BLOCK -6
SOCIAL ISSUES AND THE ENVIRONMENT

CHAPTER-1

CONCEPT OF SUSTAINABLE DEVELOPMENT, URBANISATION PROBLEMS, WATER CONSERVATION, ENVIRONMENTAL POLICIES

Sustainable development

Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts:

- the concept of 'needs', in particular the essential needs of the world's poor, to which overriding priority should be given; and
- the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs.

Thus the goals of economic and social development must be defined in terms of sustainability in all countries - developed or developing, market-oriented or centrally planned. Interpretations will vary, but must share certain general features and must flow from a consensus on the basic concept of sustainable development and on a broad strategic framework for achieving it.

Development involves a progressive transformation of economy and society. A development path that is sustainable in a physical sense could theoretically be pursued even in a rigid social and political setting. But physical sustainability cannot be secured unless development policies pay attention to such considerations as changes in access to resources and in the distribution of costs and benefits. Even the narrow notion of physical sustainability implies a concern for social equity between generations, a concern that must logically be extended to equity within each generation.

Concept of sustainable development

The satisfaction of human needs and aspirations is the major objective of development. The essential needs of vast numbers of people in developing countries for food, clothing, shelter, jobs - are not being met, and beyond their basic needs these people have legitimate aspirations for an improved quality of life. A world in which poverty and inequity are endemic will always be prone to ecological and other crises. Sustainable development requires meeting the basic needs of all and extending to all the opportunity to satisfy their aspirations for a better life.

Living standards that go beyond the basic minimum are sustainable only if consumption

standards everywhere have regard for long-term sustainability. Yet many of us live beyond the world's ecological means, for instance in our patterns of energy use. Perceived needs are socially and culturally determined, and sustainable development requires the promotion of values that encourage consumption standards that are within the bounds of the ecological possible and to which all can reasonably aspire.

Meeting essential needs depends in part on achieving full growth potential, and sustainable development clearly requires economic growth in places where such needs are not being met. Elsewhere, it can be consistent with economic growth, provided the content of growth reflects the broad principles of sustainability and non-exploitation of others. But growth by itself is not enough. High levels of productive activity and widespread poverty can coexist, and can endanger the environment. Hence sustainable development requires that societies meet human needs both by increasing productive potential and by ensuring equitable opportunities for all.

An expansion in numbers can increase the pressure on resources and slow the rise in living standards in areas where deprivation is widespread. Though the issue is not merely one of population size but of the distribution of resources, sustainable development can only be pursued if demographic developments are in harmony with the changing productive potential of the ecosystem.

A society may in many ways compromise its ability to meet the essential needs of its people in the future - by overexploiting resources, for example. The direction of technological developments may solve some immediate problems but lead to even greater ones. Large sections of the population may be marginalized by ill-considered development.

Growth has no set limits in terms of population or resource use beyond which lies ecological disaster. Different limits hold for the use of energy, materials, water, and land. Many of these will manifest themselves in the form of rising costs and diminishing returns, rather than in the form of any sudden loss of a resource base. The accumulation of knowledge and the development of technology can enhance the carrying capacity of the resource base. But ultimate limits there are, and sustainability requires that long before these are reached, the world must ensure equitable access to the constrained resource and reorient technological efforts to relieve the presume.

As for non-renewable resources, like fossil fuels and minerals, their use reduces the stock available for future generations. But this does not mean that such resources should not be used. In general the rate of depletion should take into account the criticality of that resource, the availability of technologies tor minimizing depletion, and the likelihood of substitutes being available. Thus land should not be degraded beyond reasonable recovery. With minerals and fossil fuels, the rate of depletion and the emphasis on recycling and economy of use should be calibrated to ensure that the resource does not run out before acceptable substitutes are available. Sustainable development requires that the rate of depletion of non-renewable resources should foreclose as few future options as possible.

Development tends to simplify ecosystems and to reduce their diversity of species. And species, once extinct, are not renewable. The loss of plant and animal species can greatly limit the options of future generations; so sustainable development requires the conservation of plant and animal species.

So-called free goods like air and water are also resources. The raw materials and energy of production processes are only partly converted to useful products. The rest comes out as wastes. Sustainable development requires that the adverse impacts on the quality of air, water, and other natural elements are minimized so as to sustain the ecosystem's overall integrity.

In essence, sustainable development is a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development; and institutional change are all in harmony and enhance both current and future potential to meet human needs and aspirations.

Urbanisation

Urbanization is the process by which large numbers of people become permanently concentrated in relatively small areas, forming cities. Internal rural to urban migration means that people move from rural areas to urban areas. In this process the number of people living in cities increases compared with the number of people living in rural areas. Natural increase of urbanization can occur if the natural population growth in the cities is higher than in the rural areas. This scenario, however, rarely occurs. A country is considered to urbanized when over 50 per cent of its population live in the urban areas .

An urban area is spatial concentration of people who are working in non-agricultural activities. The essential characteristic here is that urban means non-agricultural. Urban can also be defined as a fairly complex concept. Criteria used to define urban can include population size,

space, density, and economic organization. Usually, however, urban is simply defined by some base line size, like 20 000 people. Anyway this definition varies between regions and cities.

Causes of urbanisation

Urbanization usually occurs when people move from villages to cities to settle, in hope of a higher standard of living. This usually takes place in developing countries. In rural areas, people become victims of unpredictable weather conditions such as drought and floods, which can adversely affect their livelihood. Consequently many farmers move to cities in search of a better life. This can be seen in Karnataka as well where farmers from Raichur, Gulbarga districts which are drought stricken areas, migrate to Bangalore to escape poverty. Cities in contrast, offer opportunities of high living and are known to be places where wealth and money are centralized. Most industries and educational institutions are located in cities whereas there are limited opportunities within rural areas. This further contributes to migration to cities.

Adverse effects of Urbanization

There is increasing competition for facilities due to the high standard of living in urban areas, which has triggered several negative effects. Many people including farmers who move to cities in search of a better life end up as casual laborers as they lack adequate education. This leads to one of the worst problems of urbanization - the growth of slums.

Slums

They are urban areas that are heavily populated with substandard housing and very poor living conditions. As a result several problems arise.

- Land insecurity- Slums are usually located on land, which are not owned by the slum dwellers. They can be evicted at any time by the landowners.
- Poor living conditions- Crowding and lack of sanitation are main problems. This contributes to outbreak of diseases. Utilities such as water, electricity and sewage disposal are also scarce.
- Unemployment- Since the number of people competing for jobs is more than jobs available, unemployment is an inevitable problem.
- Crime- Slum conditions make maintenance of law and order difficult. Patrolling of slums is not a priority of law enforcing officers. Unemployment and poverty force people into anti-social activities. Slums become a breeding ground for criminal activities.

Environmental impacts of urbanization

- Temperature- Due to factors such as paving over formerly vegetated land, increasing number of residences and high-rise apartments and industries, temperature increases drastically.

- Air pollution- Factories and automobiles are symbols of urbanization. Due to harmful emissions of gases and smoke from factories and vehicles, air pollution occurs. Current research shows high amount of suspended particulate matter in air, particularly in cities, which contributes to allergies and respiratory problems thereby becoming a huge health hazard.

- Water issues- When urbanization takes place, water cycle changes as cities have more precipitation than surrounding areas. Dueto dumping of sewage from factories in water bodies, water pollution occur which can lead to outbreaks of epidemics.

- Destruction of Habitats- To make an area urbanized, a lot of forested areas are destroyed. Usually these areas would have been habitats to many birds and animals.

Benefits of urbanization

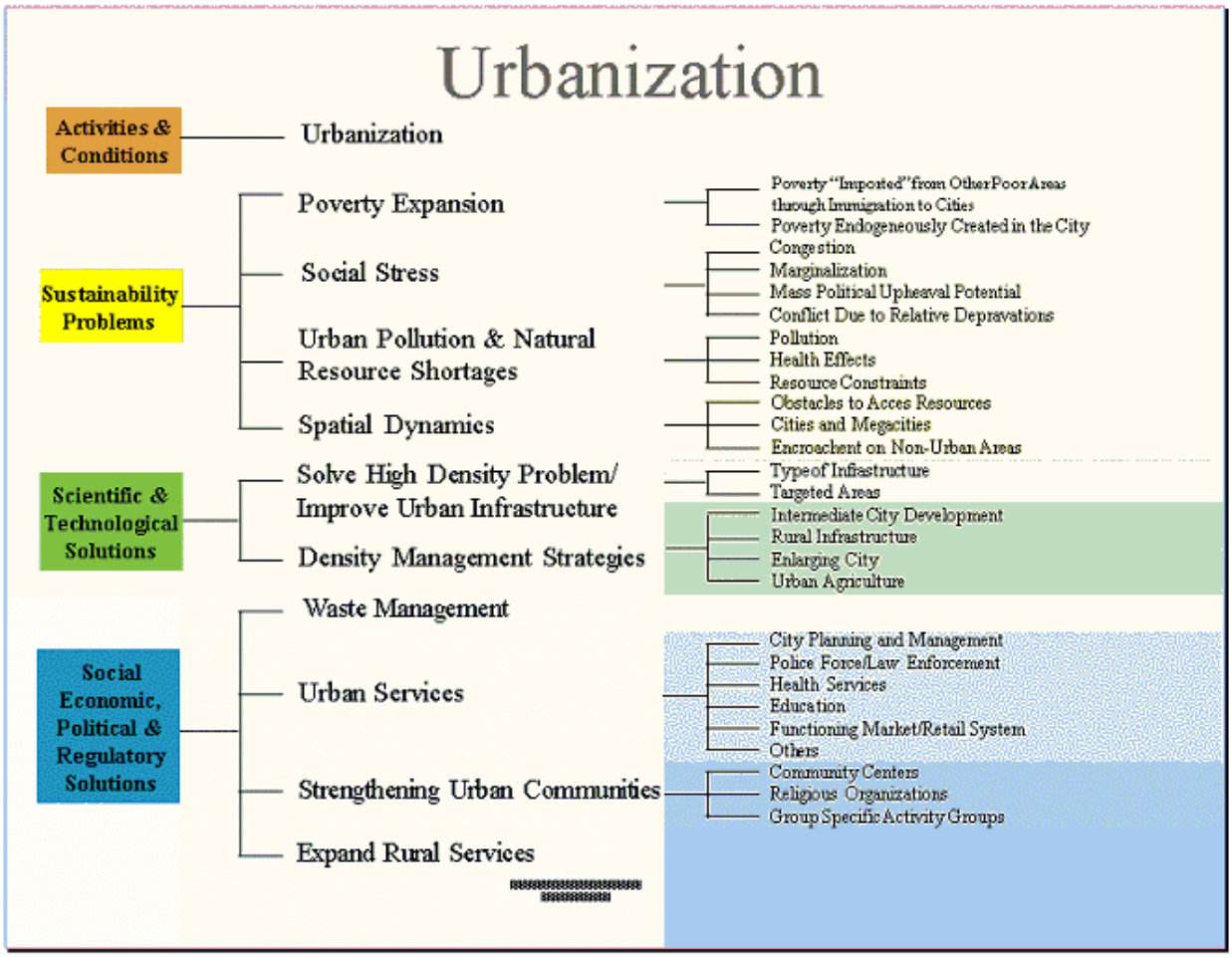
Though urbanization has drawbacks, it has its benefits

- Efficiency
- Convenience
- Concentration of resources
- Educational facilities
- Social integration
- Improvements in economy

Urbanization is set to stay for a long time. It mayslow but surely does not show any signs of stopping. In 1985, 45% of the world population stayed in cities. Scientists estimate that 60% of the

world population will be city-dwellers by 2025.

The main goal of urban planning is to make all amenities and comforts available to the public without imposing many negative effects on society and environment, aptly referred to as "Sustainable growth". The cardinal rule is to plan cities beforehand, rather than let them grow spontaneously and haphazardly. During city planning it should be ensured that adequate infrastructure is available to support the population. Residences should be conveniently located near the civic bodies. This could improve effective provision of the necessary services.



Water conservation

Our ancient religious texts and epics give a good insight into the water storage and conservation systems that prevailed in those days.

Over the years rising populations, growing industrialization, and expanding agriculture have pushed up the demand for water. Efforts have been made to collect water by building dams and reservoirs and digging wells; some countries have also tried to recycle and desalinate (remove salts)

water. Water conservation has become the need of the day. The idea of ground water recharging by harvesting rainwater is gaining importance in many cities.

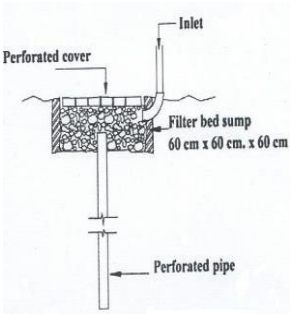
In the forests, water seeps gently into the ground as vegetation breaks the fall. This groundwater in turn feeds wells, lakes, and rivers. Protecting forests means protecting water 'catchments'. In ancient India, people believed that forests were the 'mothers' of rivers and worshipped the sources of these water bodies.

Some ancient Indian methods of water conservation

The Indus Valley Civilization, that flourished along the banks of the river Indus and other parts of western and northern India about 5,000 years ago, had one of the most sophisticated urban water supply and sewage systems in the world. The fact that the people were well acquainted with hygiene can be seen from the covered drains running beneath the streets of the ruins at both Mohenjo-Daro and Harappa. Another very good example is the well-planned city of Dholavira, on Khadir Bet, a low plateau in the Rann in Gujarat. One of the oldest water harvesting systems is found about 130 km from Pune along Naneghat in the Western Ghats. A large number of tanks were cut in the rocks to provide drinking water to tradesmen who used to travel along this ancient trade route. Each fort in the area had its own water harvesting and storage system in the form of rock-cut cisterns, ponds, tanks and wells that are still in use today. A large number of forts like Raigad had tanks that supplied water.

In ancient times, houses in parts of western Rajasthan were built so that each had a rooftop water harvesting system. Rainwater from these rooftops was directed into underground tanks. This system can be seen even today in all the forts, palaces and houses of the region.

Underground baked earthen pipes and tunnels to maintain the flow of water and to transport it to distant places, are still functional at Burhanpur in Madhya Pradesh, Golkunda and Bijapur in Karnataka, and Aurangabad in Maharashtra.



Rain water harvesting

The term rainwater harvesting is being frequently used these days, however, the concept of water harvesting is not new for India. Water harvesting techniques had been evolved and developed centuries ago.

Ground water resource gets naturally recharged through percolation. But due to indiscriminate development and rapid urbainzation, exposed surface for soil has been reduced drastically with resultant reduction in percolation of rainwater, thereby depleting ground water resource. Rainwater harvesting is the process of augmenting the natural filtration of rainwater in to the underground formation by some artificial methods. "Conscious collection and storage of rainwater to cater to demands of water, for drinking, domestic purpose & irrigation is termed as Rainwater Harvesting."

Why harvest rainwater ?

This is perhaps one of the most frequently asked question, as to why one should harvest rainwater. There are many reasons but following are some of the important ones.

- To arrest ground water decline and augment ground water table
- To beneficiate water quality in aquifers
- To conserve surface water runoff during monsoon
- To reduce soil erosion
- To inculcate a culture of water conservation

RAIN WATER HARVESTING TECHNIQUES :

There are two main techniques of rain water harvestings

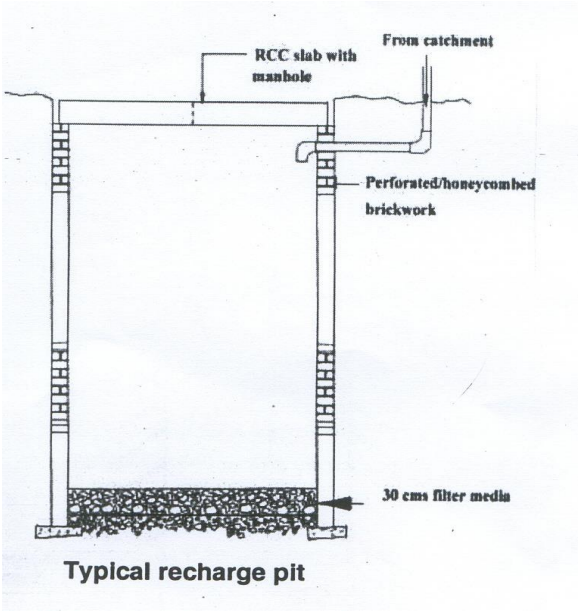
1)Storage of rainwater on surface for future use.

2)Recharging ground water.

The storage of rain water on surface is a traditional technique and structures used are underground tanks, ponds, check dams, weirs etc. Recharge to ground water is a new concept of rain water harvesting and the structures generally used are :-

Recharge Pits :- Recharge pits are small pits of any shape rectangular, square or circular, contracted with brick or stone masonry wall with weep hole at regular intervals. to of pit can be covered with perforated covers. Bottom of pit should be filled with filter media. The capacity of the pit can be designed on the basis of catchment area, rainfall intensity and recharge rate of soil.

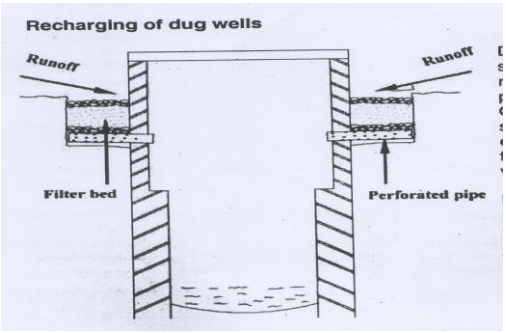
Usually the dimensions of the pit may be of 1 to 2 m width and 2 to 3 m deep depending on the depth of pervious strata. These pits are suitable for recharging of shallow aquifers, and small houses.



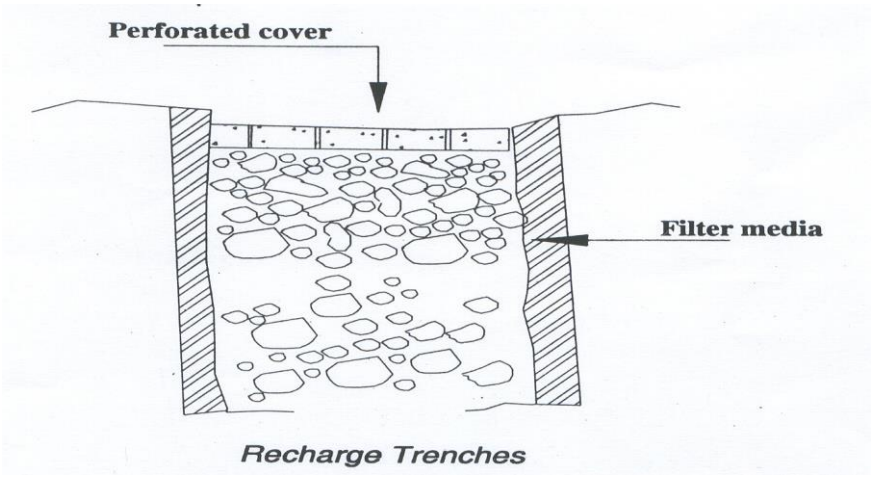
Typical recharge pit

Soak away of recharge shafts: Soak away or recharge shafts are provided where upper layer of soil is alluvial or less pervious. These are bored hole of 30 cm dia. up to 10 to 15 m deep, depending on depth of pervious layer. Bore should be lined with slotted/perforated PVC/MS pipe to prevent collapse of the vertical sides. At the top of soak away required size sump is constructed to retain runoff before the filters through soak away. Sump should be filled with filter media.

Recharging of dug wells: Dug well can be used as recharge structure. Rainwater from the rooftop is diverted to dug wells after passing it through filtration bed. Cleaning and desalting of dug well should be done regularly to enhance the recharge rate. The filtration method suggested for bore well recharging can be used.



Recharge trenches: Recharge trench is provided where upper impervious layer os soil is shallow. It is a trench excavated on the ground and refilled with porous media like pebbles, boulder or brickbats. It is usually made for harvesting the surface runoff. Bore wells can also be provided inside the trench as recharge shafts to enhance percolation. The length of the trench is decided as per the amount of runoff expected. This method is suitable for small houses , playgrounds , parks and roadside drains. The recharge trench can be of size 0.5 m wide to 1.0 to 1.5 m deep.



Recharge Trenches

Percolation tanks: Percolation tanks are artificially created surface water bodies, submerging a land area with adequate permeability to facilitate sufficient percolation to recharge the ground water. These can be built in big campuses where land is available and topography is suitable.

Surface run-off and roof top water can be diverted to this tank. Water accumulating in the tank percolates in the solid to augment the ground water. The stored water can be used directly for gardening and raw use. Percolation tanks should be built in gardens, open spaces and roadside green belts of urban area.

Rainwater Harvesting Advantages

- Makes use of a natural resource and reduces flooding, storm water runoff, erosion, and contamination of surface water with pesticides, sediment, metals, and fertilizers
- Reduces the need for imported water (the San Diego region imports between 80%-90% of its water from Northern California and Colorado River)
- Excellent source of water for landscape irrigation, with no chemicals such as fluoride and chlorine, and no dissolved salts and minerals from the soil
- Home systems can be relatively simple to install and operate May reduce your water bill

- Promotes both water and energy conservation
- No filtration system required for landscape irrigation.

Reducing water demand

Simple techniques can be used to reduce the demand for water. The underlying principle is that only part of the rainfall or irrigation water is taken up by plants, the rest percolates into the deep groundwater, or is lost by evaporation from the surface. Therefore, by improving the efficiency of water use, and by reducing its loss due to evaporation, we can reduce water demand.

There are numerous methods to reduce such losses and to improve soil moisture. Some of them are listed below.

1)Mulching, i.e., the application of organic or inorganic material such as plant debris, compost, etc., slows down the surface run-off, improves the soil moisture, reduces evaporation losses and improves soil fertility.

2)Soil covered by crops, slows down run-off and minimizes evaporation losses. Hence, fields should not be left bare for long periods of time.

3)Ploughing helps to move the soil around. As a consequence it retains more water thereby reducing evaporation.

4)Shelter belts of trees and bushes along the edge of agricultural fields slow down the wind speed and reduce evaporation and erosion.

5)Planting of trees, grass, and bushes breaks the force of rain and helps rainwater penetrate the soil.

6)Fog and dew contain substantial amounts of water that can be used directly by adapted plant species. Artificial surfaces such as netting-surfaced traps or polyethylene sheets can be exposed to fog and dew. The resulting water can be used for crops.

7)Contour farming is adopted in hilly areas and in lowland areas for paddy fields. Farmers recognize the efficiency of contour-based systems for conserving soil and water.

8)Salt-resistant varieties of crops have also been developed recently. Because these grow in saline areas, overall agricultural productivity is increased without making additional demands on freshwater sources. Thus, this is a good water conservation strategy.

9)Transfer of water from surplus areas to deficit areas by inter-linking water systems through canals, etc.

10)Desalination technologies such as distillation, electro-dialysis and reverse osmosis are available.

11)Use of efficient watering systems such as drip irrigation and sprinklers will reduce the water consumption by plants.

Water conservation tips

- Check faucets and pipes for leaks
- Check the toilets for leaks
- Use the water meter to check the hidden leaks
- Install water-saving shower heads and low-flow faucet aerators
- Insulate the water pipes
- Take short showers
- Turnoff water after wetting your brush
- Use your dishwasher and clothes washer only for full loads
- When washing dishes by hand, dont leave the water running for rinsing.
- Dont let the faucet run, while cleaning vegetables.
- Don't water gutter
- Water the lawn only when needed
- Dont run the hose while washing the car
- Use a broom, not a hose to clean driveways and side walks

Environmental policies

An environment policy is an agreed documented statement of a company's stance towards the environment in which it operates.

The policy is the corner stone of its intent to reduce its carbon footprint, improve recycling, reduce reliance on packaging, minimising waste, improve efficiencies on finite natural resources in all of the company's operations and all departments.

All environmental commitments should be an integral part of the day to day activities, clearly communicated to all employees and may form part of application for ISO 14001 certification or registration under the EMAS scheme.

The best structure

Any internal or external communication should be succinct and easily understood by the audience it's intended for and the environmental policy is no different.

Ideally it should be like a company mission statement in that it's set on one sheet of A4 paper and contains the key commitments the policy undertakes. All goals should be measurable, achievable, realistic and time bound (ie: we will do x by y date).

What should the policy contain ?

Although there is not legal requirement or standard structure for an environmental policy there are key areas that such a policy should contain. It should say what the key objectives that the company is following, who is accountable and how these are going to be achieved and by whom.

All current issues facing the green lobby and global warming issues could be covered that each function of your business covers. These could be:

- Transportation
- Stationery and supplies
- Improved efficiency
- Improve recycling/ minimise waste
- Dealing with other like minded companies
- Continuous improvement
- Invested by all employees and suppliers

Given below is the environmental policy of Tata's which will make understand the aforesaid points

clearly

TCS' commitment to the environment stems from the Tata Group's abiding concern for the environment, climate change and society, which is embodied in the Tata Code of Conduct and the Tata Group Climate Change Policy.

TCS recognizes environmental impact and climate change among the key sustainability challenges to businesses and society; affecting economic stability, ecology and vulnerable communities. TCS is committed to assume a leadership role in environmental protection and climate change mitigation while pursuing our business aspirations and enhancement of shareholder value.

TCS is a global organisation providing IT services, business solutions, and outsourcing to client worldwide. We recognize the direct impacts on the environment arising out of our operations and facilities due to consumption of resources like energy, water, etc, and generation of wastes. We also the potential of our IT services and solutions to drive efficiencies through optimization and reduction of wastages, which directly or indirectly reduces environmental / climate impact for our customers.

We shall strive to minimize our direct impacts on the environment while concurrently enhancing our services and solutions to help customers to improve their environmental and carbon performance toward meeting their sustainability objectives.

TCS aims to fulfil its environmental commitments through the following broad-level actions:

- Integrate energy and environmental considerations into the design of our new infrastructural facilities
- Improve resource efficiency in operations, especially for key resources such as, energy and water
- Reduce carbon footprint through energy efficiency measures and increasing the renewable energy component of our energy portfolio
- Adopt the "3-R" (reduce, reuse and recycle) philosophy for all types of wastes to prevent pollution and dispose off "inevitable" wastes, particularly electronic waste, in line with regulatory requirements or industry best practice
- Preserve and enhance biodiversity in our campuses

- Strive toward “greening” our IT infrastructure and operations including data centers
- Ardently promote “green procurement”
- Consider stakeholder expectations for improvement of our infrastructure, operations, processes and solutions to the extent feasible
- Set, monitor, benchmark and review objectives and targets on an ongoing basis toward achieving continuous improvement in environmental and climate performance and the overall environmental management system
- Comply with all the applicable environmental and related legal and other requirements and, wherever feasible, strive for “beyond compliance” leadership
- Engage and involve customers, vendors and contractors in our environmental sustainability mission by sharing our expectations to collaboratively achieve our environmental objectives toward greening the supply chain
- Report our environmental performance and contribution to climate-change related issues through relevant international and national forums and to other stakeholders through appropriate communication channels
- Communicate the environmental policy to all employees, customers, business associates and other stakeholders and ensure it is available to the public
- Review the environmental policy and allied management systems periodically to ensure their continuing applicability and relevance to our operations and evolving stakeholder expectations
- Strive to support various voluntary national and international protocols, conventions and agreements on environment and proactively engage with governmental and other agencies in driving future environmental policy and regulation

At TCS, protection of the environment is integral to our business strategy toward sustainability and v obligations and commitments as a truly responsible global corporate citizen.

CHAPTER 2 CLIMATE CHANGE, GLOBAL WARMING,ACID RAIN,OZONE LAYER DEPLETION,NUCLEAR ACCIDENTS AND HOLOCAUST

Climate Change

There's a lot of information floating around about climate change. Most people know it has something to do with industrial pollution, changing weather and car exhaust.

In a nutshell, climate change occurs when long-term weather patterns are altered — for example, through human activity. Global warming is one measure of climate change, and is a rise in the average global temperature.

How does it happen?

- Life on Earth is possible because of the warmth of the sun. While some of this incoming solar radiation bounces back into space, a small portion of it is trapped by the delicate balance of gases that make up our atmosphere. Without this layer of insulation, Earth would simply be another frozen rock hurtling through space. Carbon dioxide (CO_2) is the most important gas in this layer of insulation.
- Carbon is stored all over the planet — in plants, soil, the ocean, and even us. We release it into the atmosphere as carbon dioxide through activities such as burning fossil fuels (coal, oil and gas) and cutting down trees. As a result, today's atmosphere contains 42 per cent more carbon dioxide than it did before the industrial era.
- We have released so much carbon dioxide and other greenhouse gases that our planet's atmosphere is now like a thick, heat-trapping blanket. By disrupting the atmospheric balance that keeps the climate stable, we are now seeing extreme effects around the globe. It's like a thermostat that's gone haywire — it just doesn't work the way it should. The result: the climate changes, and it gets warmer. Extreme weather events also become more common.
- Global warming has already begun. Since 1900, the global average temperature has risen by 0.7 degrees Celsius, and the northern hemisphere is substantially warmer than at any point during the past 1,000 years.

Climatologists of the Intergovernmental Panel on Climate Change (IPCC) have reviewed the results of several experiments in order to estimate changes in climate in the course of this century. These studies have shown that in the near future, the global 5.8°C. Warming will be

greatest over land areas, and at high latitudes. The projected rate of warming is greater than has occurred in the last 10,000 years. The frequency of weather extremes is likely to increase leading to floods or drought. There will be fewer cold spells but more heat waves. The frequency and intensity of El Niño is likely to increase. Global mean sea level is projected to rise by 9 to 88 cm by the year 2100. More than half of the world's population now lives within 60km of the sea. They are likely to be seriously impacted by an ingress of salt water and by the rising sea. Some of the most vulnerable regions are the Nile delta in Egypt, the Ganges-Brahmaputra delta in Bangladesh, and many small islands including the Marshall Islands and the Maldives, (WHO, 2001).

Human societies will be seriously affected by extremes of climate such as droughts and floo about changes in the frequency and/or intensity of these extremes. This is a major concern for huma depends on safe drinking water, sufficient food, secure shelter, and good social conditions. All these Fresh water supplies may be seriously affected, reducing the availability of clean water for drinking floods. Water can be contaminated and sewage systems may be damaged. The risk of spread of infe diseases will increase. Food production will be seriously reduced in vulnerable regions directly and pests and plant or animal diseases. The local reduction in food production would lead to starvation and malnutrition with long-term health consequences, especially for children. Food and water shortages may lead to conflicts in vulnerable regions, with serious implications for public health. Climate change related impacts on human health could lead to displacement of a large number of people, creating environmental refugees and lead to further health issues.

Changes in climate may affect the distribution of vector species (e.g. mosquitoes) which in turn will increase the spread of disease, such as malaria and filariasis, to new areas which lack a strong public health infrastructure. The seasonal transmission and distribution of many diseases that are transmitted by mosquitoes (dengue, yellow fever) and by ticks (Lyme disease, tick-borne encephalitis) may spread due to climate change.

Global warming

Global Warming is the increase of Earth's average surface temperature due to effect of greenhouse gases, such as carbon dioxide emissions from burning fossil fuels or from deforestation, which trap heat that would otherwise escape from Earth. This is a type of *greenhouse effect*.

Earth's climate is mostly influenced by the first 6 miles or so of the atmosphere which contains most of the matter making up the atmosphere. This is really a very thin layer. In fact, if Earth is viewed from from space, the principle part of the atmosphere would only be about as thick as the skin on an onion! Realizing this makes it more plausible to suppose that human beings can

change the climate. A look at the amount of greenhouse gases we are spewing into the atmosphere makes it even more plausible.

Greenhouse Gases

The most significant greenhouse gas is actually *water vapor*, not something produced directly by humankind in significant amounts. However, even slight increases in atmospheric levels of carbon dioxide (CO2) can cause a substantial increase in temperature. There are two reasons:

First, although the concentrations of these gases are not nearly as large as that of oxygen and nitrogen (the main constituents of the atmosphere), neither oxygen or nitrogen are greenhouse gases. This is because neither has more than two atoms per molecule (i.e. their molecular forms are O2 and N2, respectively), and so they lack the *internal vibrational modes* that molecules with *more* than two atoms have. Both water and CO2, for example, have these "internal vibrational modes", and these vibrational modes can absorb and reradiate infrared radiation, which causes the greenhouse effect.

Secondly, CO2 tends to remain in the atmosphere for a very long time (time scales in the hundreds of years). Water vapor, on the other hand, can easily condense or evaporate, depending on local conditions. Water vapor levels therefore tend to adjust quickly to the prevailing conditions, such that the energy flows from the Sun and re-radiation from the Earth achieve a balance. CO2 tends to remain fairly constant and therefore behave as a *controlling* factor, rather than a *reacting* factor. More CO2 means that the balance occurs at higher temperatures and water vapor levels.

Increase in atmosphere's CO2 concentration

Human beings have increased the CO_2 concentration in the atmosphere by about 30% which is an extremely significant increase, even on inter-glacial timescales. It is believed that human beings are responsible for this because the increase is almost perfectly correlated with increases in fossil fuel combustion, and also due other evidence, such as changes in the ratios of different carbon isotopes in atmospheric CO_2 that are consistent with "anthropogenic" (human caused) emissions. The simple fact is, that under "business as usual" conditions, we'll soon reach carbon dioxide concentrations that haven't been seen on Earth in the last 50 million years.

Combustion of Fossil Fuels, for electricity generation, transportation, and heating, and also the manufacture of cement, all result in the total worldwide emission of about 22 billion tons of carbon dioxide to the atmosphere each year. About a third of this comes from electricity generation, and another third from transportation, and a third from all other sources.

This enormous input of CO_2 is causing the atmospheric levels of CO_2 to rise dramatically. The following graph shows the CO_2 levels over the past 160 thousand years (the upper curve, with units indicated on the right hand side of the graph). The current level, and projected increase over the next hundred years if we do not curb emissions, are also shown (the part of the curve which goes way up high, to the right of the current level, is the projected CO2 rise). The projected increase in CO_2 is very startling and disturbing. Changes in the Earth's average surface temperature are also shown (the lower curve, with units on the left). Note that it parallels the CO_2 level curve very well.

Global Warming Impacts

Many of the following "harbingers" and "fingerprints" are now well under way:

1. Rising Seas--- inundation of fresh water marshlands (the everglades), low-lying cities, and islands with seawater.
2. Changes in rainfall patterns --- droughts and fires in some areas, flooding in other areas. See the section above on the recent droughts, for example!
3. Increased likelihood of extreme events--- such as flooding, hurricanes, etc.
4. Melting of the ice caps --- loss of habitat near the poles. Polar bears are now thought to be greatly endangered by the shortening of their feeding season due to dwindling ice packs.
5. Melting glaciers - significant melting of old glaciers is already observed.
6. Widespread vanishing of animal populations --- following widespread habitat loss.
7. Spread of disease --- migration of diseases such as malaria to new, now warmer, regions.
8. Bleaching of Coral Reefs due to warming seas and acidification due to carbonic acid formation --- *One third* of coral reefs now appear to have been severely damaged by warming seas.
9. Loss of Plankton due to warming seas --- The enormous (900 mile long) Aleution island ecosystems of orcas (killer whales), sea lions, sea otters, sea urchins, kelp beds, and fish populations, appears to have collapsed due to loss of plankton, leading to loss of sea lions, leading orcas to eat too many sea otters, leading to urchin explosions, leading to loss of kelp beds and their associated fish populations.

Need to reduce emissions

In reality, there is a need to work on all fronts - 10% here, 5% here, etc, and work to phase in new technologies, such as hydrogen technology, as quickly as possible. To satisfy the Kyoto protocol, developed countries would be required to cut back their emissions by a total of 5.2 %

between 2008 and 2012 from 1990 levels. Specifically, the US would have to reduce its presently projected 2010 annual emissions by 400 million tons of CO2 . One should keep in mind though, that even Kyoto would only go a little ways towards solving the problem. In reality, much more needs to be done.

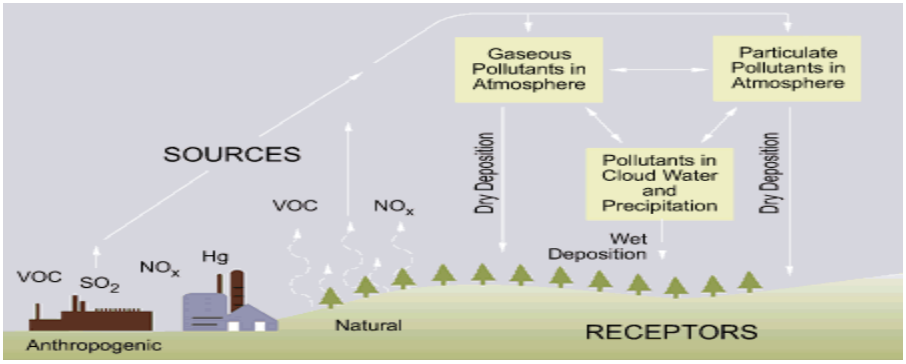
The most promising sector for near term reductions is widely thought to be coal-fired electricity. Wind power, for example, can make substantial cuts in these emissions in the near term, as can energy efficiency, and also the increased use of high efficiency natural gas generation.

To summarise, we can act now to reduce our carbon emissions, slow the pace of global warming, and pass on a safer, healthier world to our children. Or we can choose to do nothing, continue pumping massive amounts of carbon into an already overloaded atmosphere, and suffer the increasingly costly consequences.

Acid rain

Acid rain is rain consisting of water droplets that are unusually acidic because of atmospheric pollution - most notably the excessive amounts of sulfur and nitrogen released by cars and industrial processes. Acid rain is also called acid deposition because this term includes other forms of acidic precipitation such as snow.

“Acid rain” is a broad term referring to a mixture of wet and dry deposition (deposited material) from the atmosphere containing higher than normal amounts of nitric and sulfuric acids. The precursors, or chemical forerunners, of acid rain formation result from both natural sources, such as volcanoes and decaying vegetation, and man-made sources, primarily emissions of sulphur di oxide (SO_2) and nitrogen oxides (NO_X) resulting from fossil fuel combustion. Roughly 2/3 of all SO2 and 1/4 of all NOx come from electric power generation that relies on burning fossil fuels, like coal. Acid rain occurs when these gases react in the atmosphere with water, oxygen, and other chemicals to form various acidic compounds. The result is a mild solution of sulfuric acid and nitric acid. When sulfur dioxide and nitrogen oxides are released from power plants and other sources, prevailing winds blow these compounds across state and national borders, sometimes over hundreds of miles.



Wet Deposition

Wet deposition refers to acidic rain, fog, and snow. If the acid chemicals in the air are blown into areas where the weather is wet, the acids can fall to the ground in the form of rain, snow, fog, or mist. As this acidic water flows over and through the ground, it affects a variety of plants and animals. The strength of the effects depends on several factors, including how acidic the water is; the chemistry and buffering capacity of the soils involved; and the types of fish, trees, and other living things that rely on the water.

Dry Deposition

In areas where the weather is dry, the acid chemicals may become incorporated into dust or smoke and fall to the ground through dry deposition sticking to the ground, buildings, homes, cars, and trees. Dry deposited gases and particles can be washed from these surfaces by rainstorms, leading to increased runoff. This runoff water makes the resulting mixture more acidic. About half of the acidity in the atmosphere falls back to earth through dry deposition.

Effects of acid rain

Acid rain causes acidification of lakes and streams and contributes to the damage of trees at high elevations (for example, red spruce trees above 2,000 feet) and many sensitive forest soils. In addition, acid rain accelerates the decay of building materials and paints, including irreplaceable buildings, statues, and sculptures that are part of our nation's cultural heritage. Prior to falling to the earth, sulfur dioxide (SO_2) and nitrogen oxide (NO_x) gases and their particulate matter derivatives—sulfates and nitrates—contribute to visibility degradation and harm public health.

Aquatic settings are the most clearly impacted by acid deposition though because acidic precipitation falls directly into them. Both dry and wet deposition also runs off of forests, fields, and roads and flows into lakes, rivers, and streams.As this acidic liquid flows into larger bodies of water, it is diluted but over time, acids can accrue and lower the overall pH of the body. Acid deposition also causes clay soils to release aluminum and magnesium further lowering the pH in some areas. If the pH of a lake drops below 4.8, its plants and animals risk death .

Aside from aquatic bodies, acid deposition can significantly impact forests. As acid rain falls on trees, it can make them lose their leaves, damage their bark, and stunt their growth. By damaging these parts of the tree, it makes them vulnerable to disease, extreme weather, and insects. Acid falling on a forest’s soil is also harmful because it disrupts soil nutrients, kills microorganisms in the soil, and can sometimes cause a calcium deficiency. Trees at high altitudes are also susceptible to problems induced by acidic cloud cover as the moisture in the clouds blankets them.

Finally, acid deposition also has an impact on architecture and art because of its ability to corrode certain materials. As acid lands on buildings (especially those constructed with limestone) it reacts with minerals in the stones sometimes causing it to disintegrate and wash away. Acid deposition can also corrode modern buildings, cars, railroad tracks, airplanes, steel bridges, and pipes above and below ground.

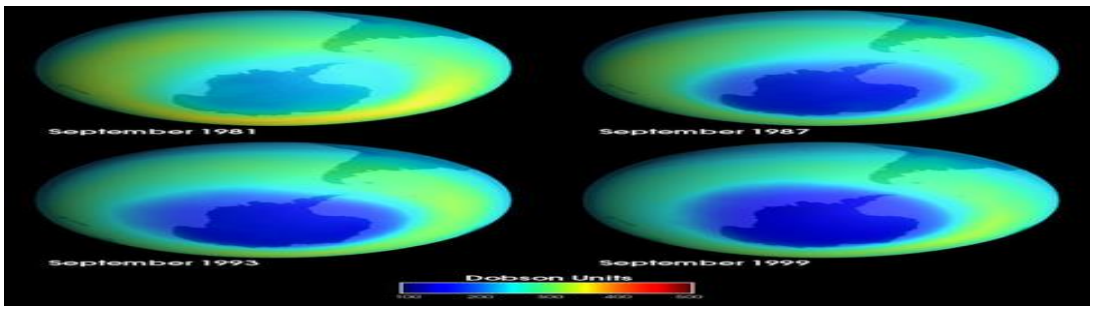
There are several ways to reduce acid rain—more properly called acid deposition—ranging from societal changes to individual action. It is critical that acid deposition be reduced, throughout the world to preserve the integrity of natural habitats, as well as to reduce damage to man-made structures.

Ozone layer depletion

The earth's stratospheric ozone layer plays a critical roll in absorbing ultra violet radiation emitted by our sun. In the last thirty years, it has been discovered that stratospheric ozone is depleting as a result of anthropogenic pollutants. There are a number of chemical reactions that can deplete stratospheric ozone; however, some of the most significant depletion comes from the catalytic destruction of ozone by freed halogen radicals like chlorine and bromine.

The atmosphere of the Earth is divided into 5 layers. From closest and thickest to farthest and thinnest the layers are: troposphere, stratosphere, mesosphere, thermosphere and exosphere. The majority of the atmosphere’s ozone resides in the stratosphere, which extends from 6 miles above the Earth’s surface to 31 miles. Humans rely heavily on the absorption of ultraviolet B rays by the ozone layer because UV-B radiation causes skin cancer and can lead to genetic damage. The ozone layer has historically protected the Earth from the harmful UV rays, although in recent decades this protection has diminished due to stratospheric ozone depletion.

These images below are from the Total Ozone Mapping Spectrometer (TOMS) show the progressive depletion of ozone over Antarctica from 1979 to 1999. This "ozone hole" has extended to cover an area as large as 10.5 million square miles in September 1998. The previous record of 10.0 million square miles was set in 1996. Figure courtesy of NASA.



The Chapman Cycle

The stratosphere is in a constant cycle with oxygen molecules and their interaction with ultraviolet rays. This process is deemed a cycle because of its constant conversion between different molecules of oxygen. The ozone layer is created when ultraviolet rays react with oxygen molecules ($O2$) to create ozone ($O3$) and atomic oxygen (O). This process is called the **Chapman Cycle**.

1. An oxygen molecules is photolysis by solar radiation, creating two oxygen radicals:

$$h\nu + O2 \rightarrow 2O.$$

2. Oxygen radicals then react with molecular oxygen to produce ozone:

$$O2 + O. \rightarrow O3$$

3. Ozone then reacts with an additional oxygen radical to form molecular oxygen:

$$O3 + O. \rightarrow 2O2$$

4. Ozone can also be recycled into molecular oxygen by reacting with a photon:

$$O3 + h\nu \rightarrow O2 + O.$$

It is important to keep in mind that ozone is constantly being created and destroyed by the Chapman Cycle and that these reaction are natural processes, which have been taking place for millions of years. Because of this, the thickness the ozone layer at any particular time can vary greatly. It is also important to know that $O2$ is constantly being introduced into the atmosphere through photosynthesis, so the ozone layer has the capability of regenerating itself.

Chemistry of Ozone Depletion

CFC molecules are made up of chlorine, flourie and carbon atoms and are extremely stable. This extreme stability allows CFC's to slowly make there way into the stratosphere (most molecules are not around long enough to cross into the stratosphere from the troposphere). This prolonged life in the atmosphere allows them to reach great altitudes when photons are more energetic. When the

CFCs come into contact with these high energy photons their individual components are freed from the whole. The following reaction displays how Cl atoms have an ozone destroying cycle:

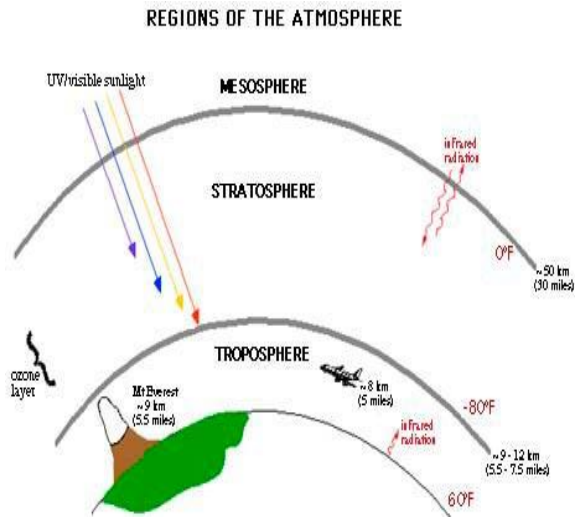
$Cl + O_3 \rightarrow ClO + O_2$

$ClO + O \rightarrow Cl + O_2$

$O_3 + O \rightarrow 2O_2$

Chlorine is able to destroy so much of the ozone because it is a catalyst. Chlorine initiates the break down of ozone and combines with a freed oxygen to create two oxygen molecules. After each reaction, chlorine is able to begin the destructive cycle again with another ozone molecule. One chlorine atom can thereby destroy thousands of ozone molecules. Because ozone molecules are being broken down they are unable to absorb any ultraviolet light so we experience more intense UV radiation at the earths surface.

Much like sunscreen for the Earth, the ozone layer shields the Earth from the sun's damaging UV-B radiation, which can adversely affect human health and ecosystems. Figure courtesy of NOAA



The Impacts of Ozone depletion

Stratospheric ozone filters out most of the sun's potentially harmful shortwave ultraviolet (UV) radiation. If this ozone becomes depleted, then more UV rays will reach the earth. Exposure to higher amounts of UV radiation could have serious impacts on human beings, animals and plants, such as the following:

Harm to human health:

- More skin cancers, sunburns and premature aging of the skin.
- More cataracts, blindness and other eye diseases: UV radiation can damage several parts of the eye, including the lens, cornea, retina and conjunctiva.
- Cataracts (a clouding of the lens) are the major cause of blindness in the world. A sustained 10% thinning of the ozone layer is expected to result in almost two million new cases of cataracts per year, globally (Environment Canada, 1993).
- Weakening of the human immune system (immunosuppression). Early findings suggest that too much UV radiation can suppress the human immune system, which may play a role in the development of skin cancer.

Adverse impacts on agriculture, forestry and natural ecosystems:

- Several of the world's major crop species are particularly vulnerable to increased UV, resulting in reduced growth, photosynthesis and flowering. These species include wheat, rice, barley, oats, corn, soybeans, peas, tomatoes, cucumbers, cauliflower, broccoli and carrots.
- The effect of ozone depletion on the Canadian agricultural sector could be significant.
- Only a few commercially important trees have been tested for UV (UV-B) sensitivity, but early results suggest that plant growth, especially in seedlings, is harmed by more intense UV radiation.

Damage to marine life:

- In particular, plankton (tiny organisms in the surface layer of oceans) are threatened by increased UV radiation. Plankton are the first vital step in aquatic food chains.
- Decreases in plankton could disrupt the fresh and saltwater food chains, and lead to a species shift in Canadian waters.
- Loss of biodiversity in our oceans, rivers and lakes could reduce fish yields for commercial and sport fisheries.
- Animals:
- In domestic animals, UV overexposure may cause eye and skin cancers. Species of marine animals in their developmental stage (e.g. young fish, shrimp larvae and crab larvae) have been threatened in recent years by the increased UV radiation under the Antarctic ozone hole.

Materials:

- Wood, plastic, rubber, fabrics and many construction materials are degraded by UV radiation.
- The economic impact of replacing and/or protecting materials could be significant.

Prevention of Further Ozone Depletion

The nations of the world have taken a crucial step in joining together to halt the production and use of ozone-destroying chemicals. But the work can't stop there. Here's what you can do:

- Know the rules: It is illegal to recharge refrigerators, freezers and home/vehicle air conditioners with CFCs.
- If you have an older vehicle with an air conditioner*, have it serviced by a qualified technician, and make sure the CFC is recaptured and recycled by technician who is specifically certified to do this work. If you don't use your air conditioner — or if the vehicle is about to be scrapped — make sure a qualified technician recaptures and recycles the CFC. *Vehicles of model year 1995 or newer do not use CFCs.
- The same rules apply to older refrigerators freezers and home air conditioners, which may contain CFCs.
- Don't buy or use portable fire extinguishers that contain halons.

Provided that we stop producing ozone-depelting substances, ozone will be created through natural processes that should return the ozone layer to normal levels by about 2050. It is very important that the world comply with the Montreal Protocol; delays in ending production could result in additional damage and prolong the ozone layer's recovery.

Nuclear accidents and holocaust

Nuclear power is generated using Uranium, which is a metal mined in various parts of the world. The first large-scale nuclear power station opened at Calder Hall in Cumbria, England, in 1956. Some military ships and submarines have nuclear power plants for engines.

Nuclear power produces around 11% of the world's energy needs, and produces huge amounts of energy from small amounts of fuel, without the pollution that you'd get from burning fossil fuels.

Nuclear power stations are not atomic bombs waiting to go off, and are not prone to 'melt dons". There is a lot U-238 in there slowing things down-you need a high concentration of U-235

to make a bomb. If the reactor gets too hot, the control rods are lowered in and it cools down. If that doesn't work , there are sets of emergency control rods that automatically drom in and shut the reactor down completely.

With most of the reactors, the computers will shut the reactor down automatically if things get out of hand(unless engineers intervene within a set time). At Chernobyl, in Ukarine, they did not have a sophisticated system, indeed they over-rode the automatic systems they did have. When they got it wrong, the reactor overheated, melted and the excessive pressure blew out the containment system before they could stop it. Then with the coolant gone, there was a serious fire. Many people lost their lives trying to sort out the mess.

If something does go wrong in a big way, much of the world could be affected-some radioactive dust called “fallout” from the Chernobyl accident landed in the UK.

With AGR reactors (the most common type) there are additional safety systems, such as flooding the reactor with nitrogen and/or water to absorb all the neutrons - although the water option means that reactor can never be restarted.

Nuclear holocaust

This refers to a possible complete of nearly complete annihilation of human civilisation by nuclear warfare. Under such a scenario, all or most of the earth is made uninhabitable by nuclear weapons in future world wars.

Nuclear physicits and theorists have speculated that nuclear war could result in an end to human life, or atleast to modern civilization on earth due to the immediate effects of nuclear fallout, the temporary loss of much modern technology due to electromagnetic pulses, or nuclear winter and resultin extinctions.

The effects of nuclear war on climate

A major nuclear war would deposit millions of tonnes of dust in the stratosphere. Some sunlight would be absorbed or reflected away from the earth by the dust, causing a decrease in the earth's temperature. This in turn could conceivably trigger a major climatic change. For example, lowered temperatures could cause an increase in snow and ice near the polar caps, thus an increased reflection of light, and further lowering of temperatures.

Stratospheric dust from a nuclear war seems unlikely to cause such climatic change. In 1883 the volcanic eruption at Krakatoa deposited some 10 to 100 thousand million tonnes of dust in the

stratosphere, and the 1963 Mt Agung eruption about half as much. These injections seem to have caused a minor cooling of the surface temperature of the earth, at most about half a degree Celsius, lasting a few years, with no long term consequences. A nuclear war involving 4000Mt from present arsenals would probably deposit much less dust in the stratosphere than either the Krakatoa or Mt Agung eruptions.

Another possibility is that decreases in ozone or increases in oxides of nitrogen levels in the stratosphere, caused by nuclear war, could lead to climatic change. A reduction in ozone levels by a factor of two could cause a decrease in surface temperature of one half to one degree Centigrade, but including oxides of nitrogen in the calculation reduces this effect. Whether or not a change in temperature at the earth's surface by this amount for a few years could cause irreversible climatic change is hard to assess. The National Academy of Sciences study concluded that the effects of dust and oxides of nitrogen injection into the stratosphere 'would probably lie within normal global climatic variability, but the possibility of climatic changes of a more dramatic nature cannot be ruled out'.Since the Academy assumed a nuclear war with the explosion of many more high-yield weapons than are presently deployed, the danger of climatic change from dust or oxides of nitrogen is almost certainly less than assessed in their report.

Fires and smoke

In mid 1982, Paul Crutzen and John Birks, drew attention to a previously overlooked major effect of nuclear war. They note that nuclear attacks would ignite numerous fires in cities, industry and especially in forests, crop areas and oil and gas fields. These fires would produce immense amounts of particulate matter which would remain in the lower atmosphere for weeks even after the fires ceased. The smaller particles, called aerosols, would absorb sunlight. A large nuclear war with many fires and large aerosol production could lead to a reduction in sunlight in the mid-northern hemisphere by 90 per cent or more for a period of a few months. This reduction would pose no *direct* threat to human health, but indirect effects could be widespread. If the nuclear war occurred during the agricultural growing season of the northern hemisphere, food production could be virtually eliminated for that season. This could greatly increase the chance of mass starvation in the north, though it is possible that stored food and changes in dietary habits could prevent this. If the reduction in ground level sunlight were 99 per cent or more, this could lead to the death of most of the phytoplankton and herbivorous zooplankton in half the northern oceans. This could lead to extinction of species and unpredictable changes in the balance of life on earth. Another effect of the fires would be production of large amounts of oxides of nitrogen and reactive

hydrocarbons in the lower atmosphere, changes in lower atmospheric dynamics, and creation of ozone and other potent air pollutants. (While ozone plays a useful role in the stratosphere it can be harmful to living things at ground level.) In effect, much of the northern hemisphere could be exposed to severe photochemical smog for a period of weeks. This could cause health problems in susceptible people, especially the aged. Potentially more disastrous would be the negative effect of the smog on agricultural productivity, further increasing the chance of crop failure and consequent starvation.

CHAPTER 3

POLLUTION CONTROL BOARDS AND POLLUTION CONTROL ACTS IN INDIA,WILD LIFE PROTECTION AND FOREST CONSERVATION ACTS

Pollution Control Board in India

The Central Pollution Control Board (CPCB), statutory organisation, was constituted in September, 1974 under the Water (Prevention and Control of Pollution) Act, 1974. Further, CPCB was entrusted with the powers and functions under the Air (Prevention and Control of Pollution) Act, 1981.

It serves as a field formation and also provides technical services to the Ministry of Environment and Forests of the provisions of the Environment (Protection) Act, 1986. Principal functions of the CPCB, as spelt out in the Water (Prevention and Control of Pollution) Act, 1974, and the Air (Prevention and Control of Pollution) Act, 1981, (i) to promote cleanliness of streams and wells in different areas of the States by prevention, control and abatement of water pollution, and (ii) to improve the quality of air and to prevent, control or abate air pollution in the country.

Air Quality Monitoring is an important part of the air quality management. The National Air Monitoring Programme(NAMP) has been established with objectives to determine the present air quality status and trends and to control and regulate pollution from industries and other source to meet the air quality standards. It also provides background air quality data needed for industrial siting and towns planning.

Besides this, CPCB has an automatic monitoring station at ITO Intersection in New Delhi. At this station Resirable Suspended Particulate Matter (RSPM), Carbon Monoxide (CO), Ozone (O3), Sulphur Dioxide (SO2), Nitrogen Dioxide (NO2) and Suspended Particulate Matter (SPM) are being monitored regularly. This information on Air Quality at ITO is updated every week.

Fresh water is a finite resource essential for use in agriculture, industry, propagation of wildlife & fisheries and for human existence. India is a riverine country. It has 14 major rivers, 44 medium rivers and 55 minor rivers besides numerous lakes, ponds and wells which are used as primary source of drinking water even without treatment. Most of the rivers being fed by monsoon rains, which is limited to only three months of the year, run dry throughout the rest of the year often carrying wastewater discharges from industries or cities/towns endangering the quality of our scarce water resources. The parliament of India in its wisdom enacted the Water (Prevention and Control of Pollution) Act, 1974 with a view to maintaining and restoring wholesomeness of our water bodies. One of the mandates of CPCB is to collect, collate and disseminate technical and statistical data relating to water pollution. Hence, Water Quality Monitoring and Surveillance are of utmost importance.

Functions of the Central Board at the national level

- Advise the Central Government on any matter concerning prevention and control of water and air pollution and improvement of the quality of air.
- Plan and cause to be executed a nation-wide programm for the prevention, control or abatement of water and air pollution;
- Co-ordinate the activities of the State Board and resolve disputes among them;
- Provide technical assistance and guidance to the State Boards, carry out and sponsor investigation and research relating to problems of water and air pollution, and for their prevention, control or abatement;
- Plan and organise training of persons engaged in programme on the prevention, control or abatement of water and air pollution;
- Organise through mass media, a comprehensive mass awareness programme on the prevention, control or abatement of water and air pollution;
- Collect, compile and publish technical and statistical data relating to water and air pollution and the measures devised for their effective prevention, control or abatement;
- Prepare manuals, codes and guidelines relating to treatment and disposal of sewage and trade effluents as well as for stack gas cleaning devices, stacks and ducts;
- Disseminate information in respect of matters relating to water and air pollution and their prevention and control;
- Lay down, modify or annul, in consultation with the State Governments concerned, the standards for stream or well, and lay down standards for the quality of air; and
- Perform such other function as may be prescribed by the Government of India.

Functions of the Central Board as State Boards for the Union Territories

- Advise the Governments of Union Territories with respect to the suitability of any premises or location for carrying on any industry which is likely to pollute a stream or well or cause air pollutions; Lay down standards for treatment of sewage and trade effluents and for emissions from automobiles, industrial plants, and any other polluting source
- Evolve efficient methods for disposal of sewage and trade effluents on land; develop reliable and economically viable methods of treatment of sewage, trade effluent and air pollution control equipment
- Identify any area or areas within Union Territories as air pollution control area or areas to be

notified under the Air (Prevention and Control of Pollution) Act, 1981; Assess the quality of ambient water and air, and inspect wastewater treatment installations, air pollution control equipment, industrial plants or manufacturing process to evaluate their performance and to take steps for the prevention, control and abatement of air and water pollution.

THE WATER (PREVENTION AND CONTROL OF POLLUTION) ACT, 1974

An Act to provide for the prevention and control of water pollution and the maintaining or restoring of wholesomeness of water, for the establishment, with a view to carrying out the purposes aforesaid, of Boards for the prevention and control of water pollution, for conferring on and assigning to such Boards powers and functions relating thereto and for matters connected therewith.

WHEREAS it is expedient to provide for the prevention and control of water pollution and the maintaining or restoring of wholesomeness of water, for the establishment, with a view to carrying out the purposes aforesaid, of Boards for the prevention and control of water pollution and for conferring on and assigning to such Boards powers and functions relating thereto;

AND WHEREAS Parliament has no power to make laws for the States with respect to any of the matters aforesaid except as provided in articles 249 and 250 of the Constitution;

This Act may be called the Water (Prevention and Control of Pollution) Act, 1974.

The main objectives of the Water Act are to provide for prevention, control and abatement of water pollution and the maintenance or restoration of the wholesomeness of water. It is designed to assess pollution levels and punish polluters. The Central Government and State Governments have set up Pollution Control Boards that monitor water pollution

Functions of the Pollution Control Boards:

The Government has given the necessary powers to the PCBs to deal with the problems of water pollution in the country. The Government has also suggested penalties for violation of the provisions of the Act.

Central and State water testing laboratories have been set up to enable the Boards to assess the extent of water pollution and standards have been laid down to establish guilt and default.

The Central and State Boards are entitled to certain powers and functions which are as follows:

Central Board: It has the power to advise the Central Government on any matters concerning the prevention and control of water pollution. The Board coordinates the activities of the State Boards and also resolves disputes. The Central Board can provide technical assistance and guidelines to State Boards to carry out investigations and research relating to water pollution, and organizes training for people involved in the process. The Board organizes a comprehensive awareness program on water pollution through mass media and also publishes data regarding water pollution. The Board lays down or modifies the rules in consultation with the State Boards on standards of disposal of waste.

The main function of the Central Board is to promote the cleanliness of rivers lakes streams and wells in the country.

State Boards: They have the power to advise the State Government on any matters concerning water pollution. It plans a comprehensive program for the prevention of water pollution. It collects and disseminates information on water pollution and participates in research in collaboration with the Central Board in organizing training of people involved in the process. The Board inspects sewage or trade effluents, treatment plants, purification plants and the systems of disposal and also evolves economical and reliable methods of treatment of sewage and other effluents. It plans the utilization of sewage water for agriculture. It ensures that if effluents are to be discharged on land the waste is diluted. The State Board advises State Governments with respect to location of industries. Laboratories have been established to enable the Board to perform its functions.

The State Boards have the power to obtain information from officers empowered by it who make surveys, keep records of flow, volume, and other characteristics of the water. They are given the power to take samples of effluents and suggest the procedures to be followed in connection with the samples. The concerned board analyst is expected to analyze the sample sent to him and submit a report of the result to the concerned Board. The Board is required to send a copy of the result to the respective industry. The Board also has the power of inspecting any plant record, register, document or any material object, and can conduct a search in any place in which there is reason to believe that an offence has been conducted under the Act.

Penalties are charged for acts that have caused pollution. This includes failing to furnish information required by the Board, or failing to inform the occurrence of any accident or other unforeseen act. An individual or organisation that fails to comply with the directions given in the subsections of the law can be convicted or punished with imprisonment for a term of three months or with a fine of Rs10,000 or both and in case failure continues an additional fine of Rs.5,000 everyday. If a person who has already been convicted for any offence is found guilty of the same offence again, he/she after the second and every subsequent conviction, would be

punishable with imprisonment for a term not less than two years but which may extend to seven years with fine.

THE AIR (PREVENTION AND CONTROL OF POLLUTION) ACT, 1981

An Act to provide for the prevention, control and abatement of air pollution, for the establishment, with a view to carrying out the aforesaid purposes, of Boards, for conferring on and assigning to such Boards powers and functions relating thereto and for matters connected therewith.

Whereas decisions were taken at the United Nations Conference on the Human Environment held in Stockholm in June, 1972, in which India participated, to take appropriate steps for the preservation of the natural resources of the earth which, among other things, include the preservation of the quality of air and control of air pollution;

AND whereas it is considered necessary to implement the decisions aforesaid in so far as they relate to the preservation of the quality of air and control of air pollution;

The main objectives of the Act are as follows:

(a) To provide for the Prevention, Control and abatement of air pollution.
(b) To provide for the establishment of Central and State Boards with a view to implement the Act.
(c) To confer on the Boards the powers to implement the provisions of the Act and assign to the Boards functions relating to pollution.

Air pollution is more acute in heavily industrialized and urbanized areas, which are also densely populated. The presence of pollution beyond certain limits due to various pollutants discharged through industrial emission are monitored by the Pollution Control Boards set up in every State.

Powers and Functions of the Boards

Central Board: The main function of the Central Board is to implement legislation created to improve the quality of air and to prevent and control air pollution in the country. The Board advises the Central Government on matters concerning the improvement of air quality and also coordinates activities, provides technical assistance and guidance to State Boards and lays down standards for the quality of air. It collects and disseminates information in respect of matters relating to air pollution and performs functions as prescribed in the Act

State Pollution Control Boards: The State Boards have the power to advice the State Government on any matter concerning the prevention and control of air pollution. They have the right to

inspect at all reasonable times any control equipment, industrial plant, or manufacturing process and give orders to take the necessary steps to control pollution. They are expected to inspect air pollution control areas at intervals or whenever necessary. They are empowered to provide standards for emissions to be laid down for different industrial plants with regard to quantity and composition of emission of air pollutants into the atmosphere.A State Board may establish or recognize a laboratory to perform this function.

The State Governments have been given powers to declare air pollution control areas after consulting with the State Board and also give instructions for ensuring standards of emission from automobiles and restriction on use of certain industrial plants.

Penalties: Persons managing industry are to be penalized if they produce emissions of air pollutants in excess of the standards laid down by the State Board. The Board also makes applications to the court for restraining persons causing air pollution.Whoever contravenes any of the provision of the Act or any order or direction issued is punishable with imprisonment for a term which may extend to three months or with a fine of Rs.10,000 or with both ,and in case of continuing offence with an additional fine which may extend to Rs 5,000 for every day during which such contravention continues after conviction for the first contravention into the atmosphere.

Other Environmental laws

1986 - The Environment (Protection) Act authorizes the central government to protect and improve environmental quality, control and reduce pollution from all sources, and prohibit or restrict the setting and /or operation of any industrial facility on environmental grounds.

1986 - The Environment (Protection) Rules lay down procedures for setting standards of emission or discharge of environmental pollutants.

1989 - The objective of Hazardous Waste (Management and Handling) Rules is to control the generation, collection, treatment, import, storage, and handling of hazardous waste.

1989 - The Manufacture, Storage, and Import of Hazardous Rules define the terms used in this context, and sets up an authority to inspect, once a year, the industrial activity connected with hazardous chemicals and isolated storage facilities.

1989 - The Manufacture, Use, Import, Export, and Storage of hazardous Micro-organisms/ Genetically Engineered Organisms or Cells Rules were introduced with a view to protect the

environment, nature, and health, in connection with the application of gene technology and microorganisms.

1991 - The Public Liability Insurance Act and Rules and Amendment, 1992 was drawn up to provide for public liability insurance for the purpose of providing immediate relief to the persons affected by accident while handling any hazardous substance.

1995 - The National Environmental Tribunal Act has been created to award compensation for damages to persons, property, and the environment arising from any activity involving hazardous substances.

1997 - The National Environment Appellate Authority Act has been created to hear appeals with respect to restrictions of areas in which classes of industries etc. are carried out or prescribed subject to certain safeguards under the EPA.

1998 - The Biomedical waste (Management and Handling) Rules is a legal binding on the health care institutions to streamline the process of proper handling of hospital waste such as segregation, disposal, collection, and treatment.

1999 - The Environment (Siting for Industrial Projects) Rules, 1999 lay down detailed provisions relating to areas to be avoided for siting of industries, precautionary measures to be taken for site selecting as also the aspects of environmental protection which should have been incorporated during the implementation of the industrial development projects.

2000 - The Municipal Solid Wastes (Management and Handling) Rules, 2000 apply to every municipal authority responsible for the collection, segregation, storage, transportation, processing, and disposal of municipal solid wastes.

2000 - The Ozone Depleting Substances (Regulation and Control) Rules have been laid down for the regulation of production and consumption of ozone depleting substances.

2001 - The Batteries (Management and Handling) Rules, 2001 rules shall apply to every manufacturer, importer, re-conditioner, assembler, dealer, auctioneer, consumer, and bulk consumer involved in the manufacture, processing, sale, purchase, and use of batteries or components so as to regulate and ensure the environmentally safe disposal of used batteries.

2002 - The Noise Pollution (Regulation and Control) (Amendment) Rules lay down such terms and conditions as are necessary to reduce noise pollution, permit use of loud speakers or public address systems during night hours (between 10:00 p.m. to 12:00 midnight) on or during any cultural or religious festive occasion

2002 - The Biological Diversity Act is an act to provide for the conservation of biological diversity, sustainable use of its components, and fair and equitable sharing of the benefits arising out of the use of biological resources and knowledge associated with it

Forest conservation Act

The Parliament has enacted the Forest (Conservation) Act, 1980, to check further deforestation and conserve forests and to provide for matters connected therewith or ancillary or incidental thereto.

This Act has five Sections which deal with conservation of forests.

The Act was enacted with the twin objectives under Section 2 of restricting the use of forest land for non-forest purposes, and preventing the de-reservation of forests that have been reserved under the Indian Forest Act, 1927. However, in 1988 the Act was further amended to include two new provisions under Section 2, where it sought to restrict leasing of forest land to private individuals, authority, corporations not owned by the Government, and to prevent clear felling of naturally grown trees.

The Act empowers the Central Government to constitute a committee to advise the Government with a grant of approval under Section 2, as also on any other matter connected with the conservation of forest and referred to it by the Central Government.

The Act provides for the punishment of imprisonment, extendable to fifteen days for the contravention of the provisions of the Act.

The Act provides for punishment of offenders from the Government Departments, including Head of the Departments and authorities. However, these persons can escape criminal liabilities if they can prove that:
-The offence was committed without their knowledge,
-They had exercised all due diligence to prevent the committing of such offence.

India’s first Forest Policy was enunciated in 1952.Between 1952 and 1988, the extent of deforestation was so great that it became evident that there was a need to formulate a new policy on forests and their utilisation. Large tracts of forestland had already been diverted to other uses. The earlier forest policies had focused attention on revenue generation only. In the 1980 it became

clear that forests must be protected for their other functions such as maintenance of soil and water regimes cantered around ecological concerns. It also provided for the use of goods and services of the forest for its local inhabitants.

The new policy framework made conversion of forests into other uses much less possible. Conservation of the forests as a natural heritage finds a place in the new policy, which includes the

preservation of its biological diversity and genetic resources. It also values meeting the needs of local people for food, fuelwood, fodder and non-wood forest products that they subsist on.It gives priority to maintaining environmental stability and ecological balance. It expressly states that the network of Protected Areas should be strengthened and extended.

In 1992, the 73rd and 74th Amendments to the Constitution furthered governance through panchayats. It gives States the ability to provide power to the local panchayats to manage localforest resources.

Penalties for offences in Reserved Forests: No person is allowed to make clearings or set fire to a Reserved Forest. Cattle are not permitted to trespass into the Reserved Forest. Felling, collecting of timber, bark or leaves, quarries or collecting any forest product is punishable with imprisonment for a term of six months, or with a fine which may extend to Rs.500, or both.

Penalties for offences in Protected Forests: A person who commits any of the following offences like felling of trees, or strips off the bark or leaves from any tree or sets fire to such forests, or kindles a fire without taking precautions to prevent its spreading to any tree mentioned in the Act, whether standing or felled, or fells any tree, drags timber, or permits cattle to damage any tree, shall be punishable with imprisonment for a term which may extend to six month or with a fine which may extend to Rs.500, or both.

When there is a reason to believe that a forest offence has been committed pertaining to any forest produce, the produce together with all tools used in committing such offences may be seized by any Forest Officer or Police Officer. Every officer seizing any property under this section shall put on the property a mark indicating the seizure and report the seizure to the Magistrate who has the jurisdiction to try the offence. Any Forest Officer, even without an order from the Magistrate or a warrant, can arrest any person against whom a reasonable suspicion exists.

Wild Life Protection Act

This Act passed in 1972, deals with the declaration of National Parks and Wildlife Sanctuaries and

their notification. It establishes the structure of the State's wildlife management and the posts designated for Wildlife Management. It provides for setting up Wildlife Advisory Boards.It prohibits hunting of all animals specified in Schedules I to IV of the Act. These are notified in order of their endangeredness. Plants that are protected are included in schedule VI.

The Amendment to the Wildlife Protection Act in 2002 is more stringent and prevents the commercial use of resources by local people. It has brought in new concepts such as the creation of Community Reserves. It has also altered several definitions. For instance in animals, fish are now included. Forest produce has been redefined to ensure protection of ecosystems.

While there are several changes, the new Act still has serious issues concerned with its implementation. Laws are only as good as the ones that can be complied with. The Act is expected to deter people from breaking the law. However, there are serious problems due to poaching. One cannot expect to use the Act to reduce this without increasing Forest Staff, providing weapons, jeeps, radio equipment, etc. for establishing a strong deterrent force.

Penalties:A person who breaks any of the conditions of any license or permit granted under this Act shall be guilty of an offence against this Act. The offence is punishable with imprisonment for a term which may extend to three years or with a fine of Rs 25,000 or with both. An offence committed in relation to any animal specified in Schedule I, or Part II of Schedule II, like the use of meat of any such animal, or animal articles like a trophy, shall be punishable with imprisonment for a term not less than one year and may extend to six years and a fine of Rs 25,000.In the case of a second or subsequent offence of the same nature mentioned in this sub-section, the term of imprisonment may extend to six years and not less than two years with a penalty of Rs.10,000.

CHAPTER 4 ISSUES IN LEGALISATION AND PUBLIC AWARNESS, EIA AND RISK MANAGEMENT

It is necessary to create awareness about the norms and projected environmental restrictions under which organization may have environmental regulations and legislations rests with a number of different agencies. Central government is responsible for enforcement of various environmental legislation for less polluting small scale industries. There is an urgent need to use a range of measures to complement regulations.

Issues in legalisation

In pursuance of the Water (Prevention & Control of Pollution) Act. 1974, the Central Government set up a Central Board for the Prevention and Control of Water Pollution. Similar Boards were set up in various States at different points of time when the Act was adopted by the State Legislatures.

Subsequently, the responsibility for enforcement of the Air (Prevention & Control of Pollution) Act, 1981 was also entrusted with these organisations which were renamed as the Central and State Pollution Control Boards. With the enactment of the Environment (Protection) Act, 1986, which is umbrella legislation, the Central Government assumed the overall responsibility of "environmental protection and improvement".

Although the Act empowered the government to designate Authorities for specific tasks, separate machinery for enforcement of the Act was not set up or designated except the Central Ground Water Board which was designated as the Central Ground Water Authority.

It is only in recent times, empowered Authorities have been constituted for specific assignments which include the following:

(1) Environment Pollution (Prevention & Control) Authority for National Capital Region set up in January, 1998;

(2) Loss of Ecology (Prevention of Pollution and Payment of Compensation) Authority, Tamil Nadu.

(3) Coastal Zone Authority.

(4) Dahanu Taluka Environment (Protection) Authority, Maharashtra.

(5) National Environment Appellate Authority.

(6) Taj Trapezium Zone Pollution (Prevention & Control) Authority

The powers of the Environment (Protection) Act have been exercised by the Central Government through the Ministry of Environment & Forests. However, the monitoring mechanism for implementation of the Act is still undefined although for the various regulations enforcement institutions have been enlisted. Also, in several areas of environmental concern such as vehicular- pollution control, the Ministry of Environment & Forests has no decisive role since it is implemented by a separate Ministry through the Motor Vehicles Act.

Legal Loopholes:

It is often argued that our enforcement mechanism is very weak although the laws are very well drawn up. But, a careful analysis of the laws may reveal their inherent deficiencies which are closely linked to lapses in enforcement. To make clear this issue, let us refer to the Water Act, 1974.

The key person for enforcement of this Act is the Chairman of the State Pollution Control Board who should be professionally qualified and appointed on a full time basis. However, the Act does not stipulate such requirement. Several State Pollution Control Boards are headed by part-time Chairmen without requisite qualifications and experience.

Besides the Chairman and Member Secretary, as per provisions of the Act, the State Pollution Control Board is supposed to have 15 member's nominated by the Government. Most of these part-time members are drawn from Government Departments and local civic authorities.

Many of these members, as pre-occupied as they are with their jobs, find very little time for making any constructive contribution towards effective functioning of the State Pollution Control Boards. On the contrary, the State Pollution Control Boards are faced with un-enviable situation of having such members who represent the polluting public sector units and civic services. The enforcement action in such situation is understandably weak.

Institutional infirmities:

Over the years, the Pollution Control Boards have been assigned the responsibilities for enforcement of various environmental regulations in addition to the Acts relating to water and air pollution control.

Also, in a number of cases, the Boards are called upon to deal with the issue such as municipal wastes, safety measures in factory premises, vehicular pollution and traffic management although the agencies like Municipal Corporation, Factories Inspectorate and Transport Authorities are responsible for enforcement of regulations in their respective areas of work.

The Pollution Control Boards are hardly equipped with the necessary wherewithal to cope up with these daunting tasks. Professional manpower and laboratory infrastructure for pollution monitoring are the basic requirements for effective functioning of the pollution control machinery. But, the Boards are dismally short of such facilities because of dwindling budgetary support and restrictions imposed on recruitment of personnel besides lack of training and career opportunities for the existing staff.

Planning and enforcement of anti-pollution measures require sustained and cohesive team initiatives. But, the manner in which the Boards are constituted and the time given to the Boards are not in favour of such initiatives. As per provisions of the Act, the Boards are constituted for a period of 3 years and even within this limited period, the memberships of the Boards including the Chairmen and Member Secretaries are frequently changed.

The Pollution Control Boards are expected to function as statutory autonomous bodies. But, in reality, the Boards cannot function in such a manner for various reasons including over-dependence on the Government for their existence. For effective functioning, the Pollution Control Boards should have the autonomy and over-ridding powers to enforce the laws.

Public Awareness

Environment includes all living and non-living objects. We live in the environment and use the environmental resources like air, land and water to meet our needs. Development also means meeting the needs of the people. While meeting the ever-growing needs, we put pressure on the environment. When the pressure exceeds the carrying capacity of the environment to repair or replace itself, it creates a serious problem of environmental degradation. If we use any environmental resource such as ground water beyond its limit of replacement, we may lose it forever. Therefore, there is a need to create ‘awareness’ about Environmental protection. While efforts are being made at the national and international level to protect our environment, it is also the responsibility of every citizen to use our environmental resources with care and protect them from degradation. In this lesson we will discuss the meaning and causes of environmental degradation and the importance of environmental conservation.

There is no denying the fact that environment has to be protected and conserved so to make

future life possible. Indeed, man's needs are increasing and accordingly the environment is also being altered, indeed, nature's capacity is too accommodating and too regenerative yet there is a limit to nature's capacity, especially when pressure of exploding population and technology keep mounting. What is required is the sustenance, conservation and improvement of the changing and fragile environment.

Some methods to increase the public awareness as listed by UNEP are given below:

1)Targeted efforts

According to UNEP, environmental awareness campaigns are most successful when targeted to specific groups or populations. Many people don't pay much attention to environmental problems because they don't understand how the problem would affect them or their lifestyle. One reason that hybrid cars, energy-saving appliances, and solar panels have become so popular in the past few years is because of targeted awareness. Showing people how much money they could save by purchasing a hybrid or installing a solar panel has helped to "convert" people who normally wouldn't have paid much attention to environmental problems.

2)Local outreach

Environmental education is just as important in the developing world as it is in industrialized nations; however, reaching out to the people in those countries can be very difficult. Language barriers, illiteracy, and cultural differences can prevent them from learning about environmental issues, particularly in rural or tribal areas. Reaching out to tribal, religious, and community leaders can often help a government organization or non-governmental organization (NGO) educate the people on environmental issues. Community leaders can help ease communication problems and bridge the cultural divide that often stands in the way of outreach efforts.

3)The Media

In developed countries and urban areas, the use of print, broadcast, and Internet media can be a great way to increase education and awareness. By working with the media, government agencies and non-profit organizations can help spread their message, either by holding press briefings, issuing printed press releases, or even setting up online databases that can be used as information centers. Information centres can be useful tools to educate both the public and journalists about environmental concerns. Many media outlets may want to increase their coverage of

environmental issues, but don't know where to find accurate information. Having a central information clearinghouse that is accessible to journalists and the public can be extremely useful

4)Class room education:

Thirty percent of the world's population is under the age of eighteen, according to UNEP, which is why educating children and young adults about environmental problems is crucial to long-term success. This will help them foster a sense of responsibility and "proactive citizenship," so that when they become adults they will make choices that help the environment rather than harm it. Integrating environmental education into current science classes or teaching environmental science as a separate discipline is one of the best ways to educate children and teens about environmental problems, particularly if the classes involve some sort of "hands-on" learning, like starting a garden or caring for an animal.

Individual efforts to increase the awareness

- Start **an e-mail contact list** of friends and family who are interested in learning more about this issue. When you come across articles, news, or relevant information, forward it to everyone on this list.

- Add a catchy phrase or quote that's meaningful to you into the tagline of your e-mails. A thing as simple as an **e-mail signature** will remind others of the importance of this issue. Not only would you be sharing your point of view with others who might be unaware of the problem, you'd also be opening up the lines of communication about the issue by creating opportunities for those who come in contact with your e-mails to educate themselves about the topic. You'd be surprised by the impact of such a simple thing!

- Make your own **website** in support of the cause.Not only will you be serving as a role model, you have no idea all the people you'll be helping to educate about this topic. We all need to get the word out, and this is one way that takes very little effort.

- Call **radio talk shows**. Ask questions. Make a statement. Be courteous and professional even if the host disagrees with you, but be firm on the issues. This is simply another way to get the word out and tell your story.

- Put a meaningful bumper sticker on your vehicle and ask your friends, family, and neighbors if they will also put a **bumper sticker** on their cars.

- Attend **local political and community meetings**. Make friends. Without forcing your agenda on others, it's important to speak up about the issue whenever it's appropriate. When people ask for more information, have something ready to hand them.
- If you or someone in your local 4-wheeling club is talented at public speaking, arrange to **give a presentation** at the local library, local lodge or community event. Most public libraries will reserve a meeting room at no charge where you can show a video and give a presentation. Be sure to submit your event announcement to the local media and post flyers around town so that people know about it.
- Call or write your local newspapers and televisions. The **media is always looking for human-interest stories**. Tell your story. If you have two or three others who also have a story to tell, offer to arrange a meeting over coffee with the reporter and a small group for interviews. Try to develop a friendly, professional relationship with the local media - even if some disagree with you.

- Create a "buzz" about land issues. **Start a word of mouth campaign** simply by telling your friends, your family, and your co-workers about local land issues. And ask them to tell someone too. Pass it on!

Environment Impact Assessment

Environment Impact Assessment (EIA) is an important management tool for ensuring optimal use of natural resources for sustainable development. A beginning in this direction was made in our country with the impact assessment of river valley projects in 1978-79 and the scope has subsequently been enhanced to cover other developmental sectors such as industries, thermal power projects, mining schemes etc. To facilitate collection of environmental data and preparation of management plans, guidelines have been evolved and circulated to the concerned Central and State Government Departments. EIA has now been made mandatory under the Environmental (Protection Act, 1986) for 29 categories of developmental activities involving investments of Rs. 50 crores and above.

Need for EIA

Every anthropogenic activity has some impact on the environment. More often it is harmful to the environment than benign. However, mankind as it is developed today cannot live without taking up these activities for his food, security and other needs. Consequently, there is a need to harmonise developmental activities with the environmental concerns. Environmental impact assessment (EIA) is one of the tools available with the planners to achieve the above-mentioned

goal.

It is desirable to ensure that the development options under consideration are sustainable. In doing so, environmental consequences must be characterized early in the project cycle and accounted for in the project design.

The objective of EIA is to foresee the potential environmental problems that would arise out of a proposed development and address them in the project's planning and design stage. The EIA process should then allow for the communication of this information to:

(a) the project proponent;

(b) the regulatory agencies; and,

(c) all stakeholders and interest groups.

EIA integrates the environmental concerns in the developmental activities right at the time of initiating for preparing the feasibility report. In doing so it can enable the integration of environmental concerns and mitigation measures in project development.EIA can often prevent future liabilities or expensive alterations in project design.

Impact Prediction

Impact prediction is a way of mapping the environmental consequences of the significant aspects of the project and its alternatives. Environmental impact can never be predicted with absolute certainty and this is all the more reason to consider all possible factors and take all possible precautions for reducing the degree of uncertainty.

The following impacts of the project should be assessed:

(i)Air

- changes in ambient levels and ground level concentrations due to total emissions from point, line and area sources
- effects on soils, materials, vegetation, and human health

(ii)Noise

- changes in ambient levels due to noise generated from equipment and movement of vehicles
- effect on fauna and human health

Water

- availability to competing users
- changes in quality
- sediment transport
- ingress of saline water

Land

- changes in land use and drainage pattern
- changes in land quality including effects of waste disposal
- changes in shoreline/riverbank and their stability

Biological

- deforestation/tree-cutting and shrinkage of animal habitat.
- impact on fauna and flora (including aquatic species if any) due to contaminants/pollutants
- impact on rare and endangered species, endemic species, and migratory path/route of animals.
- Impact on breeding and nesting grounds

Socio-Economic

- impact on the local community including demographic changes.
- Impact on economic status
- impact on human health.
- mpact of increased traffic

For every project, possible alternatives should be identified and environmental attributes compared. Alternatives should cover both project location and process technologies. Alternatives should consider no project option also. Alternatives should then be ranked for selection of the best environmental option for optimum economic benefits to the community at large.

Risk Management

In general, a risk refers broadly to situations where the outcomes are uncertain. The term “Risk” is described in two ways in the Concise Oxford dictionary:

* Firstly, risk is described as a hazard or a chance of bad consequences, loss, etc, and
* Secondly as an exposure or a chance of injury or loss.

Therefore, both the hazard and exposure descriptions are relevant risk dimensions in terms of parameters used in the identification of risks.

Risk can also be defined as the variation of the actual outcome from the expected outcome, which implies the presence of uncertainty. This definition indicates that there is an uncertainty surrounding the outcome of an event and about the degree of uncertainty of the actual outcome that is expected. Furthermore one could consider uncertainty in the context of two dimensions, namely a range of possible outcomes and the probability of an outcome occurring.

A range of possible outcomes:

There are a few situations where a range of possibilities is very narrow. For example, in tossing a coin one thinks of two outcomes, heads or tails, but the possibility of the coin landing on its edge or rolling away and becoming lost is very remote.

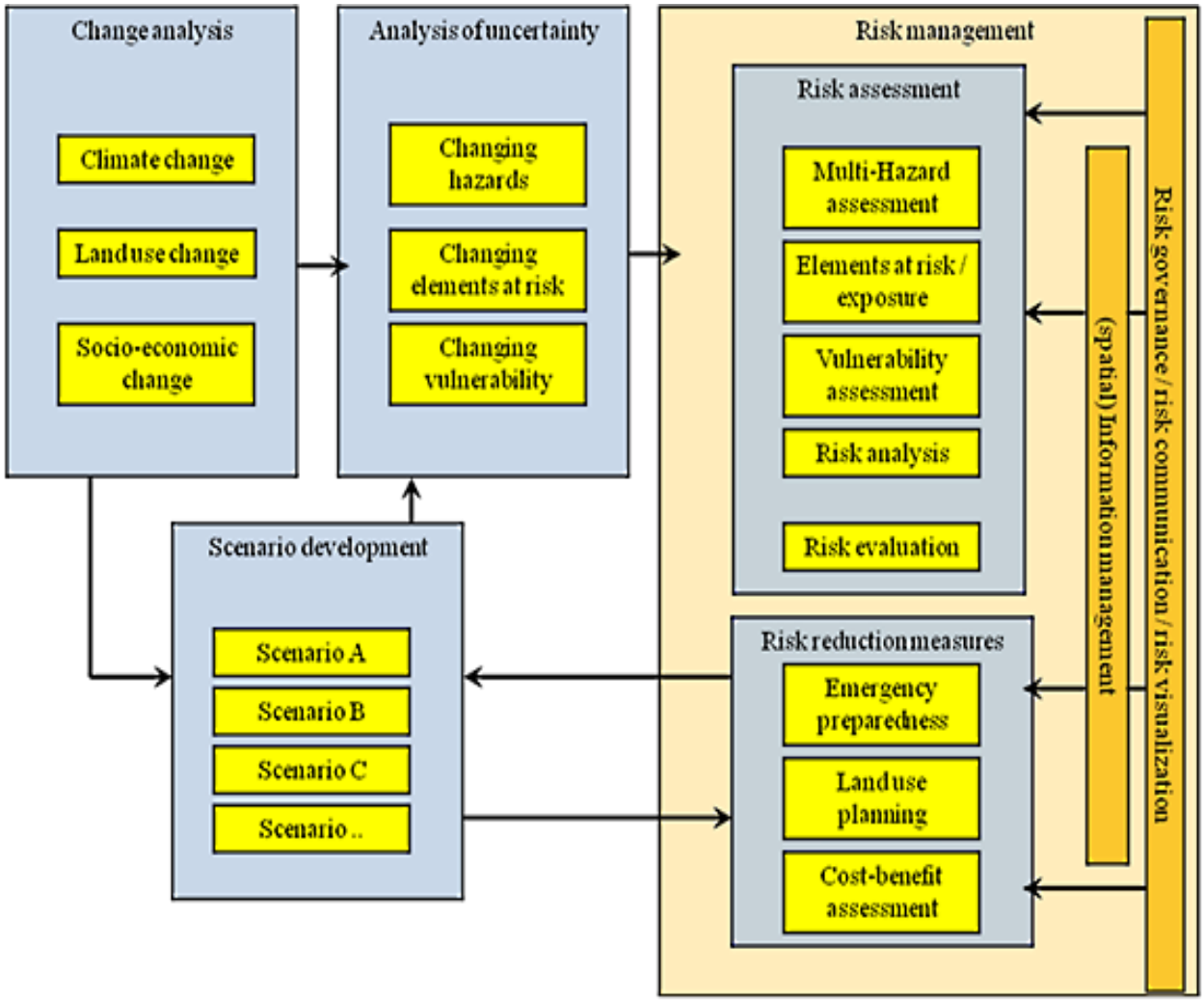
However, with other risks, possible outcomes can be hard to foresee, as the possible range of impact outcomes can be more or less infinite. Environmental impacts are a good example of this, as some outcomes may be unpredictable or indirect, as is the case with secondary or synergistic impacts.

The probability of an outcome occurring:

Probability means the chance that a particular outcome will occur. In some cases this is easier to predict, like rolling dice where the odds of a particular number coming up are 1 in 6 or 16.75 percent. In other cases it may not be possible to calculate a probability exactly, in which case it will be only an estimate. Normally insufficient information is available to determine the probability of some events, like earthquakes or volcanic eruptions.

<u>The Risk Management Process</u>

The Risk Management Process is a universal stepped process that can be applied to manage any enterprise, organisation, business or operation, etc, with the overall objective of reducing the occurrence of risk related loss incidents to acceptable risk and impact levels.



WHEN TO USE THE RISK ASSESSMENT AND THE RISK MANAGEMENT PROCESSES

Whenever there are situations where the nature of risks, their causes and their magnitude are unknown or poorly defined, formalised risk assessments should be performed, followed by the other risk management process steps. For example:

* At the start of new projects related to development projects, like new site or plant designs, etc. The HAZOP and What-if risk assessment technique tools are often used for these risk assessments.

* When plans are being made to perform machinery or production process modifications, facility extensions or expansions, etc where the potential risks are unknown or poorly defined. Here again HAZOP is often used in both the parameter and procedural forms to achieve the desired outcomes. Change Management assessments can also be used for assessing some operational modifications.

* After an accident or incident where harm, damage, machinery or process failure incidents have occurred and the actual causes of the incident are unknown or unclear, a FMEA or Fault Tree Analysis risk assessment technique can be used.

* Before planning for an operation to be relocated, discontinued, closed or demolished, there is a need to assess the various risks that could arise. The effective loss of an operation or losses arising from actions and activities performed while relocating, demolishing or removing plant, services or structures are risks that can be avoided or mitigated if proper risk assessments are performed during early planning stages. For example, an early assessment of the closure requirements and the potential risks is an important element in terms of achieving mine or other environmental closures. A change management related risk assessment can enable the likely problems (ie. both the environmental and other issues) to be identified up front and this allows time to deal with and resolve the issue.

BENEFITS OF RISK ASSESSMENT AND THE RISK MANAGEMENT PROCESSES

There are a number of benefits from performing risk assessments and using the risk management process,

as presented below:

* The basic steps of the risk assessment process are flexible enough to facilitate the process being used to identify, evaluate and value judge a wide range of risks.
* In some cases once a risk assessment has been performed, the process may not have to be repeated unless some change has given rise to a new risk occurring or the previously assessed risks have undergone some dynamic change, necessitating a re-assessment.
* Performing risk assessments facilitates compliance with legislation of various sectors such as occupational health and safety, mining, environment, etc.
* Risk assessments at the early stages of a project will permit certain design measures, controls and procedures to be developed and incorporated into the project's design to eliminate the causes of potential risks. This can avoid the need to provide for certain additional resources for re-active cleanup and can save on retrofit upgrade design changes or alteration costs at a later stage.
* With the nature and causes of risks established, it is possible to develop suitable risk control standards, systems, compliance and management systems to effectively control the risks, particularly in relation to worker accident or incident prevention.
* Risk assessments followed by applying risk controls is a proactive means to avoid incidents, with an accident or incident investigation being the reactive means of addressing incidents.
* The risk assessment and risk management process is an accepted and systematic method of identifying, assessing and managing the risk, such that most risks will be identified and can be suitably eliminated or managed in the long-term.
* The risk management process provides a generic framework approach to identify and manage all forms of risk and it can be easily and systematically applied to all the different business management function fields of any sized enterprise.

* The risk management process approach permits a cyclic process review leading to a continual improvement in ability to control risk.

The Risk Assessment and Risk Management Process is a generic systematic method for identifying, evaluating, appraising risks and permitting these to be identified and to be risk controlled through a process of applying risk mitigation actions to reduce the risks to acceptable levels.
The remaining and residual risks can present a financial risk should an incident occur, necessitating Risk Financing to be provided to pay for such losses and to facilitate a recovery to normal operations.
As risks are often dynamic there needs to be a monitoring and review process in place to monitor that the risk management processes are implemented and are maintained to effectively cater with the existing and newly identified risks. This closing of the loop facilitates the process being of a cyclic nature with the objective of achieving continual risk improvement in the longer term

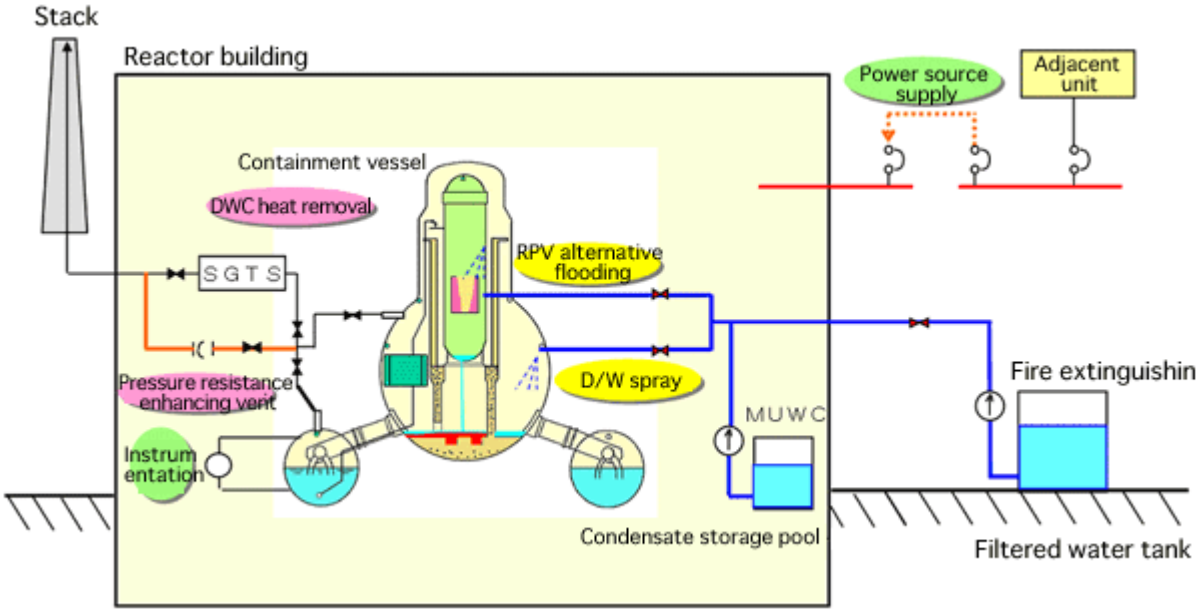
A severe earthquake and massive tsunami hit the Pacific coastline of eastern Japan on March 11, 2011. A total of six nuclear power plants automatically shut down because of the earthquake. Power from outside the plant was also lost. Emergency diesel generators started operating. Emergency reactor cooling systems also began to operate. However, the massive tsunami that struck about an hour later damaged the pumps of the seawater cooling system so the last-resort means of dissipating heat into the sea was lost. The diesel generators also stopped working due to electrical insulation failure so the entire AC power source was lost. The result was a severe accident exceeding the plant's design standards. Systems capable of supplying water to the reactors without using AC power operated, but finally these shut down when their control DC power supply was lost between several hours and two days after the accident.

Without the last-resort means of heat dissipation, the temperature and pressure of the water in the reactors rose, due to post-shutdown heat generation from fuel radiation (decay heat) and water levels in the reactor vessels began to fall. The loss of both AC power and final means of heat dissipation occurred in all of the reactors (common cause failure) so reactors 1 to 4 plunged into crisis one after the other. Reactors 5 and 6 were not at risk because their emergency diesel generators kept working and supplying electricity for their cooling systems to work.

Fire extinguishing equipment was used to douse the reactors in water in an attempt to cool them with the steam generated from the nuclear fuel. These severe accident response measures were established in the 1990s as seen in the figure below.

CHAPTER 5 CASE STUDY FUKUSHIMA DISASTER CHERNOBYL DISASTER

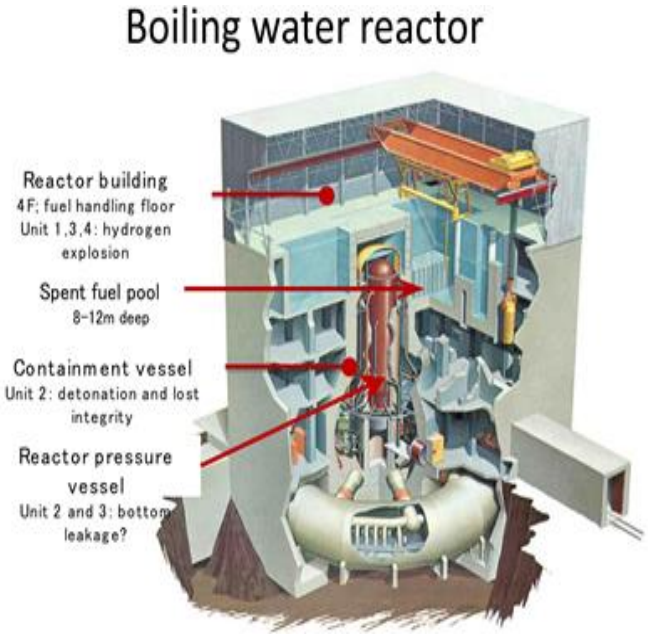
FUKUSHIMA DISASTER



Accident development: Common cause failure of loss of power and loss of ultimate heat sink

Because the reactor pressure was higher than the capacity of the pumps in the fire extinguishing system, water could not be fed in properly from outside. While work for pressure reduction was repeatedly held up by power outages, the fuel rods in the reactor (Unit 1) became exposed, their temperature rose, and oxidation of the zirconium at fuel cladding tubes caused water reduction resulting in the generation of hydrogen. Radiation doses were also high, which further hampered work activity.

Hydrogen is noncondensable so the pressure within the containment vessels rose. To reduce the pressure in the containment vessels (and thereby prevent damage to them and maintain their containment function), gas was released from inside. As the pressure in the reactors and containment vessels fell, hydrogen collected in the top of the reactor buildings. On March 12 and 14 respectively, the hydrogen in Units 1 and 3 ignited explosively and the two reactor buildings were destroyed. The reactor pressure vessels and their containment vessels are housed within concrete 2 meters thick so they were not damaged. (The reactors did not explode. They shut down.) In Unit 2 there was an explosion in the bottom of the containment vessel, which damaged the reactor pressure vessel and the containment vessel(refer the figure below)



Accident resolution: Cooling by injecting water

Water has being injected into the reactors to cool them. The most important thing for cooling the fuel and preventing the release of radioactive materials is to keep the fuel covered in water. Although the cooling method of injecting water and condensing the resulting steam is unstable, the external power supply has been restored so there is only a low possibility of failure to the extent that there would be long-term fuel uncover.

Restoration of the pump and power supply in Unit 2 is taking a long time because of the high radiation level. The contaminated water injected into the reactor flows from the reactor building to the turbine building and has a high radiation dose, and the pump and power supply are positioned in these buildings. The water injected into the unit was flowing from the pit in through a crack caused by the earthquake and into the ocean. The flow from the pit in Unit 2 has been stopped. Leaking and cooling can be resolved by returning the leaking water to the reactor and connecting a heat exchanger along the way to achieve stable cooling.

(The path to accident resolution was shown by TEPCO on April 17. Simultaneous measures include stable cooling of the reactor and spent fuel pool, the containment, treatment, and storage of contaminated water and its reuse for cooling, and the control of radioactive material.)

Atmospherically released radiation: Far less than Chernobyl

Radioactive materials were released in the air together mainly with steam in the explosions on March 12 and 14. The amount of radioactive materials released was extremely low compared with

the accident at Chernobyl in which the reactor itself exploded. (The level of radioactive iodine released-the IAEA's accident evaluation standard-was estimated at between one tenth and one hundredth that of Chernobyl. In Fukushima, hardly any nuclear fuel itself has been released.) Most of the radiation is inside the reactor pressure vessels, containment vessels and reactor buildings. The released substances are noble gases and volatile fission products. Noble gases are dispersed by the wind and disappear. They are not reactive so even if inhaled they are then exhaled. For the volatile fission products of consequence, iodine and cesium are mainly released as cesium iodide. Being water soluble, cesium iodide released into the atmosphere exists in dust and water droplets, and it fell to the ground in rain on around March 20. Water and vegetables became contaminated.

Iodine accumulates in the thyroid gland of infants. Cesium does not collect in any particular organ. The respective half-lives of iodine and cesium are eight days and 30 years while their respective elimination half-lives when taken into the human body are 5 days and 80 days. Contaminated vegetables and milk have been taken off the market. Their permissible radiation amount is set to the low exposure level due to naturally occurring radiation. This does not pose any health hazard.

To be able to store the highly contaminated water that had collected in the turbine building and trench, the water in the radwaste building tank was released into the ocean. The radioactive concentration of the latter was 1/10000th that of the highly contaminated water in the turbine building and trench, so this release was an unavoidable emergency measure. The permissible radiation concentration for seafood is controlled at the same level as for vegetables and other agricultural produce, and fish exceeding that level are taken off the market. This, along with harmful rumors, has had a significant impact on fishermen. Contaminated water flowing out of the plant is dispersed in the eastern Pacific by the Oyashio Current colliding with the Kuroshio Current. Measurement and control of seafood particularly along the coast is important. Long-term research into the accumulation of radiation in marine life is being conducted. Fisherman cannot operate in the seas around the nuclear plant because fishing rights for that area have been originally revoked.

Issues to be examined: Conflict between conservatism in safety measures and impact on people at major disasters

Evacuation places a huge burden on residents with the possibility of disrupting and separating families. Harmful rumors also jeopardize the livelihood of fishermen and farmers. Safety is always considered in a conservative light, but the number of residents forced to evacuate varies greatly depending on the figures used as the basis for evacuation. The same is true of harmful rumors. A detailed response from the government is required. In a major disaster such as this, being conservative may not necessarily help the residents of the affected region. Disaster evacuation can be conducted in the way similar to the evacuation of children during wartime. Perhaps the

conflicting issues of conservatism in safety measures and the impact on people need to be examined going forward.

For factors that are difficult to determine with certainty such as the effects of low dose radiation, the government should not simply respond with conservative figures such as zero or one. Rather, a new kind of relationship between the government and the public may need to be examined which could, for example, take the form of a policy of approval for the return of residents to their homes if they submit a letter of understanding of the potential risk (thereby consenting not to take legal action against the government.)

Although the crisis has not yet been resolved, progress is being made even if it will take a long time. Power and water sources are being restored and there is little possibility of their being lost for a prolonged time. Furthermore, half of the nuclear fuel has already destroyed, and radioactive iodine's half-life of eight days means that most of it has already decayed and disappeared. So there is no possibility of more radioactivity than at the time of the initial hydrogen explosion being emitted going forward. Cesium 137 has a half-life of about 30 years and will now become the main constituent of environmental radioactivity. Radiation damage that can be attributed to the effects of cesium has not been measured in the Chernobyl accident. Results of tests on soil contaminated by radioactivity emitted from above ground nuclear testing indicate that after two to three years, cesium had adhered to the soil and hardly any was being absorbed by rice. Also, the half-life of cesium in the earth's atmospheric circulation is 1.1 years, so even if radioactivity from Fukushima is observed overseas, such observed values are short-term and only about 1/100th of the values seen in the era of above ground nuclear testing.

Of course long-term follow-up studies and research will be required into the effects of cesium not only on the earth's surface but also on marine life.

Conclusion: Accident caused by massive tsunami; drastic improvements to safety mechanism needed

The cause of the accident was an unexpectedly large tsunami. Although the earthquake was the largest on record, the plant actually withstood it and the plant's emergency equipment did function. Possible future measures include installing an emergency power supply or cooling type heat exchanger at an altitude that would not be reached by a tsunami, improvements that have already begun at other nuclear power plants. Many costly lessons have been learned from this accident, but there is a risk of the institutions concerned moving too far towards a detailed tightening of regulations. First, there is a need to drastically improve the country's safety mechanism which was not based on an evaluation of safety against the kind of massive tsunami that

only occurs once every thousand years or so. Detailed regulatory tightening has been continually conducted in Japan since the country began to use nuclear power. Although a lot of effort was put in, some essential points were missed. Since the Tokaimura nuclear accident, there has been wide-ranging reinforcement of nuclear regulatory bodies. This latest accident illustrates the shortcomings of these regulatory bodies and the problems with the safety mechanisms. However, although a drastic overhaul of safety organizations is required, improving the mechanisms does not mean creating another organization.

With the aim of improving global competitiveness, the overriding proposition is for Japan to build the very best national response mechanisms in order to survive the 21st century, not only in terms of safety. Countries and organizations that have built such top rate mechanisms are the ones that have survived.

CHERNOBYL DISASTER

In the early hours of 26 April 1986, one of the four nuclear reactors at the Chernobyl power station exploded.

Moscow was slow to admit what had happened, even after increased radiation was detected in other countries.

The lack of information led to exaggerated claims of the number killed by the blast in the immediate area.

Contamination is still a problem, however, and disputes continue about how many will eventually die as a result of the world's worst nuclear accident.

How the accident occurred?

25-26 April 1986

Engineers on the evening shift at Chernobyl's number four reactor began an experiment to see whether the cooling pump system could still function using power generated from the reactor under low power should the auxiliary electricity supply fail.

At 2300 control rods, which regulate the fission process in a nuclear reactor by absorbing neutrons and slowing the chain reaction, were lowered to reduce output to about 20% of normal output required for the test.

However, too many rods were lowered and output dropped too quickly, resulting in an almost complete shutdown.

Safety systems disabled

Concerned by possible instability, engineers began to raise the rods to increase output. At 0030 the decision was taken to carry on.

By 0100 power was still only at about 7%, so more rods were raised. The automatic shutdown system was disabled to allow the reactor to continue working under low power conditions.

The engineers continued to raise rods. By 0123, power had reached 12% and the test began. But seconds later, power levels suddenly surged to dangerous levels.

Overheating

The reactor began to overheat and its water coolant started to turn to steam.

At this point it is thought that all but six control rods had been removed from the reactor core - the minimum safe operating number was considered to be 30.

The emergency shutdown button was pressed. Control rods started to enter the core, but their reinsertion from the top displaced coolant and concentrated reactivity in the lower core.

Explosions

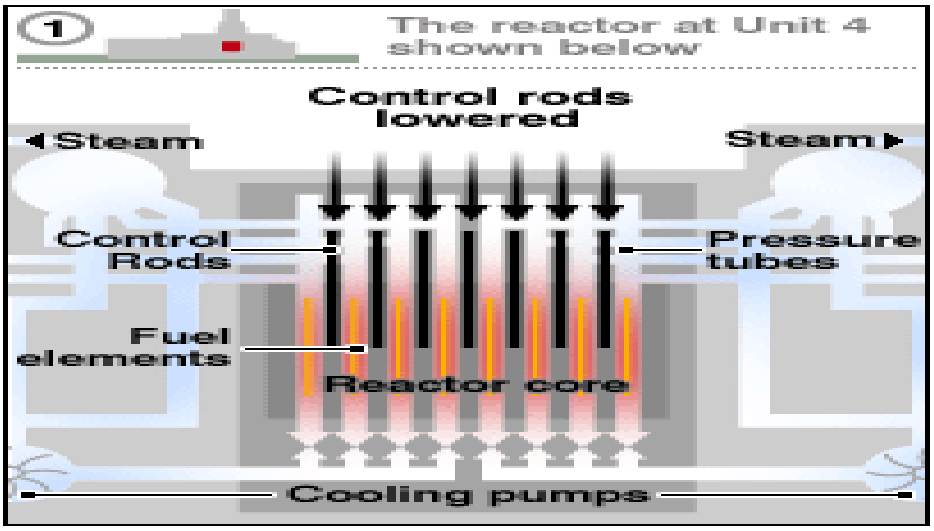
With power at roughly 100 times normal, fuel pellets in the core began to explode, rupturing the fuel channels.

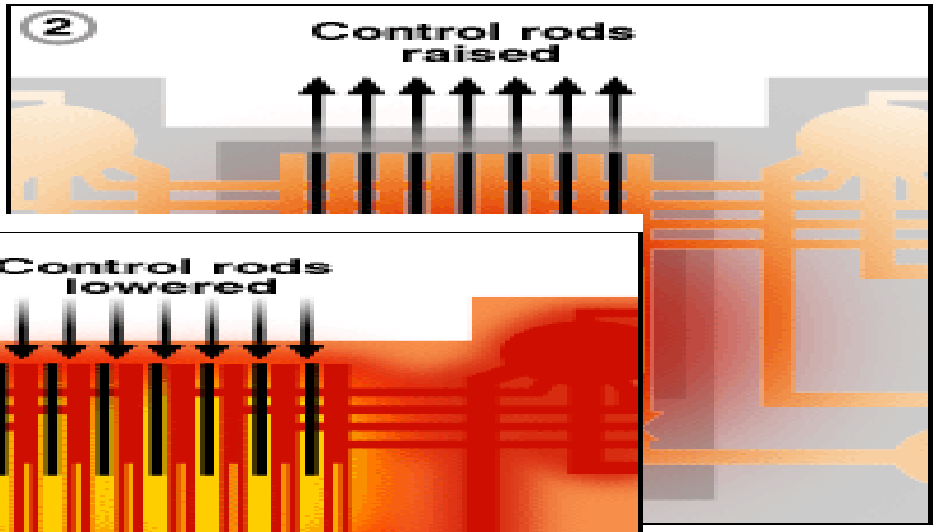
At about 0124, two explosions occurred, causing the reactor's dome-shaped roof to be blown off and the contents to erupt outwards.

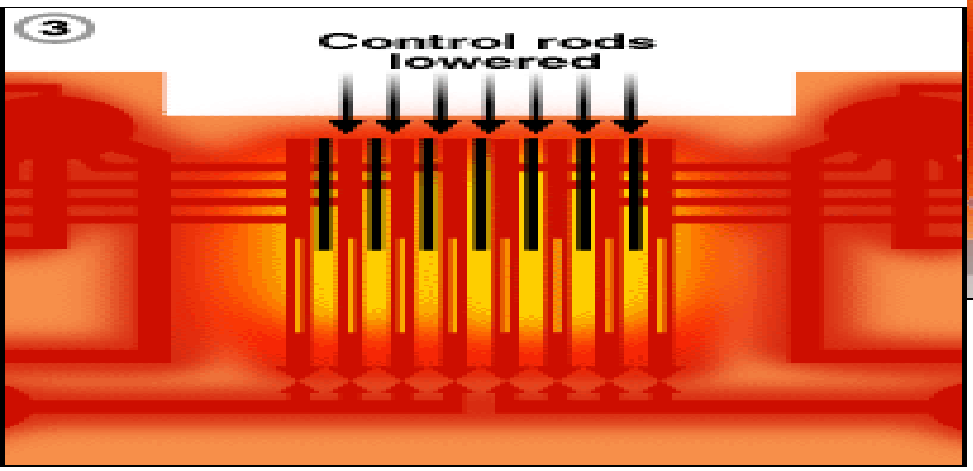
As air was sucked in to the shattered reactor, it ignited flammable carbon monoxide gas causing a reactor fire which burned for nine days.

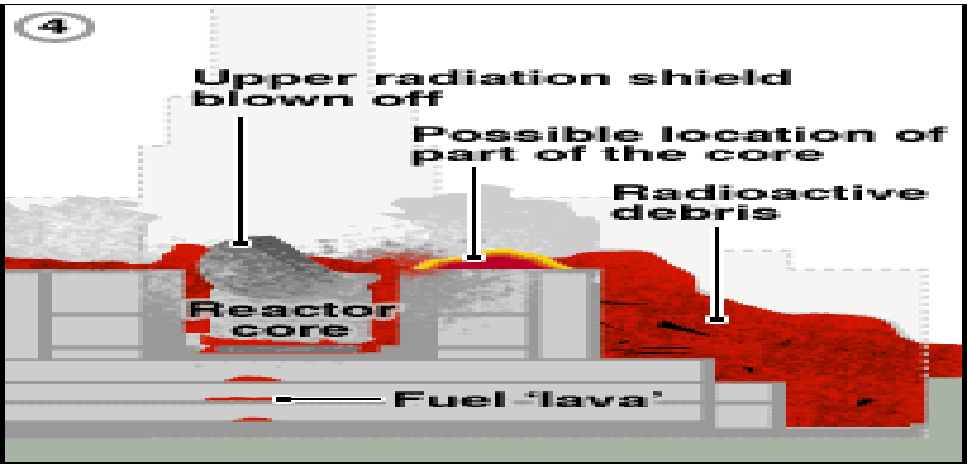
Because the reactor was not housed in a reinforced concrete shell, as is standard practice in most countries, the building sustained severe damage and large amounts of radioactive debris escaped into the atmosphere.

Firefighters crawled onto the roof of the reactor building to fight the blaze while helicopters dropped sand and lead in an effort to quell the radiation.


1
The reactor at Unit 4 shown below
Control rods lowered
Steam
Steam
Control Rods
Pressure tubes
Fuel elements
Reactor core
Cooling pumps


2
Control rods raised


3
Control rods lowered


4
Upper radiation shield blown off
Possible location of part of the core
Radioactive debris
Reactor core
Fuel 'lava'

Effect on environment

The disaster released at least 100 times more radiation than the atom bombs dropped on Nagasaki and Hiroshima.

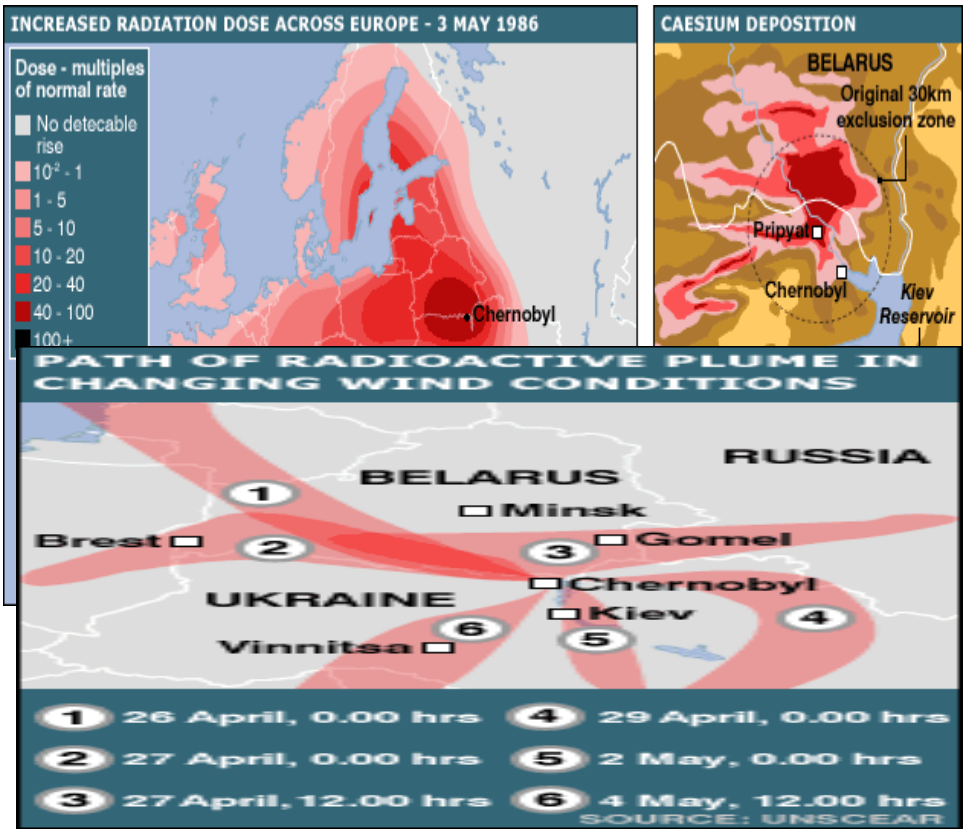
Much of the fallout was deposited close to Chernobyl, in parts of Belarus, Ukraine and Russia. More than 350,000 people resettled away from these areas, but about 5.5 million remain.

Contamination with caesium and strontium is of particular concern, as it will be present in the soil for many years.

After the accident traces of radioactive deposits were found in nearly every country in the northern hemisphere.

But wind direction and uneven rainfall left some areas more contaminated than their immediate neighbours.

Scandinavia was badly affected and there are still areas of the UK where farms face post-Chernobyl controls.



Health effects

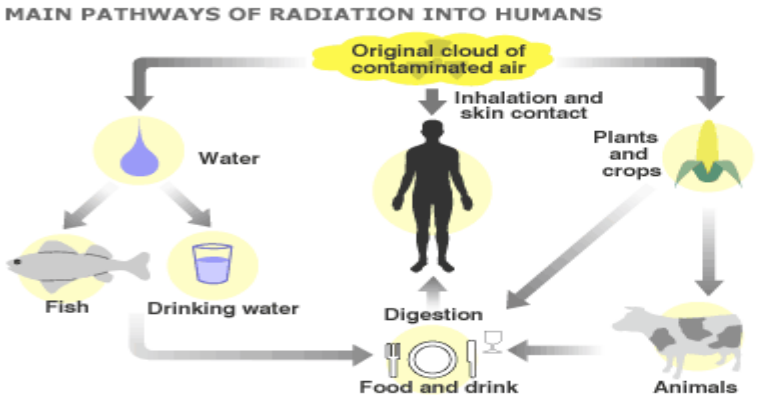
The number of people who could eventually die as a result of the Chernobyl accident is highly controversial.

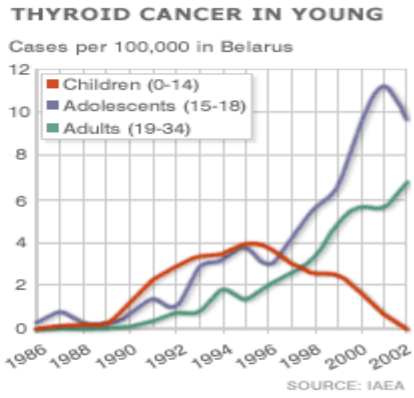
An extra 9,000 cancer deaths are expected by the UN-led Chernobyl Forum. But it says most people's problems are "economic and psychological, not health or environmental".

Campaign group Greenpeace is among those to predict more serious health effects. It expects up to 93,000 extra cancer deaths, with other illnesses taking the toll as high as 200,000.

The most obvious health impact is a sharp increase in thyroid cancer. About 4,000 cases of the disease have been seen, mainly in people who were children or adolescents at the time.

Survival rates are high and only 15 people are known to have died. But Greenpeace says there could eventually be 60,000 cases of the disease, among 270,000 cases of all cancers.





Present day

The sarcophagus encasing Chernobyl was built in haste and is crumbling. Despite strengthening work there are fears it could collapse, leading to the release of tonnes of radioactive dust.

Work is due to begin on a £600m replacement shelter designed to last 100 years. This New Safe Confinement will be built on site and then slid over the sarcophagus.

The shelter will allow the concrete structure to be dismantled and for the radioactive fuel and

damaged reactor to be dealt with. The ends of the structure will be closed-off.

Despite the lasting contamination of the area, scientists have been surprised by the dramatic revival of its wildlife.

Wild horse, boar and wolf populations are thriving, while lynx have returned to the area and birds have nested in the reactor building without any obvious ill-effects.