of salinity etc.
Value education as a tool for sustainability: At last, apart from various approaches to maintain environmental sustainability, the most important and effective approach is Value based Environmental Education. The Principles of ecology and fundamentals of environment can really help in creating a sense of Earth – Citizenship and sense of duty to care for the nature and its resources.

III. CONCLUSION

On the basis of all challenges and approaches for the environment it is concluded that Sustainable development can be best realized by 'A Common Future' or 'Global Sharing' concept [46-50]. This lays

emphasis on the link between economic and environmental development. It is recognized that it is not possible to de-link environment from economic development, inequity in the global economy, and abuses due to human rights. Further, structural inequalities in the global.

Economic system is also responsible for the hindrance in realizing the issue of sustainable development in totality. To make the process of sustainable environment development feasible and operational, it is important to establish a common focus that can integrate the outlook and efforts of various participants in development worldwide, realizing the diversity, in terms of geography, society, economics, level of science and technology (S&T) capabilities and capacities, education standards/levels. It can thus be easily appreciated that the issues to be addressed for attaining sustainable development cannot be generalized. Some or rather most of the issues, need to be first addressed on the regional basis. Once this is done, the regional issues, concerns, solutions can be clubbed together and discussed on a global perspective, to take care of the world requirements and concerns.

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