Chapter 2

Institutions (Social, Economic, Political, Legal and Cultural) and Environment

2.1 Evolution of Technology, Social, Economic and Political Organisation and Growing Resource Demands

Human dominance of the biosphere is in large measure due to our ability to fabricate and use artefacts, i.e., to our technology. Well before our own species stepped on the earth, our hominid ancestors had begun to use wood, bone and stone tools. At this time they lived in small social groups that administered themselves and often struggled with other groups. They gathered resources for themselves and had minimal resource demands. Our own species, *Homo sapiens*, initially followed much the same pattern. But around 45 thousand years ago, they further elaborated the tool technologies and importantly added to their repertoire fabrication of decorative articles and painting of caves. They also seem to have initiated some barter and trade. They began to spread over many areas of land, and might even have crossed the seas to reach Australia.

The next major technological revolution was the domestication of animals and cultivation of plants, beginning around 10 to 12 thousand years ago. This led to the elaboration of village societies, much higher population densities, and with them greater overall resource demands. The next major technological

advances, around 6000 years ago, entailed irrigated agriculture, use of metals and domestication of the horse facilitating fast movements. This permitted development of surplus food production that could support people entirely devoted to priestly and soldierly occupations. This led to the rise of a state and in turn, more extensive trade. Alongside human permeation growth, there were new resource demands for religious, war and trade purposes. In turn, religion, war and trade all fuelled further technological growth, use of and demand for newer and newer resources such as timber for ships.

The development of knowledge of how the world works and elaboration of technologies has always gone hand-in-hand. Both received a new impetus around 17th-18th centuries with the elaboration of the modern scientific method. The scientific methodology insisted on the primacy of empirical evidence as the source of knowledge and rejection of all religious and other authority. These developments occurred in Europe permitting European societies to usher in the industrial revolution and colonise much of the non-European world. There were vast empires with colonies and a substantial increase in the rate of resource use in the colonies to meet the imperial demands.

This imperial-industrial phase culminated in the Second World War, fought over access to resources of the colonial world by the imperial powers. The War itself stimulated development of new technologies, culminating in the electronic and computer revolutions. These have brought the world closer together, creating a "global village" with new forms of social, political, economic organisations, including the rise of multi-national corporations. This has led to an explosion of economic activity the world over with human demands for resources of the world reaching unprecedented levels.

2.2 Impact of Economic Growth on Environment

Economic growth of a country is expressed as Gross Domestic Product (GDP). It also indicates the rise in per capita income and purchasing power of the people and thus, is one of the indicators of quality of human life in the modern world.

Over the last century, countries of the world have seen an enormous growth in their economies. India is

one of the fastest growing economies after China (9.5 per cent) and Argentina (9 per cent) with an annual economic growth rate of 7.5 per cent.

While growth in GDP has been looked at as a good sign for economic sustainability there have been growing concerns over environmental sustainability over the past few decades.

Rise in economic growth as reflected through rise in incomes indicates that there are more jobs available and more and more people can seek employment and thus many can pull themselves out of poverty. It also indicates possibilities for increase in taxes and hence public money can be directed for the public good such as better maintenance of public infrastructure. It also attracts more foreign investment and hence greater domestic opportunities. Higher consumption means higher production (and hence revenues) indicating higher incomes.

In the early years of industrialisation, the developed countries experienced a rapid economic growth, which was based on the exploitation of the natural resources on their lands and in other countries. This resulted in problems such as environmental pollution, consumerism, social inequalities, and added an uncertainty factor in the world economic scenario.

In sharp contrast to this, during the same period, developing countries were struggling to bring in economic development and foreign investments were limited to exploitation of natural resources in these countries. As the developing countries altered their foreign and economic policies it then became possible for foreign industrial corporations to invest directly, that is to access their domestic markets. The result was a type of economic growth that was detrimental to the environment and which followed the footsteps of the developed world's growth model.

Thus, there are several risks of economic growth. In developing countries a lack of technology and funds for sustainable exploitation of natural resources and mitigation of environmental problems, pollution of air, water and soil has been rampant; over-exploitation of natural resources such as coal and minerals has devastated forest landscapes and arable land; solid and liquid wastes have polluted water bodies beyond clean up and the air is highly polluted by vehicles that release harmful pollutants in the air increasing human health

costs. Congestion in traffic networks have become hourly events and we now even face an energy crisis.

Thus, on one side when certain sections of the society in the developing world are experiencing the benefits of economic growth, most of its population is exposed to risky environmental situation, which have been a resultant of environmentally unsustainable economic growth. Economic and social inequalities have been the most important side-effects of economic growth and with rise in incomes the gap between the rich and the poor has increased further.

Most serious effects of economic growth perhaps have been due to over population, depletion of natural resources due to over harvesting, global warming, generation of large amounts of wastes, and loss of biodiversity.

No country can develop without the use and exploitation of its natural resources. We get our water, air, food and fuel from nature. But long-term economic sustainability goes hand-in-hand with environmental sustainability.

2.3 Inequitable Economic Growth, Poverty and Environment

India harbours a most complex society. We may view it as comprising people belonging to four major categories, namely, (a) rural poor: comprising small and marginal farmers practicing rainfed agriculture, herders, artisans, forest produce collectors, artisanal fisherfolk and landless agricultural labourers, (b) rural well-off: primarily owners of good sized irrigated agricultural land, (c) urban poor: primarily those subsisting on wages in unorganised sector, and (d) urban well-off: primarily employed in the organised sector. Our failure to ensure inclusive economic growth has meant that two of these groups, namely, urban and rural well-off tend to be subsidised at the cost of rural and urban poor. We may illustrate this with respect to water. Water is becoming an increasingly scarce resource all over India, and conflicts over water are occurring at all levels. Such conflicts display many dimensions pertaining to

Jhum cultivation

issues of poverty associated with inequitable economic growth. Consider as an example the use of ground water in the coastal tracts of the Uttara Kannada district of Karnataka. Traditionally, the crops of this region include rice (largely cultivated by small holders) and betel nut, primarily cultivated by richer orchard owners. When, fifty years ago, there were no electrified pump sets, the water table was at a depth of about five meters, and the small holders were able to hand irrigate and raise a second crop of rice in the winter. Following rural electrification, free power was made available to farmers along with subsidised pump sets. These facilities were primarily availed of by the orchard owners, who began to extensively irrigate betel nut in the dry season, substantially increasing its yields. But this drove the water table down. As a result, the poorer small holders could no longer raise a second rice crop. This compelled their women to switch to the sale of fuelwood as a livelihood activity in the dry season, resulting in extensive conflicts with forest authorities and the degradation of forests at a rapid pace.

2.4 India as a Country where many different Modes of Resource use Co-exist

India is a land, not only of great biological diversity, but also of cultural diversity. It at once harbours hunter-gatherers and shifting cultivators, practitioners of low input rainfed agriculture, modern high input agriculture, country boat fishermen and modern trawlers and purse seiners, village artisans and modern industrial and post-industrial enterprises.

Humans are a tool-using species par excellence. They initially deployed these tools for hunting animals, digging roots and tubers, gathering insects, etc. This constituted the hunting-gathering mode of resource use. Residents of Sentineles islands in the Andamans still depend totally on hunting and gathering. The next stage of resource use intensification came in with simple hoe cultivation, with frequent shifts of the land under cultivation, and long fallows – the shifting cultivation.

Such shifting cultivation is invariably accompanied by extensive hunting-gathering. This form of resource use continues in many parts of north-eastern hill states such as Mizoram and Arunachal Pradesh, as well as parts of Orissa, Jharkhand, and Chhattisgarh. Settled agriculture began with simple irrigation facilities, such as small scale village ponds or wells. While frequent shifting of agricultural fields was abandoned, rains remained the mainstay of agriculture. Such rainfed cultivation continues all over the country in pockets, covering over half of cultivated land. Large scale irrigation further intensified agricultural resource use and was initiated with dams on rivers built in Mauryan times over 2000 years ago. However, development of extensive tracts under irrigation began first with the British rule, and has intensified over the last fifty years. In these tracts there is also extensive use of chemical fertilizers, pesticides and high yielding crop varieties. Such intensive cultivation is now practiced all over the country in pockets, covering nearly half of cultivated land.

Indian farming has been closely associated with maintenance of cattle and other livestock. While this continues in good measure, intensive dairying and especially poultry keeping is now prevalent in pockets all over the country. India has also harboured specialist pastoral people – cattle or sheep keepers, many of them semi-nomadic, since historical times. They have been particularly important in semi-arid regions and in the Himalayas. These practices continue to this day.

India's rivers as well as the seas have supported fishing activities since time immemorial. With technological advances fishing has been revolutionised, especially in the seas. But here too simple country boat fishing continues along with use of mechanised boats. A recent introduction is that of aquaculture, both of carps in fresh waters and of shrimp along the coast.

India has a rich tradition of village industries and crafts, from oil pressing to handlooms and basketry. Though attenuated, many of these continue, along with modern industries, including information technologies.

This persistence of an incredible diversity

of modes of resource use is related in good measure to the diversity of India's environmental regimes, from islands and coast to high mountains, and from the world's rainiest place to hot and cold deserts. But it is also related to very uneven economic development and substantial regional differences.

2.5 Open Access, Community Controlled, Private and State Management of Resources

Many natural resources such as forests, fisheries, pastures and irrigation systems are instances of common pool resources. In general, a common pool resource is characterised by two main attributes. Firstly, it is subtractable i.e., the extraction of some units of the resource by one user means that there is less of the resource available for other users. For instance, the harvest of fuelwood from a forest, or water from an irrigation system, depletes the quantity of the resource that is available for other users to access. In contrast, public goods such as street lights or radio broadcasts are non-subtractable. If one person on the street enjoys the benefits of street lighting, this does not take away the benefit from others on the street. The second characteristic of a common pool resource is that it is difficult and costly to prevent potential users from accessing the resource. For example, it requires extensive patrolling and the use of punitive measures to prevent over-exploiting of forest produce.

These two characteristics combine to make common pool resources vulnerable to problems of congestion, overuse and potential destruction. Careful, limited extraction of these resources at a level that allows for natural renewal, and the exclusion of at least some potential users, will enable the sustainable use of these resources over time.

The sustainability of a common pool resource depends on the property rights regime used to manage it. Typically, these regimes can be classified into four major types.

Open access, where all users are allowed to access the resource, and harvest from it. Typically, situations like these lead to discussions of the "Tragedy of the Commons", where there are no limits to the amount

that each user can harvest from the system. This leads to eventual overuse and eventually, to the collapse of the system.

Community controlled, where a group of individuals get together to share the right to the resource. They often agree on limits within which harvest is allowed, and monitor the levels of use to ensure that the natural resource is able to renew itself over time. In countries such as India, with a long standing tradition of community use of natural resources, there have been multiple documentations of traditional institutions of forest, fisheries, irrigation and grazing that have been successful in managing natural resources in an equitable and sustainable manner over time.

Private management, where a single individual or private firm has complete rights over the resource, including the right to harvest as well as to exclude other users from harvesting. In cases where the private owner is powerful enough to enforce their rights over the resource, and adopts a long term perspective, this can lead to effective management.

State management, where a formal government (ranging in size from a local *panchayat* to a national government) claims ownership over the resource, as well as the rights to determine who is permitted to access resources, and to what extent. Forests, for instance, come under State management in many countries across the world, including in India. The enforcement of state rights over natural resources often however leads to resentment from local communities, and can make it difficult for Governments to enforce these rights.

2.6 Evolution of Environmental Concerns in different Societies over the Course of History

An interest in conservation of environment is by no means a modern phenomenon. Indeed, the small-scale, egalitarian societies of hunter-gatherers, shifting cultivators and horticulturists which encompass much of human history exhibit a number of practices of restraint in the use of environmental resources. Such societies view the world around them as a community of beings. To them rocks and rivers, trees and birds are

fellow beings, often viewed as kin or as benefactors. These may then be accorded respect and protection in several ways. The restraints so motivated include regulation of two main kinds of processes, namely harvests of biological populations and transformation of habitats. Regulation of harvests may range all the way from occasional lowering of hunting pressure to complete protection. Thus, several Pacific islanders give up fishing from particular lagoons if the catches from these lagoons decline. Some New Guinea tribes stop hunting birds-of-paradise when their populations have declined. Other plants and animals may be totally protected at all times. Amongst the more notable of such instances of total protection is that accorded to several tree species of the genus *Ficus* in many parts of Africa and Asia. Because of this, *Ficus* trees are often left standing when forests are clear-cut in India, and huge trees of *Ficus religiosa* dot India's thickly settled rural countryside, and persist even in city centres. *Ficus* is considered a keystone resource of tropical forests, since it often fruits in months when none of the other plants are in fruit and therefore, promotes the persistence of frugivorous birds and primates.

Small-scale societies regulate habitat transformation by protecting samples of natural communities on sacred sites (e.g., sacred groves, sacred ponds). These sacred sites may be associated with nature spirits resident in trees or pools of water or with more formalised worship as with Buddhist temple groves of Thailand or groves associated with Shinto shrines in Japan. Sacred groves, ponds and lagoons persist to this day in many parts of Asia, Africa and some of the Pacific islands; a sacred cacao grove has also been described from Mexico. Such protection to sacred groves is paralleled by protection to sacred ponds, or pools along rivers. Indeed, the only surviving population of a freshwater turtle *Trionyx nigricans* now occurs in a sacred pond dedicated to a Muslim saint in Bangladesh.

As small-scale gatherer-shifting cultivator societies gave way to larger agrarian societies, regimes of regulation of the use of the biological resource base underwent a transformation. The agrarian societies are characterised by far greater levels of social stratification, with an elite supported by the surplus generated by the peasantry. The elite have access to surplus produced from many different localities; it therefore, has little motivation to promote sustainable resource use in any particular

locality. The elite of agrarian societies, however, have their own new conservation techniques; particularly the hunting preserves where game is strictly protected for hunting by the aristocracy. Such hunting preserves played an important role in biodiversity conservation in medieval Europe and Asia. The Mughal emperors of India, for instance, maintained large areas of several hundreds of square kilometers each as hunting preserves in northern India.

Much of the European expansion beginning in the fifteenth-sixteenth century carried a spirit of rejection of any attempts at restraints on the use of environmental resources or transformation of natural habitats. It was this ethic, which promoted large-scale felling of forests in the north-eastern United States and the massacre of hundreds of thousands of buffaloes (*Bison bison*) of the prairies. The European impacts also related to large-scale introduction of exotic plants and animals on the many continents and islands newly colonised by them. Domesticated animals such as cattle and sheep, and rabbits running wild, were responsible for a significant decline in Australia's indigenous marsupial fauna.

Notions of conservation arose amongst Europeans only in the second half of the nineteenth century as frontiers of new lands to be colonised seemed to be closing and deforestation led to serious negative consequences in parts of Europe such as Switzerland. These led to protection of forests for their watershed function in colonial possessions, and the revival of forest cover under communal management in Switzerland. This also led to the National Park movement in the United States with the setting aside of large scenic areas such as Yellowstone National Park. Notably enough, these areas were thought of as primeval nature untouched by man. In reality, they were humanised landscapes where nature was lightly trodden upon and much of its diversity protected over thousands of years of use by indigenous people. So in the National Park system the emphasis was on regulating human access by deploying bureaucratic machinery.

The 1960s witnessed the beginnings of a strong interest in environmental issues on the part of the developed countries. This interest began with a realisation that pesticides persisting in the environment were reaching excessive levels of concentrations in the bodies of animals high up in the food chain, with serious

consequences, such as reproductive failure in the case of the peregrine falcon *Falco peregrine*. The discovery of DDT in the bodies of penguins from Antarctica also highlighted the ubiquity of these substances. The result was the passage of the Endangered Species Act of 1973 in the United States. This act committed the United States Federal Government to protect critical habitats of endangered species thereby promoting conservation of a diversity of natural habitats outside the National Park system.

The 1970s saw the beginning of serious attention being paid not only to protecting specific areas, but also to regulating processes that have an impact on environment. Such regulation pertains to the production of harmful substances such as pesticides and a variety of industrial effluents that directly affect living organisms, as well as molecules such as Chlorofluorocarbons (CFCs) that have an indirect effect through destruction of ozone and consequent increase in levels of ultraviolet radiation. The regulatory process has also broadened to assessment of environmental impacts of a range of developmental activities, such as the damming of rivers or extraction of timber.

2.7 India's Manifold Traditions of Conservation and Sustainable use

Environmental consciousness is not a recent concept in our country. Several traditional societies still retain what they have learned from their forefathers about their own surroundings. But during the 'modern' era, much of this traditional learning has disappeared. In the past, most societies learned from experiences in and from nature herself. They knew about the life giving rain and the threat from storms. They knew which plants have medicinal values and which were poisonous. They knew about several animals and birds in the forests. They understood the cyclic phenomena of grasslands and wetlands. In fact they appreciated all the species of plants and animals that were useful in nature and those that were dangerous. They also appreciated life forms that have a deep spiritual or religious meaning in their day-to-day lives. These species were given specific names from very early times.

We know of traditions that are specific to different cultures in the world from both the agricultural and urban

environments. The Indus Valley civilisation is known to have had multiple sites far away from Mohenjodaro and Harappa throughout the Western part of India. They had remarkably well planned townships, environmentally appropriate housing, broad streets, bathing tanks and a complex of efficient drainage systems. They appear to have had carefully studied and planned urban environments.

India has perhaps some of the most ancient information bases on and about environment and its management. The Vedas have enmeshed in them several environmentally sensitive concepts that are linked to spiritual thought-processes. There are repeated teachings about the value of life itself. The Buddhist and Jain philosophies brought these issues at the centre stage of life of every human being.

References to land tenure, water management and protection of forests and wildlife recur frequently. For example, the *Arthashastra* gives the king deep insights into how to manage land and its resources, how to justify the collection of taxes in the form of a percentage of agricultural produce based on the productivity of the land, without oppressing the poor. It teaches how to relax these norms in times of a crisis such as droughts. It was the king's duty to look after the land and thus the welfare of his people. This could only be possible by managing environmental resources appropriately. The *Arthashastra* also provides for differential management of forests. Those for people to collect resources, those that were protected for the king's *shikar* (game), and forests that were to be kept inviolate where elephants could breed in peace and be captured only for the ruler. Elephants constituted the most efficient 'army tanks' of the period and were a key to victories in battle.

Ashoka's well known edicts not only asked his people to protect forests, but appear to be the earliest list of what we would refer to today as 'Schedule Species', those that require a different and more intensive level of protection.

Many of India's tribal people protect small patches of natural forests as sacred groves even today. There are sacred tanks and springs dotted

Sacred grove, Meghalaya

all over India. The *Ganga* is considered sacred throughout her length. The Himalaya, the source of our perennial water supply to the great agricultural plains of India have been venerated through the ages.

During the medieval period we have the Mughul Emperor Jehangir whose interest in *shikar* led him not just to kill thousands of animals, but to study their behaviour in great detail and make his artists paint them in superb miniatures. Shivaji Maharaj had an edict to protect trees in the Western Ghats even though there was a great need to fell timber for building warships. He said that the trees were to be protected like one protects children and that their destruction by force would be an act of tyranny against the people.

The British who ruled India for nearly 200 years were here to exploit India's natural resources. To do this more systematically they developed mechanisms and institutional arrangements to document India's natural resource wealth. Many administrators became so absorbed by what they saw in India's natural environment that they became great botanists, mammalogists, ornithologist, herpetologists and entomologists. This information later became the formal basis of the scientific knowledge of Indian botany and zoology.

There were other equally valuable and important environmental concerns. Prevention of air and water pollution was known in several ancient civilisations. Many cultures reused waste water for kitchen gardens. Wells, lakes and canals for irrigation were carefully managed as a community resource.

Across the country traditional pastoralists who moved from place to place with their sheep have had their own rules to limit grazing so that pasture areas are not over-grazed.

Many of their traditional conservation practices have been retained in different parts of our country even today. There are sacred groves especially in tribal areas of Maharashtra, Gujarat, Madhya Pradesh, Orissa and the North Eastern states.

In Rajasthan the Bishnoi community have protected Khejadi trees for decades. When a King tried to fell trees in ancient times, the village women laid down their lives to prevent the destruction of these trees. This led Sundarlal Bahuguna naming his movement to prevent deforestation in the Himalayas as *Chipko Andolan* after the Bishnoi community's action to protect their trees from being felled when soldiers were cutting them down. The Bishnois even today zealously protect wildlife and have apprehended poachers who have killed blackbucks in their areas.

In Chilka lake in Orissa, fishermen protect the water fowl that gather there in large numbers each winter. In many village communities across India, the recent initiatives are to form village level 'Forest Protection Committees' that guard against felling of trees. Examples include the Gond tribal folk in Gadchiroli in Maharashtra. In Assam the village people have created a sanctuary for the rare golden *langur*. The forests around Khonoma village have been managed sustainably in Nagaland. The village of Khonoma in Nagaland is a wonderful example of people's initiative to protect the rare bird called the Tragopan in a sanctuary managed by local people. This is organised and protected by the village council. Along the Western and Eastern coastal belts, local people have started movements to prohibit trawling by mechanised boats that are destructive to fisheries and marine biodiversity such as the rare marine turtles, and coral reefs.

In a village in Karnataka called Kokkare Bellur local people have protected the large colonies of pelicans and storks that nest on the trees within the village. These fish-eating birds roost and nest in the village. The villagers collect the droppings of the birds, which are used as a fertilizer. The result is the colony of birds has been carefully protected for decades. There are many more examples of community initiatives that protect environmental resources.

The only way of ensuring that biodiversity conservation becomes a reality in our country is through participation from local people who live in and around wilderness areas. As new lifestyles infiltrate into their communities, traditional values begin to disappear. The outcome is environmental degradation.

In 2002, the Wildlife (Protection) Act, 1972 was amended to include 'Community Reserves' to add to our network of National Parks and Wildlife Sanctuaries to protect India's great wealth of biodiversity.

Government has now set up new methods for conserving our rapidly disappearing natural resources. Eco-development projects have been initiated especially around tiger reserves. While Government have been policing National Parks and Sanctuaries over the last hundred years, the concept of Community Conserved Areas has now become a part of legislation. These reserves are being managed by people living in the area. In the North East India, the village people of Shankar Ghola are protecting the endangered Golden *Langur*. Chakrashila Wildlife Sanctuary is supported by local people to protect this rare monkey. In Garhwal, the village people of Jardhargaon have restored a large area of natural forest of oak and rhododendrons. In the recent past the Government have included 40 Community Conserved Areas in the network of protected areas.

Mahatma Gandhi said that the earth can support everyone's needs but not our greed. It was perhaps the earliest message that we are using up earth resources through unsustainable development. Proactive leaders and conservation conscious people have teamed together to bring about conservation in more recent times. Salim Ali, the great ornithologist, was able to convince Smt Indira Gandhi, the former Prime Minister of India, to save the incredible forests of Silent Valley of the Western Ghats where a dam was to be built. Much of the thought behind this came from NGOs and individuals concerned with environmental protection. Many of India's Pro-conservation Acts and the advocacy to spearhead the Convention on International Trade in Endangered Species were initiated by these and similar NGOs. This helped protect the killing of animals such as tigers, leopards, elephants, rhinos, musk deer etc. being killed for fur, skin and medicinal products for domestic consumption and export.

We need to see that people's initiatives grow to become large generalised movements to bring about conservation in our country. The only definite way forward is for school teachers to bring about pro-conservation behaviour and a love for nature in the young minds of our school children. India urgently needs a new young and effective green movement to help bring about sustainable development and a concern for our environment.

2.8 Shift of Environmental Regulation from Nature Worship, Customary Law to Wildlife Act, Forest Conservation Act, Environmental Impact Assessment and Biological Diversity Act, etc.

The manner, in which numerous environmental regulations on forest, wildlife, water, air and land among others have evolved in India, reflects not only the changing political and economic climate but also is rooted deep in cultural, ethical and spiritual ethos of the Indian society. Mythological references to various aspects of environment have been a tradition of the Indian society.

The *Vedas*, *Manusmriti* and the *Puranas* have all considered the basic tenets of ecology and environmental ethics. Forests have been regarded as 'Devaranya' or 'God's Abode' and strict prohibition was placed on cutting live trees. In fact 'Aranyaka' texts include some of the oldest Upanishads which are meant for the study of those who had embraced 'Vanaprastha'. Earlier laws relating to wildlife have been mere moral sanctions rather than codified legislation. The earliest codified law traces back to the 2300 BC when King Ashoka made a law in the matter of preservation of wild life and environment wherein he prohibited the killing of certain species of animals such as parrots, geese, rhinoceros etc. *Arthashastra*, the state craft manual written by Kautilya, too refers to *Abhyaranyas* or forest sanctuaries.

The modern codified law on environment has its roots in the British administrative system. The colonial era saw the emergence of a plethora of laws for consumption and use of natural resources. Land Acquisition Act, 1894, Indian Forest Act, 1927, Elephant Preservation Act, 1878, Wild Animals and Birds Act of 1912 and Indian Easement Act, 1872 are few such examples.

In the international arena the early legal controls were initiated not out of a desire to protect the environment *per se* but out of the recognition of dangers to health associated with pollution. In fact, the United Nations Stockholm Conference in 1972 proved to be the watershed in the history of environmental policy making in several nations including India. The Wildlife (Protection) Act, 1972 and Water Act of 1974 adopted around this time reflect not only international commitments but also strong political concern on

environmental issues. However, proactive legislations on environmental protection in India are of recent origin and most of them have been enacted in the post nineteen eighties. Until then, the regulatory system on this issue was fairly dull.

India responded quickly to the Bhopal gas tragedy through enactments of several environment laws such as, the Environment Protection Act, 1986 and later the Public Liability Insurance Act, 1991, National Environmental Tribunal Act, 1995 and the National Environmental Appellate Authority Act, 1997. These laws in quick succession within a decade show a pattern and priority of the Government.

The developments that triggered post 1991 liberalised economy phase also witnessed knee jerk and tentative legislative responses in the form of Environment Impact Assessment Notification, 1994, Coastal Regulation Notification, 1991 and numerous pollution, waste management and other environment related rules under the Environment Protection Act, 1986. Two more significant events happened almost simultaneously. One, there was an internal environmental crisis due to habitat destruction and its fragmentation by those engaged in developmental activities. Secondly, there emerged a stronger India from the economic standpoint, which forced her to assume a more proactive international role and respond to international commitments. The Biodiversity Act, climate change concerns, Amendment Act, 2006 to the Wildlife Act that created the Tiger Conservation Authority, demonstrate this clearly.

The need for integrating local community and their concerns in natural resource management also witnessed several policy changes in the form of participatory strategies with or without legal backing. Another global concern is the issue of security of tenure on lands on which communities subsist. This culminated into the most recent and historic legislation, the Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006.

The role of judiciary and especially the Supreme Court cannot be undermined and it has shown exemplary courage in standing up to environmental concerns while maintaining a delicate balance between the need of the ecology and the poor. Let us all remember what E.P. Gee, a great naturalist who once said: "The existence of a sound nature and wild life conservation organisation in a

country is a reliable indication of the stage of a country's progress and development."

2.9 Tools of Environmental Management, Efficiency of Resource use, Sustaining Harvests, Pollution Control

Environmental Management (EM): Introduction

We depend on the environment to meet our basic requirements such as food, fuel, fibre, fodder, minerals and vital support systems (e.g., water and air). However, due to our continuous indulgence in the exploitation of nature for immediate gains, we contribute to environmental degradation and depletion of natural resources, and this needs to be arrested. It is, therefore, essential that we understand the function and interaction of physical and biological elements of the environment and apply this knowledge for sound management programmes to conserve the natural resources we are endowed with. Sustainable management of renewable resources in industry, agriculture, recreation, health, forestry, fisheries, education or urban development and for that matter any human activity, is therefore, critical. The conservation of resources and maintenance of the quality of ecosystem requires as much imaginative and innovative technology as the active participation of the public.

Essentially, Environment Management represents the management of various activities, including environmental planning, conservation of resources, environmental status evaluation and environmental legislation and administration. It focuses more on implementation, monitoring, auditing, practice and the real-world issues rather than on theoretical planning of course anticipation of consequences, both short and long term of human activities/actions whether of individuals or collective is essential for effective EM. The goal/ objective of EM, which is an approach for environmental stewardship integrating ecology, policy-making, planning and social development, include:

- preventing and resolving environmental problems;
- establishing limits;
- establishing and nurturing institutions that effectively support environmental research, monitoring and management;
- identifying threats and opportunities;
- sustaining and, if possible, improving existing resources;
- improving the quality of life;
- identifying environmentally sound technologies or policies.

Some of the approaches followed for EM to accomplish sustainability include the following:

- Adhoc approach: This means an approach developed in reaction to a specific situation.
- Problem-solving approach: This refers to an approach that follows a series of logical steps to identify problems, needs and solutions.
- Systems approach: This approach focuses on interactions and inter-relations between various micro and macro systems such as ecosystem (e.g., mountain, high latitude, savannah, desert, island, lake, etc.), agro-ecosystem, social systems to identify the genesis of the problems and to arrive at plausible solutions.
- Regional approach: This is based on ecological zones or bio-geophysical units such as watershed, river basin, coastal zone, islands, etc.
- Specialist discipline approach: This refers to the approach often adopted by professionals like air quality management, water quality management, land management, environmental health, urban management, conservation area management, etc.
- Voluntary sector approach: This represents the approach NGOs (Non-Government Organisations) encourage and/or support.

Environmental Management Tools

One of the outcomes of policy development since 1970 has been the evolution of the techniques for the analysis and management of environmental effects. Some of the tools are:

(i) Environment Impact Assessment (EIA).

(ii) Economic assessment, usually through Cost-Benefit Analysis (CBA).
(iii) Environment Impact Statements (EIS).
(iv) Environment Audits.
(v) Waste minimisation programme and environmental management systems.
(vi) Life Cycle Assessments (LCA).
(vii) Environmental Design (ED).

These tools are indispensable as far as environmental management is concerned. But, rather than being comprehensive, self-contained procedures, these tools are really aids that can be adapted for various situations. Legislative and bureaucratic frameworks for environmental management differ considerably, not only between nations, but also among states or regions within countries. Some procedures fit within others, for example, an environment impact statement is a tool or instrument, used within a more general environment assessment process. These methods are contributions to decision-making, rather than complete decision-making procedures.

Environmental Impact Assessment (EIA)

In recent years, there has been a remarkable growth of interest in environmental issues, sustainability and the better management of development in harmony with the environment. Associated with this growth of interest has been the introduction of new legislation, emanating from national and international agencies (e.g., the European Commission) that seek to influence the relationship between development and environment. Environmental Impact Assessment (EIA) is an important tool to assess the viability of a project from the environment point of view. It is defined as an activity designed to identify and predict the impact of legislative proposals, policies, programmes, projects and operational procedures on the bio-geophysical environment and on the health and well being of all living forms in general, and human beings in particular and to interpret and communicate information about the impact.

That is to say, EIA focuses on problems, conflicts or natural resource constraints that could affect the viability of a project. It also examines implications of a project that might harm people, their homeland or their livelihoods, or other nearby developments. After

predicting likely environmental consequences and related problems, EIA identifies measures to minimise the cause of problems and outlines ways to improve the project's suitability keeping its impact on the environment within manageable limits.

In the last three decades, EIA has been recognised as the most valuable, inter-disciplinary and objective decision-making tool with prospects to suggest alternate routes for development, process technologies and project sites. It is considered to be an ideal anticipatory mechanism allowing measures that ensure environmental compatibility in our quest for socio-economic development.

EIA is generally wider in scope and less quantitative than other techniques, such as Cost Benefit Analysis. EIA has the potential to be a basis for negotiation among the developers, public interest groups, planning regulators, and other stake holders.

Purposes of EIA

EIA is a process with several important purposes, which can be categorised as follows:

To facilitate decision-making: For the decision-maker, for example the local authority, it provides a systematic examination of the environmental implications of a proposed action, and sometimes alternatives, before a decision is taken. The decision-maker along with other documentation relating to the planned activity can consider the Environment Impact Statement (EIS).

To aid in the formation of development: Many developers see EIA as another set of hurdles for them to cross in order to proceed with their various activities. It can be an aid to the formulation of developmental actions, indicating areas where the project can be modified to minimise or altogether eliminate the adverse impacts on the environment. The consideration of environmental impacts during the stage of planning the developmental activity can lead to an environmentally sensitive development, improve relations between the developer, the planning authority and the local communities and a smoother planning permission process and sometimes to a worthwhile financial return on the expenditure incurred.

To be an instrument for sustainable development: The key characteristics of sustainable development include

maintaining the overall quality of life, maintaining continuing access to natural resources and avoiding lasting environmental damage. Institutional responses to sustainable development are, therefore, required at several levels i.e., local, regional and global. For example, issues of global concern, such as ozone-layer depletion, climate change, deforestation and biodiversity loss, require a global political commitment to action.

The United Nations Conference on Environment and Development (UNCED) held in Rio-de-Janeiro in 1992 was an example of international concern and also of the problems of securing concerted action to deal with such issues. Governments have recognised the interaction of economic and social development and the ecosystems, and the reciprocal impact between human actions and the bio-geophysical world. While there are attempts to manage this interaction better, investigations reveal disquietening trends that could have devastating consequences for the quality of the environment. These trends are likely to be more pronounced in developing countries where, because of high rates of population growth and lower current living standards, there is more pressure on environmental resources.

Steps in EIA Process

EIA represents a systematic process that examines the environmental consequences of the development actions, in advance. The emphasis of EIA is on prevention and, therefore, is more pro-active than reactive in nature. The EIA process involves a number of steps, some of which are:

Project screening, Scoping, Consideration of alternatives, Description of the project/development action, Description of the environmental baseline, Identification of key impacts, The prediction of impacts, Evaluation and assessment of significance, Mitigation, Public consultation and participation: EIS presentation, Review, Decision-making, Post-decision monitoring, Auditing.

Environmental Impact Statement (EIS)

The Environmental Impact Statement (EIS) provides documentation of the information and estimates derived from various steps in the EIA process. The information contained in the EIS provides the decision-makers/ regulators with valuable information that could ultimately

contribute to either the abandonment or substantial modification of a proposed development action.

Impact Indicators

An impact indicator is an element or a parameter that provides a measure (in at least some qualitative sense) of the significance of the effect, i.e., the magnitude of an environmental impact. Some indicators are morbidity and mortality statistics and crop yields and associated numerical scales. Other impact indicators, however, can only be ranked as 'good', 'better', 'best' or 'acceptable', 'unacceptable', etc. The most widely used impact indicators are those within statutory laws, acts, i.e., indicators such as air and water quality standards that have statutory authority. For example, the problem of designing an environmentally acceptable oil-fired generating station is simplified for the engineers, if they are given one or both of the following:

(i) Emission standards for various pollutants
(ii) Air and water quality standards.

Environmental Clearance Procedure in India

As the utility of EIA became clear, there was a need to establish project clearance procedure. The first step in that direction was to define the EIA process, as presented earlier. In general, the following impacts of a project need to be assessed:

Air: The 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 are to be assessed.

Noise: The changes in ambient levels, due to noise generated from equipment and movement of vehicles, and their impact on fauna and human health are to be assessed.

Water: The availability to competing users, changes in quality, sediment transport and ingress of saline water (intrusion of saline water in aquifers) are to be assessed.

Land: The changes in land use and drainage pattern, land quality including effects of waste disposal, shoreline/river bank and their stability are to be assessed.

Biological: The level of deforestation/tree-cutting and shrinkage of animal habitat, the impact on fauna and flora (including aquatic species, if any) due to

contaminants/pollutants and the impact on rare and endangered species, endemic species, and migratory path/route of animals are to be assessed, as also the impact on breeding and nesting grounds.

Socio-economic: The impact on the local community including demographic changes, economic status, human health and increased traffic are to be assessed.

Environmental Auditing (EA)

An Environmental Audit (EA) is a systematic, independent internal review to check whether the results of environmental work tally with the targets. It studies whether the methods or means used to achieve the goals or ends are effective. EA involves studying documents and reports, interviewing key people in the organisation, etc., to assess the level of deviations between targets and results.

Environmental audits are being used as a tool and an aid to test the effectiveness of environmental efforts at local level. They can be carried out for a number of reasons including the following:

- To verify compliance.
- To review implementation of policies.
- To identify liabilities.
- To review management systems.
- To identify needs, strengths and weaknesses.
- To assess environmental performance.
- To promote environmental awareness.

Objectives and Scope

The objectives of an environmental audit are to evaluate the efficiency and efficacy of resource utilisation (i.e., people, machines and materials), to identify the areas of risk, environmental liabilities, and weakness in management systems and problems in complying with regulatory requirements and to ensure the control on waste/pollutant generation.

Scope

The scope of an environmental audit can fall under either of the following two options:

(i) To assess the adequacy of the policies.
(ii) To assess the degree of compliance with policies.

Waste Audits and Pollution Prevention Assessments

Waste audits are intended to identify the possibilities for improvement. The recommendations contained in waste audits are not based on objective comparisons between expectation and results, but instead are based on technical and economic evaluation of various waste minimisation alternatives.

Audits, which contain an explicit pollution prevention approach, are considered to be pollution prevention audits. This classification is used regardless of whether the audit is conducted independently, or the pollution prevention approach is integrated into compliance, management, and/or risk audits, as represented in Figure 2.9a.

Fig. 2.9a: The Pollution Prevention Approach

Note that pollution prevention audits are operative in the sense that they include the creation and analysis of correction and improvement alternatives. In formal environmental audit, this is a task reserved for management. Furthermore, pollution prevention audits and similar audits require the active involvement of management in information gathering and proposals for change. For reasons such as these, in this context, the term assessment is considered to be more appropriate than audit.

Life Cycle Assessment

Life Cycle Assessment (LCA) is a tool to evaluate the environmental effects of a product or process throughout its entire life cycle. An LCA entails examining the product from the extraction of raw materials for the

manufacturing process, through the production and use of the item, to its final disposal, and thus encompassing the entire product system.

The assessment process includes identifying and quantifying energy and materials used and wastes released in the environment, assessing their environmental impact and evaluating opportunities for improvement.

The unique feature of this type of assessment is its focus on the entire life cycle, rather than a single manufacturing step or environmental emission. The theory behind this approach is that operations occurring within a facility can also cause impacts outside the facility's gates that need to be considered when evaluating project alternatives. Some examples are mentioned in 4.7 of Chapter 4.

Environmental Management Systems (EMS)

The growing public interest in environmental issues and concern for environmental quality has led to the emergence of strict pollution control regimes. This has brought about the development and implementation of various voluntary schemes and standards for environmental management and pollution control. An Environmental Management System (EMS) of an organisation is a system designed to:

(i) meet the regulatory and legislative system requirements;
(ii) improve the control of the environmental impact;
(iii) provide confidence to the customers that the products and services are manufactured with the aim of reducing the negative impact on the environment;
(iv) suitably accommodate changing market trends and gain competitive edge;
(v) reduce the costs associated with environmental liabilities and insurance;
(vi) gain public and media support.

Environmental Risk Assessment

Risk may be defined as the combination of the probability of occurrence of an event and the possible extent of its adverse effects and consequences in terms of economic loss or human injury. Risks can relate to hazards to humans from natural disasters, and events

such as traffic accidents and diseases and chronic dangers such as cigarette smoking. Health risks such as probabilities of contracting a particular disease are environmental hazards in the sense that they arise in our surroundings. They may be connected with projects such as development of industrial plants or particular production processes, and must be included in environmental assessments. Economic risk is yet another type of risk. Fairly sophisticated mathematical techniques have been developed for analysing economic risks and introducing probabilistic risk assessments into cost-benefit analysis. Other forms of risk may relate to hazards from industrial processes, safety of workers and effects of emissions on natural systems, flora and fauna. Ecological risk is handled using similar techniques as human health risks.

Environmental Design (ED): An Exposition

Environmental Design (ED) or designing for environment is a perspective in which environmental aspects of an existing or new product, process or facility, design/redesign are optimised systematically and continuously for minimal adverse impact on the environment. In other words, it helps in designing and developing environmentally benign (friendly) products and processes that have the lowest life cycle for environmental impact. Acting as a catalyst, ED helps provide businesses with information to make environmentally informed choices. Note that this approach is also referred to as life cycle design, eco-design, sustainable design or design for eco-efficiency.

Some key principles of ED are:

(i) The design of a project, process or product must incorporate environmental objectives, in addition to other objectives such as economic efficiency and practicality.

(ii) The core environmental objective is the overall sustainability of:

- the use of resources, including energy;
- the process used in the manufacturing of a product or constructing a project;
- the product or project in operation;
- the product or project at the end of its use or operation, i.e., the actions involved in discarding, recycling or dismantling the product or project.

(iii) While sustainability is the principal environmental concern, other environmental objectives that should be considered are:
- the restoration and enhancement of landscapes;
- the dignity, comfort and safety of workers in work places;
- the restoration and enhancement of ecosystem;
- fostering of human creativity and art.

(iv) Environmental objectives that refer specifically to a project, process or product should be stated explicitly, to a level of detail equivalent to those of the other objectives. These objectives are to be agreed upon at the outset by administrators, sponsors and designers.

(v) Since the environment is multi-sectoral and multi-disciplinary, design for environmental objectives is inevitably a multi-discipline exercise and multi-disciplinary activity must be considered within the environmental design.

(vi) The design of a project, process or product should proceed from its initiation by the conscious definition and integration of environmental and other practical considerations. This requires the consideration and statement of design process that is, product- or project-specific.

Thus, EM is complex and involves process, which requires careful and scientific studies on various aspects of processes involved in any development activities and its impact on the environment.

2.10 Concept of Sustainable Development

The application of principle of sustainability in the development process came into prominence in the late 1960s and early1970s. However, sustainability has been a basic concept in management of forests for a long time. The basic tenet of forestry is sustainable yield where yield is only the increment and the capital is left intact.

Sustainable development has its economic, political, ecological, technological, ethical, social and international connotations. Consequently, the interpretation of sustainability has varied from the angle one wants to look at it. For an economist, Sustainable Development (SD), means leaving the future generation enough option for development and consumption as is available for us

today. However, it was for the first time that a workable and meaningful definition of SD was provided by the Brundtland Commission, World Commission on Environment and Development (WCED) in 1987. WCED has defined the sustainable development as the one, which meets the needs of the present without compromising the ability of future generations to meet their needs. The commission gave a new dimension to economic development based on the ecological concept of development.

Sustainability has four critical elements namely, environment sustainability, economic sustainability, social sustainability, and institutional sustainability. Environment sustainability is achieved when the productivity of key natural resources are conserved or enhanced for future generations. Economic sustainability is achieved when economic welfare is sustained. Social sustainability is achieved when social exclusion is minimised and social inclusiveness is maximised. Institutional sustainability is achieved when the institutions and processes have the capacity to continue and to perform well. Broadly, at the operational level the concept of SD encapsulates the issues related to human rights, sustainable consumption, natural resources, greenhouse effect, cultural and ethnic diversity, non-renewable energy sources, eco products, fair trade and education for sustainability.

Since the basic concepts itself differ, operationalising often involves compromising between varied objectives. However, in the heart of sustainable development is the ethical issue of equity both in respect of time and space. Thus, the question of inter generational and intra generational equity is implicit.

Sustainable development poses three important questions:

(i) Is sustainable development more likely to thrive under some particular set-up of political and economic institutions than others?

(ii) Should the value that forms the basis for this development become part of the mainstream ethical system?

(iii) If answer to these questions is "yes" then, are we prepared to live with the outcomes?

Conclusively it can be said that the political, economic and ethical settings in which sustainability is pursued will determine its success or failure.

In essence sustainable development should address the following pertinent questions:

Where are we and where are we heading to?

Where do we want to go?

What should we do to get there?

What progress are we making?

Sustainable development is a difficult issue to measure and there is no one agreed method. However, a number of methods are being tried in developed nations and organisations to measure sustainable development that are a combination of economic, social, institutional and environmental indicators. A few examples of these measures are Gross Domestic Product (GDP), Net National Product (NNP), System of Integrated Environment and Economic Accounting (SIEEA), Human Development Index (HDI), Physical Quality of Life Index (PQLI) and Environmental Impact Assessment (EIA).

There are serious problems in developing measures of sustainable development such as, availability of data, development of single compound indices, development of institutional indicators and the integration of various aspects of sustainable development.

The major steps to measure sustainable development are

(i) Effective and appropriate mechanisms for data collection.

(ii) Development of appropriate indicators.

Environmental education is important for promoting sustainable development and improving the capacity of the people to address environmental and developmental issues. According to Agenda 21 of the Earth Summit held in Rio-de-Janeiro, 1992: "Education is critical for achieving environmental and ethical awareness, values and attitudes, skills and behaviours consistent with sustainable development and for effective public participation in decision-making".

Obliviously, an inter-sectoral, holistic and participatory approach is clearly needed for sustainable development. The pre-occupation of the policy maker with short-term issues create problems in management of natural resources and in conservation of valuable ecosystems. That in turn requires a holistic approach, which considers economics and ethics as a part of the whole – an inter-connected circle, which at present has been broken. Sustainable development can only be achieved where people are well informed of the challenges

and have the relevant knowledge, skills and motivation to address them.

2.11 Concept of Sustainable Consumption

Source: Whither Common Lands? Published by Samaj Parivartana Samudaya, Dharwad et al. (October 1988)

Source: Whither Common Lands? Published by Samaj Parivartana Samudaya, Dharwad et al. (October 1988)

Based on the definition of Sustainable Development (SD), we can define Sustainable consumption as "consumption that meets the needs of the present without compromising the ability of the future generations to meet their own consumption needs".

But, unlike other animals, consumption by humans is not limited to fulfiling the basic needs for survival – it also involves satisfying 'necessities' and 'luxuries'. Needs are resources absolutely fundamental to life, whereas necessities are essential to maintain a particular lifestyle, while desires pertain to a particular lifestyle's comforts or luxuries.

It has usually been found that the resources required to fulfil a community's luxuries are far greater than the resources required to fulfil basic needs. To meet resource requirements and other inputs necessary to support community life, every modern human settlement depends on an area much larger than that is actually occupied by the settlement itself. Also, the waste and other outputs generated are dispersed over an area far beyond the settlement limits and boundary. The total combined area required to satisfy these inputs and outputs is

described as the ecological footprint for the human settlement under consideration. When considering the global human settlement, it has been estimated that human societies occupy approximately 2 per cent of the planet's surface area, but consume 75 per cent of the planet's resources. Considering this consumption and corresponding resource depletion, all individuals are equally to blame.

Requirement Class	Community Requirements
NEEDS (fundamental to Life)	Food, Water, Shelter, Clothing
NECESSITIES (minimum Standard of Living)	Primary Education, Basic Health Services, Social Security
DESIRES (varying Standards of Living)	Entertainment, Public Comforts, Personal Luxuries

Source: Sustainability and Human Settlements: Fundamental Issues, Modeling and Simulations. M. Monto, L.S. Ganesh, and Koshy Varghese. Sage Publications (2005)

Inequity in Consumption

It is seen that consumption patterns vary between the developed and developing nations, and within each nation – between the rich and the poor.

Usually the more affluent people consume more resources and also contribute more to pollution, as they aspire to satisfy their luxurious requirements in addition to their basic needs. This results in corresponding damages to the environment. Some of the major pollution problems that the world faces today including depletion of ozone cover, the implications of global warming, and the accumulation of toxic wastes in the environment are mostly due to the high consumption associated with affluent lifestyles.

In the case of poor people, the impact on the environment is not as much—they can barely

fulfil their basic survival needs. Many poor especially in urban dwellings lack access to clean drinking water and toilets; they live in unhygienic conditions, and cannot afford nutritious food. These environmental conditions often lead to spread of disease.

The Population Problem

There will be more than 7 billion individuals on the planet by the year 2010. The question then arises as to how will the earth support this additional population with needs of food, clean water, clothing and housing (basic needs)? Are there enough resources available? In addition, if the desire for luxury of this population are considered, what will be the situation in terms of environmental pollution?

Sustainable Consumption – What Can Be Done?

Some steps, which can be taken to help the environment and future generations, would include:

- Reuse items
- Reduce waste
- Recycle waste
- Control population
- Environmental education.

2.12 Ecological Footprints

Ecological footprint is an intuitively appealing measure of sustainability. It is defined as the total land and water area required to produce all that the human population consumes and to dispose all the wastes that it generates at any given point of time. This area would typically include agricultural and horticultural land, grazing areas, parts of rivers and oceans that are used for fishing, waste disposal sites and crucially, the land required to support the plant life, essential for maintaining the level needed to sequester atmospheric carbon. Clearly, if this area is greater than the earth's geographical area, human consumption is not sustainable.

This concept was formally developed by a Canadian ecologist William Rees and his doctoral student Mathis Wackernagel in the early 1990s. Subsequently, the concept has been widely applied both in academic and policy-making circles.

To understand the utility of this concept, we need to appreciate the fact that any given habitat can indefinitely

support only a certain (maximum) population of a given species without impairing its productivity permanently. This is indeed the notion of carrying capacity. When applied to human populations however, the concept could be somewhat inadequate (as a sustainability measure) since humans are capable of increasing their numbers by importing resources that are locally scarce and upgrading technologies at their disposal. The concept can then be inverted by asking the question: how much of productive land (and water) is required to sustain a human population indefinitely, wherever the land (and water) is located, given the level of technological sophistication. Area of land/water required in terms of a numeric value say hectares provides a snapshot view of the ecological burden and could be a reliable parameter to emphasise the finite character of global resources.

In practical terms, there are several ways to calculate ecological footprints. The Wackernagel and Rees calculation method begins with the construction of a 'consumption by land use' matrix for a given population. The 'consumption' dimension covers food, housing, transport, consumer goods and services, while the 'land use' dimension encompasses built-up areas (supporting roads, housing and other infrastructure), crop land and pastures (for production of food and other goods), managed forest (for production of wood products), and energy-land (for sequestering carbon dioxide emissions resulting from the burning of fossil fuels). Aggregating the land area appropriated by each land use category generates the ecological footprint.

An important question is the scale at which the ecological footprint is calculated. When calculated at the level of countries, it could point to the differential burdens imposed on world's resources by countries at different levels of economic development. According to an estimate by Rio+5 Forum (1997), ecological footprint for the entire world is 2.8 hectare per capita whereas the available capacity is 2.1 hectare per capita. Corresponding figures for U.S.A. are 10.3 and 6.7, while those for India are 0.8 and 0.5. While both U.S.A. and India are consuming more than their ecological limits, an average U.S. citizen is creating an ecological burden almost thirteen times than that of the average Indian citizen. Looked at this way, it draws attention to uneven ecological burdens created by countries and emerges as a political rallying in international negotiations.

2.13 International Economic Regimes, Forces of Globalisation

International economic regimes refer to the conditions, norms, regulations and procedures that help coordinating economic action of various global players – countries, groups of countries and national/international interest groups. Regimes are usually associated with specific political or economic positions subscribed to by major global actors. Post Cold War world politics (1990s) is largely based on liberalised trade relationships among nations, and a 'free trade' regime is clearly the dominant economic regime today. The World Trade Organisation (WTO) – the 'postrunner' of the General Agreement on Tariffs and Trade (GATT) – is the key institution that attempts to set the rules of world trade and shape global economic governance.

The environmental counterpart of WTO is not one organisation, but a large number of multilateral environmental agreements like the Kyoto Protocol and the Convention on Biological Diversity (CBD). These agreements bind signatories to domestic action for the benefit of the global environment. For example, the Kyoto Protocol enjoins its parties to reduce greenhouse gas emissions to levels specified for each of them, and the CBD mandates countries to develop national programmes for conservation and sustainable use of biodiversity.

An inevitable consequence of these processes is the integration of national economies into the global economy at an increasing pace; this phenomenon is most often referred to by the umbrella term – globalisation. However, as seen above, globalisation occurs at various levels, economic and environmental, each one influencing the other in complex ways. For example, free trade could have adverse environmental consequences if developed countries can 'export' their pollution to developing countries rather than mitigate it within their territories, which could be a costlier action. Likewise, reduction of greenhouse gas emissions could reduce the pace of economic growth in developed countries and indeed in some late-developing countries. It is recognised that the ecological footprints of developed countries are several times higher than those of developing countries, indicating that the costs of affluent lifestyles of citizens of rich nations are usually borne by people across the globe.

The forces of globalisation also influence local cultures and knowledge systems, specially in developing countries, often leading to accentuation of the rich-poor divide. For example, mass-produced chemically synthesised medicines tend to crowd out traditional systems of herbal medicine, leading to both loss of local biodiversity and erosion of knowledge about curative properties of herbs. In the agricultural sector, widespread use of high-yielding and input-intensive seed varieties likewise reduces the number of traditional crop varieties that are products of centuries of local innovation. Interestingly, such local knowledge could provide crucial pointers towards product development of commercial interests, such as pharmaceutical companies, in the developed world. The Convention of Biological Diversity indeed requires member states to encourage equitable sharing of benefits (commercial) out of use of local knowledge and innovations.

Anti-globalisation has emerged as a political rallying point in recent years. An alternative economic regime based on reinforcement of national sovereignty and selective isolation from global markets is often proposed by political systems that are arguably a global minority. An environmentally benign development path based on a mix of modern and traditional production systems has also been proposed, albeit at geographically restricted scales, as a barrier against homogenisation of technology.

2.14 International Regimes of Environmental Regulation, Framework Convention on Climate Change, Law of Sea, Trans-boundary Movement of Hazardous Wastes, etc.

Modern international environmental laws are the result of advances in scientific and technological knowledge that led to a better understanding of the impact of globalisation of economic activities and human interference with nature.

Origins and Early Development

The bilateral fisheries treaty to curb overfishing to prevent extinction of certain fish species (19th century) can be said to be the first international treaty concerning

environmental law. The global consensus towards protection of environment came with the convening of 1972 UN Conference on Human Environment (UNCHE) at Stockholm. UNCHE resulted in the adoption of the Stockholm Declaration of Principles, establishment of the United Nations Environment Programme (UNEP), adopting an Action Plan for the development of environmental policy, and creation of an Environment Fund. In 1987, the Brundtland Report brought out by the U.N. defined sustainable development as has been stated in section 2.10. The attention received from the Brundtland Report and World Commission on Environment and Development (WCED) laid the foundation for the convening of the United Nations Conference on Environment and Development (UNCED) in 1992 at Rio, Brazil (the Earth Summit).

Rio and Beyond

The Earth Summit adopted three non-binding instruments: the Rio Declaration; UNCED Forest Principles and Agenda 21. It also put forward two binding legal instruments: United Nations Framework on Climate Change (UNFCC) and the Convention on Biological Diversity (CBD). UNFCC sets an overall framework for inter-governmental efforts to tackle the challenge posed by climate change. A legally non-binding treaty, adopted in 1994, recognises that the climate system is a shared resource whose stability can be affected by industrial and other emissions such as greenhouse gases (GHG) including carbon dioxide. Since the treaty is non-binding in nature, member countries of the UNFCC negotiated an international agreement known as "the Kyoto Protocol" which came into force in 2005. Through a set of "common but differentiated responsibilities", the Protocol mandates developed countries to reduce GHG emissions as per treaty requirement. For developing countries like China, India and others it obligates monitoring and reporting GHG emissions and do not enforce a cap. The three innovative market-based mechanisms, Emissions Trading, Joint Implementation and the Clean Development Mechanism, under the protocol provides developed countries to earn and trade emissions-credits through projects implemented either in other developed countries or in developing countries, which they can use towards meeting their commitments.

International effort towards protecting biodiversity led to the adoption of the Convention on Biological Diversity (CBD). CBD covers all ecosystems, species, and genetic resources and recognises that the conservation of biological diversity is "a common concern of humankind". The CBD has three main goals: first, the conservation of biodiversity, second, sustainable use of the components of biodiversity, and third, sharing the benefits arising from the commercial and other utilisation of genetic resources in a fair and equitable way. These goals are to be achieved through respective national legislations.

In order to deal with the issues of biosafety under the CBD, the Cartagena Protocol on Biosafety, a supplementary agreement to CBD, was adopted. The Protocol through precautionary approach seeks to protect biological diversity from the potential risks posed by genetically modified organisms resulting from modern biotechnology. It establishes an advance informed agreement procedure for ensuring that countries are provided with the information necessary to make informed decisions before agreeing to the import of such organisms into their territory.

Other Initiatives

The last four decades saw proliferation of multilateral environmental treaties. The difficulty has been the extent of coverage environmental issues pose and in defining "environment". Various environmental disasters in the high seas such as Torrey Canyon, 1967, Amoco Cadiz, 1978, the Exxon Valdez, 1989 and the Prestige, 2002 have resulted in several regional and international cooperation agreements dealing with pollution in marine environment. The United Nations Convention on the Law of the Seas, 1982 adopted to provide a comprehensive agreement establishing legal order and rules, defining rights and responsibilities of nations and addressed pollution of the marine environment.

The Convention on the Control of Transboundary Movement of Hazardous Waste and their Disposal, 1989 establishes a global regime based on Proximity Principle for control of international trade in hazardous and other wastes. It setsforth State parties obligation, i.e., exporting, transit and importing countries, through prior informed written consent to ensure that the transboundary movement is reduced to minimum inconsistent with environmentally-sound and efficient management.

Over the years, general concepts that found place in international environmental treaties, national legislations, and judicial decisions have become well-established principle of international environmental law. These principles i.e., sustainable development, precautionary principle, polluter pays principle, inter-generational and intra-generational equity, principle of common but differentiated responsibility etc., are now entrenched in most legal systems.

International environmental law is now a full-fledged subject covering all the conceivable aspects of environmental law. This has led to multiplicity of institutions; there has been a call for setting up a world environmental organisation in similar lines to World Trade Organisation to streamline the implementation of international environmental law.