Natural Resources and Sustainable Development

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Introduction

"Earth Provides enough to satisfy every man's need, but not for every man's greed"

…..Mahatma Gandhi

"The citizen, men and women equally, have the right to an adequate means of livelihood" and it shall be duty of every citizen of India "to protect and improve the natural environment including forests, lakes, rivers and wildlife, and to have compassion for living creatures"

…..Article 51A The Constitution of India

'Contemplation of the world's disappearing supplies of minerals, forests, and other exhaustible assets has led to demands for regulation of their exploitation. The feeling that these products are now too cheap for the good of future generations, that they are being selfishly exploited at too rapid rate, and that in consequence of their excessive cheapness they are being produced and consumed wastefully has given rise to the conservation movement. The method ordinarily proposed to stop the wholesome devastation of irreplaceable natural resources, or of natural resources replaceable only with difficulty and long delay, is to forbid production at certain times and in certain regions or to hamper production by insisting that obsolete and inefficient methods be continued'

……Hotelling (1931) 1993

There is an enormous flow of literature on Sustainable Development (SD) in India, particularly after the Rio Earth Summit in 1992, wherein India presented its approach towards sustainable development. There is growing awareness among the people about the issues of development, ecology and health. A series of publications by institutes such as CSE, TERI, MOEF, NEERI…… have roused public interest and concern about the issues of material development.

This monograph addresses to the main issues that have emerged in India during the period 1990-2002 in this field with a particular reference to natural resources viz. forest, land, water and bio diversity. The first section is an introductory note, while second section gives a detailed description of the two interrelated concepts –Natural Resources and Sustainable Development. The third section presents the state of natural resources in India. In the fourth section we present the constitutional provisions and the policy framework and the national programmes related to natural resource development aiming at sustainability. An overview of the Five Year Plans that reflect the national goals and policies towards development in the environmental context with special reference to the period i.e. eighties and nineties is given in section five. Sections six and seven present natural resource and SD as a theme adopted for teaching at graduate/postgraduate levels and for doctoral research in different Indian

Universities. A thematic review of the research in the field follows in section eight, which also presents proposed policies and programmes for Sustainable development. In section nine we enlist the main Indian contributors to the field during the reference period of 1990-2002. The research gaps and the need for further research as emerged from this review are presented in the last section.

We draw upon ideas from the main international and national policies and programmes/summits that have preceded 1990 as the concept of SD linking it to environmental stability has evolved more meaningfully and rapidly since 1980s. We refer to the ideas of international environmental economists while making a presentation of the conceptual framework. We have included the studies of foreign researchers who have worked on Indian problems and issues related to SD and natural resources. Some studies, which are published after 1990, but have specifically used data for the period before 1980 have been left out of the scope of this study as they give an account of the situation in those periods sometimes not relevant to the current situation, policies, programmes and resource management strategy. For understanding the status of our current natural resources we have referred to government reports and studies published in recent years i.e. for the years 2003- 2004.

We have focused our review mainly on non mineral natural resources, particularly land, water and forest resources, and biodiversity as lot of literature in India concentrates around these aspects. There are some specific references to energy, which is crucial for SD. There are few studies on air pollution in India. We highlight about the emerging interests in this subject.

1.1 The Context

In poor countries though the dependency on natural resources as soil, water, forests, animals and fisheries is high, environmental resources have not been included properly in government planning models neglecting the fact that they are (particularly the rural part) biomass based subsistence economy (Dasgupta 2001:338). As a result of dependency on environmental resources in poor countries there are clashes or differences in understanding, negotiating and developing a concrete plan for acute global environmental problems. While the developed countries focus on greenhouse effect, need for mix of environmental resources and manufactured

capital in aggregate production, poor countries feel the stress of decline in fuel wood and water availability.

The importance of natural resources to Indian economy and the impact of their degradation on sustainable development is highlighted in many research studies (CSE 1982 (1996; TERI 1998; Kerr and Swarup 1996; Shiva 1998; Sury 2001; Nadkarni 2002;Gadgil and Guha 2000). Every aspect of modern India's economy is in some way dependent on natural resources. In rural areas people utilize natural resources on day-to-day basis. They use them directly with minimum processing by gathering fuel wood from forest, growing food on their own land, collecting water directly from the ground and streams, and grazing their animals on pasture lands and in forests (Kerr and Swarup 1996:8; Shiva 1998; Nadkarni 2002).

There is need to understand the link between resource use and economic development. Perrings (1997:142) quotes of a study by Pearce and others (1988) in Africa, which indicates that Africa's economic crisis was the result of Africa's agricultural crisis fuelled by the environmental effects of a set of incentives that encouraged the myopic use of resources. The environmental issues have become more challenging in the world of economic reforms, technological changes, market economy, private sector entry and community participation. Natural resource degradation imposes burden on the economy restricting prospects for sustainable growth. The economic costs of environmental degradation have been estimated at 4 to 8% of Gross Domestic Product (GDP) of many developing countries (World Bank ….:xviii). The balancing of economic, environmental and social objectives involves value judgments and prioritization leading to trade offs among generations, social groups and countries, which influence sustainable development (World Bank …. :xviii).

Inspite of the significant progress made in reducing poverty, increase in agricultural production, improving literacy, health standards of people, and infrastructural facilities such as transportation and communication India still faces challenges in meeting the requirements of sustainable development. Our human development indicators are still low as compared to other developing countries and there are disparities in terms of distribution of the developmental and welfare measures among regions, social groups, gender and classes.

The study of natural resources in the environmental system for SD has gained importance in the light of the following factors;

- Natural resources once regarded as free goods have become scarce resources, hence pricing is necessary
- Sustainable growth is at stake and may not be feasible in the long run unless measures are taken to prevent depletion and degradation of natural resources
- It is assumed that an enquiry based on scientific and engineering approaches to environmental problems may help in understanding the two-way linkages between ecological and economic systems i.e. by identifying the causes, measuring or quantifying the extent of damages and estimating the value of damages so as to facilitate decision making
- Shift from command and control type approach to incentive oriented economic/market based instruments for environmental protection
- Budget constraints of the government in environmental protection and management
- Need for cost-benefit analysis for developing new environmental legislation resetting environmental standards and introducing new policy instruments for environmental protection
- Analysis of the impact of international agreements on environment of the member nations.

A recent report on "Empowering People for Sustainable Development" brought out by the Ministry of Environment and Forests (MOEF) GOI draws out an environmental strategy for India encompassing many of the above factors. The report provides a comprehensive account of India's perspectives on SD and its adherence to the principles of Agenda 21 adopted at Rio Earth Summit, 1992. Energy, industry and transport constitute the core sectors that intermediate between environment and development and growth of these sectors is essential for the future growth of the Indian economy, which is slated to grow at 8% per annum (MOEF 2002:1). The report specifies that the challenge before India is to conserve the enormous natural wealth that it has and at the same time use it to improve the living standard of its citizens. The challenges before the nation in terms of improving the quality of life are indicated as below;

India's Human Development Indicators: Challenges in Sustainable Development

- Infant mortality –72 per thousand live births
- Literacy rates -65.2%
- Households with access to safe drinking water- 62.3%
- Households with access to proper sanitation facilities- 49.32%
- Households with electricity connection- 42.37%
- Households with electricity, safe drinking water and proper sanitation facilities-16.1%
- Households with permanent houses-30.95%
- Households with temporary shelters-27.44%

Adapted from MOEF 2002:13

1.2 India's March Towards Sustainable Development

Success

- Sufficient food stocks, with accumulation of 58 million tons by January 2002.
- Emerged as largest producer of food in the world accounting for 10% of the world's fruit production
- Second largest producer of vegetables next to China
- Emerged as largest producer of milk in the world
- Diversification of agricultural production
- Successful experiments in participatory management of forest and water resources
- Decentralisation in management and empowerment of women

Concerns

- Food security
- Increased use of pesticides
- Continued disparity in the distribution of wealth and income
- Infrastructure constraints in power and transport
- 40% of the villages unconnected by roads and transport system
- Conversion of forest and agricultural land for development projects
- Oil price increase

India’s future programmes for SD are portrayed in EPSD, which epitomizes the concerns as well as the initiatives taken by different Ministries and Departments in this direction. The strategies for SD include combating poverty; decentralized governance; harnessing scientific and technological prowess; setting appropriate environmental standards and enactment of legislations for creating institutions to monitor the protection of environment; conservation of natural resources; and promoting development in core sectors such as energy, industry and transport.

S e c t i o n - II

Conceptual Framework

Economic growth is not a panacea for environmental quality. What matters is the content of growth- the composition of inputs (including environmental resources) and outputs (including waste products). This content is determined by, among other things, the economic institutions within which human activities are conducted. These institutions need to be designed so that they provide the right incentives for protecting the resilience of ecological systems. Such measures will not only promote greater efficiency in the allocation of environmental resources at all income levels, but they would also assure a sustainable scale of economic activity within the ecological life support system. Protecting the capacity of ecological systems to sustain welfare is of as much importance to poor countries as it is to those of rich.

Arrow, Bolin, Costanza, Dasgupta, Folke, Holling et. al. (1997)

Why is the term 'sustainable development' generally linked to environmental or natural resources. It is because the whole socio-economic life and materialistic objectives lie within the sphere of natural resources and the eco system. Human life is influenced, affected and governed by the surrounding environment and it depends on the maintenance of the ecological system.

2.1 The concept of Natural Resources

In a broader sense natural resources are all those things available to man as 'gifts of nature' and in an economic usage natural resources are the living and non-living endowments of the earth, which are exploited by man as sources of food, raw material and energy i.e. they are the stocks available in the environment from which economic activity draws flows of input (Common 1996:231).

The role of natural resources in economic development was recognized and made explicit by classical economists. They considered natural resources as basic to economic development, influencing international trade and distribution of income (Heal Geoffrey 1993:xi). Country's endowment of natural resources was the key feature in the theories of Ricardo, Mill and Malthus. Malthus was concerned with land and food constraints choking off population growth and the well being of individuals thereby expressing it in his theory of population. His theory propagates that natural resource scarcity impairs economic growth and in the absence of checks to

population growth, which imposes heavy burden on natural resources, nature itself will take its own action by restricting the population to subsistence level. Malthus argued that economic growth cannot go indefinitely due to natural resource constraints. Since natural resources exist in finite amounts the continuous increasing flows of natural resources into production implied by continuing economic growth cannot be indefinitely sustained –eventually natural resources are exhausted, and the eco system collapses (Common 1996:15). Natural resource use has been an area of concern for economists since the simultaneous births of modern economics and industrial society in the eighteenth century (Hartwick and Olewiler 1986:1). Dasgupta and Heal (1993:56) argue that in the long run the limited availability of resources, together with their technological importance, would begin to act as a constraint on the economy's growth potential.

Resources are seen as the basis for national prosperity, power and wealth (Kneese 1995:3). Natural resources include land, water, air, forests, minerals, aquatic species, wild flora and fauna. Natural resources consist of renewable and nonrenewable resources. Renewable resources are self-renewing at a limited rate depending on the size of the stock in existence at any given time and non-renewable resources are those for which limited, concentrated stock exists for allocation over all time (Kneese 1995:3). Fisheries, grazing land, forests, water in lakes and rivers and ground water resources are capable of self-production and their stocks can increase with time only if their rates of harvesting are below their natural rates of growth (Sankar 2001:7). L.C.Gray (1994, cited in Kneese 1995:5) in his article on the economics of exhaustible resources widely recognized as the pioneering work in the field, considered depletable resources to be different from an ordinary good as it is limited in quantity and not producible, which implies that use of one unit of such a resource today leaves a unit less of it tomorrow. Coal, crude oil, natural gas, and other minerals such as iron ore, gold, bauxite, etc., are finite, hence the question of optimal depletion of resources overtime emerges (Sankar 2001:7). However, the consumption of renewable as well as non exhaustible resources such as solar energy and wind by one does not reduce the magnitude of resource flow to others using or non using these resources. Biological natural resources such as forests, fish, animals and other bio mass stock are renewable but, exhaustible if they are harvested beyond their regeneration capacity. Their unlimited use reduces the quantity available to others at least in the short run or at a point of time.

According to Sankar (2001:8), renewable natural resources generally come under common property regimes and are subject to congestion, depletion or degradation when its use is pushed beyond the limit of sustainable yield.

Natural resources viz. land, forest, water and air support life and economic process under the umbrella of ecosystem. Soil is the source of agriculture supporting food production on the earth, hence it is directly or indirectly the livelihood source for the entire population. Forests help in attracting rainfall, protect water sources, help in preventing soil erosion, floods, sustain biodiversity and engulf carbon formation in the air, thereby releasing fresh air. Natural resources are factors of production inputs, which combined with labour, capital and materials produce goods and services.

To meet the goal of sustainable development it is necessary to address environmental problems arising both because of resource depletion and negative externalities caused by development processes and projects (Ecological Economics Unit 1999). The issues that address sustainable development should recognize the duality between environmental problems and the pattern and extent of resource use.

2.2 What is Sustainable Development?

The concept of sustainability has become a beguiling word with the increasing awareness on environmental protection and the emerging need for preservation of habitats. Sustainability is a dynamic concept. It does not mean maintaining the same level, but refers to continuity with growth. Sustainability is not stability. Resilience is most important element in sustainability. Ecosystem resilience is considered as one of the index of environmental sustainability (Arrow et.al.1997:490). Protecting the resilience of the ecosystem is an element in a strategy of SD. An important factor in resilience of ecological systems is the diversity of organisms that mediate essential ecosystem functions and processes (Perrings 1997:xix). As stated by Perrings (1997:85) the sustainability indicators as specified by Solow are measures of value, while Holling's sustainability is a physical concept deriving from a condition for the stability of ecosystems say population indicators and, resilience i.e. a responsiveness in the distribution of the system parameters to perturbation in resource stocks.

The need for SD emerged with the concern for present vs. future. Environmental friendly economic growth has emerged as a necessity and environmental resources such as clean air, clean water and atmosphere are no longer freer. Appropriate pricing of the resources is inevitable. The impact of environmental degradation is already visible. The global warming, acid rains, drought, polluted water are some of the illustrations of increasing environmental degradation due to unregulated use of natural resources without combined effort to restore it and protect it from human activity induced pollution. Worldwide growth in material production and much of human well being is based largely on the use of natural resources and loss of bio diversity (Perrings 1997: 211). In achieving material welfare we forget that the protection of lakes, rivers, streams and groundwater from pollution is fundamental to food production, public health and health of all living species (Simpson 1990:103).

There are two concepts of sustainability (Markandeya et al 2002): weak sustainability, which implies compensation for losses of natural capital by increase in man made capital of equal value, and strong sustainability, which demands that aggregate natural capital should not decrease. The Hicksian definition of income subsumes the notion of sustainability by guaranteeing that any individual entity or notion is at least as well off at the end of a given accounting period as it was at its commencement (Lawn 2000:18).

The sudden interest in SD has emerged in response to the recognition of the environmental crisis due to pollution of water resources, thinning of ozone layer hence the global warming, deforestation, extinction of species of plants, birds and animals, soil degradation, population growth, urbanization, industrialization, etc.

The term SD was first used in 1980 by the World Conservation Strategy presented by the International Union for conservation of Nature and Natural resources. The term SD became popular after the 1987 report entitled "*Our Common Future*" furnished by the World Commission on Environment and Development of the United Nations. The report is generally referred to as the "Brundtland Commission Report" in honor of the Chairperson Dr. Gro Harlem Brundtland, the Prime Minister of Norway.

Brundtland's Commission Report (World Commission on Environment and Development 1987:43) defines "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs" .

This definition points out three issues related to SD;

(i) there should be limit on the use of resources

(ii) the present generation should be answerable to the future

(iii) consideration of inter generational equity

(iv) development of the present generation

Solow (2001:270) views sustainability as our obligation to the future. He critically comments on the definition that he observed in a UNESCO document which reads "… every generation should leave water, air and soil resources as pure and unpolluted as it came on earth", which according to him would mean that there shall not be any use of mineral resources, any permanent constructions, buildings, roads and dams. According to Solow sustainability is about distributional equity, who gets what and the obligation to leave behind a generalized capacity to create well-being and not any particular thing or any particular natural resource, which ultimately means sharing of well-being between present people and future people. The problem of sustainability arises because there is free-ride on each other and on the future. Current environmental protection contributes to sustainability if it comes at the expenses of current consumption, but not at the expense of investment that add to the future capacity (Solow 2001:274).

SD is based on a holistic model of planning with long term approach incorporating economics, efficiency, equity and environmental considerations. SD is that which spreads its benefits in to the long run.

SD is based on the following main considerations;

1. Poor depend largely on natural resources for their livelihood, hence vulnerable to natural resource degradation.
2. Degradation of natural resources i.e. water and air pollution poses threat to public health and hence imposes heavy cost on the economy.
3. Degradation of natural resources leads to natural disasters killing poor people who are vulnerable to such incidents.
4. Sustainable environmental management is an essential condition for long term eco-growth and lasting improvements in people's well-being.
5. Maximisation of net benefits of economic development while maintaining the stock of all environmental and natural resources overtime.
6. Policy, regulatory and institutional framework is necessary to support action for sustainable environmental management.
7. Sound market for environmental goods and services.

To overcome and meet the challenges of environmental resources degradation Herbert (1994:2-3) outlines six levels of intervention. On the technical level, the substitution of non-renewable energies by renewable energies like solar, wind and biomass, recycling practices for water and other waste products and cleaner technologies are proposed. The economic intervention involves products polluting the environment to bear the actual costs, market prices for environmental goods, and imposing of fiscal and legal controls for sustainable practices in production and use of natural resources. Environmental considerations are reflected in afforestation projects, encouraging organic practices and bio-pest control through research and assistance and protection of bio diversity. Social measures imply universal primary education, health care and social liberation of women. Political will is essential to ensure fairer distribution of wealth and resources, hack corrupt practices and prevent practices that destruct environment hence impoverishing the indigenous people. On the information level there is need for building information and data base to facilitate the development of a sound economic, social and environmental accounting system.

Until 1980's the prime objective of the developing countries was to exploit the natural resources to the maximum extent so as to achieve rapid economic growth and increase in Per Capita Consumption (PCI) of people. But, with the UN convention on Environment and Development there is increased awareness among countries and people, hence the emergence of concern for environmental protection.

There is a direct linkage between natural resources and the economic system. The depletion of natural resources, which is a physical process has economic consequences such as affecting agricultural productivity, availability of raw materials to industrial sector and livelihood base of poor households. The rate of depletion of renewable resources takes place at a faster rate than their regeneration.

A review of literature on SD indicates that even after several years of discussion, there is no consensus on the definition of sustainable development. The Brundtland Commission report has been criticized for being anthropocentric, for non-specification of the extent or limit to meet the needs, for supporting the interests of developed countries and being silent on their desire for continued economic growth (Wheeler 2004:23).

Definitions of 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" **[Commission on Environment and Development 1987:43]**
- World Conservation Union in 1991 defined sustainable development as "improving the quality of human life while living within carrying capacity of supporting eco system".
- "Sustainable development is development that improves the long term health of human and ecological systems" **[Wheeler 2004:24]**
- "Sustainable development describes a process in which natural resource base is not allowed to deteriorate. It emphasizes the hitherto unappreciated role of environmental quality and environmental inputs in the process of raising real income and the quality of life" **[Pearce and Warford]**
- The Food and Agricultural Organisation (**FAO:1995**) defines sustainable development as "The management and the conservation of the resource base and the orientation of technological and institutional changes in such a manner as to ensure the attainment and continued satisfaction of human needs for present and future generations. Such sustainable development is environmentally non-degrading, technically appropriate, economically viable and socially acceptable" (cited in Reddy 1995:A-21).

Ballabh and Thomas (2002:154) have defined sustainability as "those strategies of managing human affairs and resources which alleviate poverty, reduce social inequality and also restore ecological imbalances". They have presented the case study of Village Shankerpura, Gujarat that has managed its water and land resources with the help from an NGO named SWDF. Villagers' effort in growing trees and construction of a lift irrigation system and has successfully brought about an improvement in the living conditions of the community.

Srivastava (1996:9) lays down three conditions of sustainability: (i) Access to resources and the distribution of costs and benefits must be fair and equitable to both rich and poor (ii)

Development must be appropriate to the status and concerns of local people, especially for those living in conditions of extreme marginality (iii) The decision making should be participatory, liberating, collaborative and consensus building.

SD is interpreted as a method of returning to the co-evolutionary development process with the diversity that remains and deliberates fostering of further diversity to permit adoption to future surprises (Sundaram 1993:53). Development is about improving well being of the people by enabling increase in living standards, improving education and health by providing equal opportunity for all. But, in the course of development a specific concern is expressed that those who enjoy the fruit of economic development today may be making future generations worse off by degrading the earth's resources and polluting the earth's environment (Jauhari 2002: 2). The close linkage between sustainability and carrying capacity signifies that the physical limits to economic development are essentially defined by the maximum rate of resource exploitation which can be sustained without impairing bio-productivity potential and ecological status (Rao 1996:450). SD attempts to strike a balance between the demands of the economic development and the need for protection of the environment. It seeks to combine the elements of economic efficiency, intergenerational equity, social concerns and environmental protection. Although the term SD has many interpretations, it generally refers to non-declining human well-being over time (MOF 1998-99:156).

SD is achieving food security and rural development. The land and water eco systems on which human food supplies depend have the potential to produce an adequate supply of safe nutritious food for the world's population now and up to the year 2010 at projected rates of population growth and even beyond (Mukherjee 2002: 5).

According to Parikh (1996), inspite of income growth the society may not be attaining welfare of the population as it is in the case of Gujarat, which is richest in terms of per capita income in the country. Gujarat's development appears to be lopsided due to persistence of poverty, illiteracy and increasing environmental stress. Parikh prescribes a SD path, which leaves at the end of a generation (to say 20 years) a production possibility set that includes all the present production possibility set.

As specified by several writers in total the concept of SD includes meeting the needs of all the people, based on carrying capacity of the eco system without affecting the capacity of the future generation to meet their needs, by protecting the environment from further degradation

and by restoring effectively the lost resources. The ecological sustainability refers to the efficient and effective use of natural resources in a way that maintain natural environment and ensure equal opportunities for all both in the present and future generation to benefit from the better quality of life

2.3 Environmental Protection for Sustainable Development

Natural resource base is under constant threat due to overexploitation and pollution. Land degradation, soil erosion, industrial pollution, water resource degradation, deforestation and loss of bio-diversity are serious environmental problems.

For sustainable development environmental protection is necessary and there are three main ways of protecting environmental resources;

1. Command and control approach
2. Market based incentives
3. Participatory approach

Addressing to the issue of externalities associated with natural resource use, Sankar (2001:3) advocates the Coasean approach, which advocates a role for the state in defining and enforcing property rights for environmental resources and mitigating transaction costs instead of levying tax or fixing standards as advocated by Pigou. This is so because it is difficult to define property rights for natural resources like air, water in lakes, rivers, and oceans and scenic spots. Here, the transaction cost in reaching a negotiable settlement between polluters and pollutees can be high when the number involved is very large and polluters and pollutees are widely dispersed and measurement of the value of damages is highly uncertain.

Since environmental goods and services provide use and non-use values and as most environmental externalities are in the nature of local or global public bads, government intervention is necessary to solve environmental problems (Sankar 2001:443).

The conception of SD has emerged from the objectives specified below;

- Meeting needs i.e. the goal for development
- Meeting both present and future needs i.e. the goal for sustainability
- Maintaining consistency between population size and ecosystem productive capacity considering the limits and requirements for balance
- Implementing a process of change as the fulfillment of the needs and the requirements for attaining a sustainable balance is a dynamic one and will change with situations, conditions and time

Need for SD

- Increasing population densities
- Increasing rates of per capita resource use
- Over-harvesting of renewable resources
- Exhaustion of nonrenewable resources
- Mismanagement of natural capital
- Degradation of environmental quality
- Extinction of species
- Disruption in the quality of life of population dependent on natural resources
- Greater risks to individual human health, safety and security
- Increasing disparity in living standards

The idea of sustainable development is not new to India. It is based on spirituality and it helps in keeping the greed for materials and resources in check. Gandhian philosophy is also based on the same philosophy i.e. ‘Simple Living and High Thinking’. If we adopt his principles, we can achieve sustainable development.

S e c t i o n - III

State of Natural Resources in India

The growing population of India (1.03 billion in 2001) is posing greater pressure on natural resources of the country. There is decline in per capita availability of land and fresh water. The self-sufficiency in food grains production is attained at the cost of land degradation and depleting water table and water quality. As Cassen (2000 cited in MoEF 2001:2) puts it 90% of the increased demand for food comes from population increase while only 10% comes from an increase in income. The National Population Policy, 2000 warns that "India's current annual increase in population of 15.5 million is large enough to neutralise efforts to conserve the resource endowment and environment" (MoHFW 2000). A brief about the state of prime natural resources of the country is presented in this section.

3.1 Land Use Pattern

Agriculture constitutes the major use of land in the country. Nearly 70% of the population is dependent on agriculture for the livelihood. It contributes about 25% of Gross Domestic Product (GDP). The land under agricultural use has increased to the extent of 9% during the period 1958-59 to 1999-00. The proportion of land under forests, as per legal status during this period has increased to 31%. The area under non-agriculture use has also increased to a larger extent. This does not mean that the area under the forest cover has increased. There is a significant decline in the area under barren and uncultivable land, miscellaneous trees and groves, cultivable waste, permanent pastures and grazing and other fallows. The following Table:3.1 shows land utilization pattern of India.

Table 3.1 Land Utilization Pattern of India

Land Utilization.	Area in '000 Hectares			% Change		
	1958-59	1993-94	1999-00	1958-59 to 1993-94	1993-94 to 1999-00	1958-59 to 1999-00
Forest	52675	68421	69024	29.9	0.9	31.0
Non-agricultural Use	13563	22035	22967	62.5	4.2	69.3
Barren & Uncultivable Land	32879	18975	19440	-42.3	2.5	-40.9
Miscellaneous Trees & Groves	5711	3657	3618	-36.0	-1.1	-36.6
Cultivable Waste	20610	14468	13828	-29.8	-4.4	-32.9
Permanent Pastures & Grazing	13112	11176	11040	-14.8	-1.2	-15.8
Other Fallows	12286	9703	10108	-21.0	4.2	-17.7
Agricultural Use	143136	156428	156029	9.3	-0.3	9.0
Total Geograhical Area	293972	304863	306054	3.7	0.4	4.1

Source: ISEC 1999:273-75; CMIE 2004: 8

3.2 Forest

India is having 675538 sq km of forest cover and it constitutes 20.55% of its geographical area. The dense forest constitutes 416809 sq km (12.68 per cent) and open forest 258729 sq km (7.87). It is surprising that the forest cover has increased to an extent of 38245 sq km (6 %) during the year 1999 and 2001 (Government of India, 2004:257). According to the State of Forest Report 1997 India has lost 0.548 million hectares of forest cover during 1993 –1995. Again during 1995 and 1997, the forest cover went down from 63.89 million hectare to 63.34 million hectare. Dense forests (forests that have a tree canopy cover of more than 40%) decreased in the two-year period between 1991-93 and 1993-95 by 1.78 million hectare. On December 12, 1996, the Supreme Court banned felling of trees in all natural forests to prevent illegal felling of trees (except those under state working plan). According to The State of Forest Report 1995, *Jhum* cultivation and non-regeneration of degraded forests are the main causes of depletion of forests in the country. But, the 1997 report does not analyze the causes of forest destruction (Agarwal et. al.1999:111-12).

3.3 Land Degradation and Wastelands

The increasing population of human and livestock, poverty, and rapid economic development are exerting heavy pressure on the land. This has led to very significant land degradation. According to Sehgal and Abrol, 1994 (cited in MoEF, 2001:1) 57% of the total geographical area of India has been degraded.

From the point of view of ecological development, it is important to understand the extent and magnitude of wastelands (Kadekodi 2004:39). According to National Remote Sensing Agency (NRSA), the total all-India wastelands in 1999 stood at 64 million hectares, as against 44 million hectares in 1998-99. This amounts to a sharp rise in wastelands by almost 44% over ten years (Kadekodi (2004:47). The following table shows extent of wasteland in India.

Table:3.2 Extent of Wasteland in India: Data From Remote Sensing Agency, 1999

Sl No	Type of Land	Area (Sq. Km)
1	Gullied/ravinous land	20553.35
2	Land with or without scrub	194014.29
3	Waterlogged/marshy land	16568.45
4	Saline/alkaline area	20477.38
5	Shifting cultivation area	35142.20
6	Degraded notified area	140652.31
7	Degraded pastures/grazing lands	25978.91
8	Degraded land under plantation lands	5828.09
9	Sands-islands/coastal	50021.65
10	Mining/ industrial wastelands	1252.13
11	Barren rocky area	64584.77
12	Steel sloping area	7656.29
13	Snow/glacier area	55788.49
14	Total wastelands	638518.31
15	Total geographical area	3166414.00
16	Percentage of wastelands to total geographical area	20.17

Source: Kadekodi (2004:49)

3.4 Water Resources

India's land and water mass account for about 2.4% and 2.5% of those in the entire world (respectively) on which 1.03 billion (2001 census) people constituting 16% of the world population are dependent for domestic and non domestic purposes. In India, the average run-off of water in the river system is 1869 km3 (cubic kilometers) whereas its utilizable portion is about 690 km3. The potential is estimated at 432 km3. The annual per-capita availability of water fell from 6008 cubic metres in 1947 to 2464 cubic metres in 1990 to 2266 cubic metres in 1997 (Pachuari and Sridharan 1998:44) and 1869 cubic metres in 2001 with great variation in water availability in different river basins (Government of India 2004: 667-8). At the end of the Ninth Plan India's irrigation potential had been increased to about 93.98 million hectare from 22.6

million hectare in 1951 (Government of India 2004:668), an increase of 316 percent during a period of about 50 years.

The ministry of water resources, GOI lays down policies and programmes for development and regulation of the country's water resources. The National Water Policy of 1987 was reviewed and updated and the National Water Policy 2002 has been adopted by the National Water Resources Council. The National Water Policy envisages that each State shall formulate its own State Water Policy backed with an operational Action Plan. (MoWR 2002).

The problem of pollution of national water resources has become a matter of serious concern in India. To protect the quality of water, Ministry of Environment and Forests (MoEF) constituted Water Quality Assessment Authority (WQAA) in May 2001(Government of India 2004:673).

All the rivers in India are polluted with toxic items (including small and big) (Agarwal et al 1999:58). The main causes of water pollution are; urbanization, industrialization, over utilization of irrigation water leading to water logging and salization, agricultural runoff with accumulation of pesticides and discharge of domestic untreated waste including religious and social practices such as disposal of corpse and other waste materials into the rivers. Most of the cities in India depend on rivers for their drinking water requirements (Agarwal et al 1999:58). But, the growing pollution of our rivers constitutes the biggest threat to public health. During 1990's more than 1 million children died due to diarrhea and other gastrointestinal disorders. Since independence, 50 million children have died and now adults will begin to die of horrendous diseases because of the growing chemical pollution (Agarwal et al 1999:58).

The National River Action Plan (NRAP) was formulated in 1992-93 along the lines of the Ganga Action Plan (GAP). Then it was felt that more than a river-cleaning programme, it is necessary to have a long-term plan that would eventually lead to conservation of rivers. In July 1995, NRAP was renamed as National River Conservation Plan (NRCP) (Agarwal et. al. 1999:91).

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Act was passed in 1991 in deference to the commitments that the Indian government had made at the United Nations Conference on the Human Environment held in Stockholm in June 1972. And all the State Pollution Control Boards (SPCBs) that were set up have been collecting some data about air quality in a limited number of cities and locations in those cities. Agrawal et al observe that all this has been mere a paper action. There is no city for which an action plan has been prepared to control air pollution. Hardly any one has shown the courage or the vision to take strong action (Agarwal et. al. 1999:168).

3.6 Health

At least a million die in India every year because of water pollution and another 50000 to 100000 because of air pollution. (Agarwal et al 1999:282).

According to World Bank, cost of environmental damages in India is US $9.7 billion (about Rs.34000 crore) per year or 4.5 per cent of the GDP in 1992. The World Bank study reveals that the largest share of economic and health costs emerge from the growing pollution of water and air about US$7 billion (Rs.24500 crore) a year (Agarwal et al 1999:283).

Table 3.3 Total Economic Losses due to Water Related Diseases

Diseases	Estimates
I. Adult sufferers of water related diseases (based on direct responses) (Mll.)	**41.7**
* Passed worms in stool in past one month	16.2
* Diarrhoea lasting more than two days in past one month	22.4
* Jaundice in past two years	7.7
II. Children (below 15 years) sufferers of water related diseases (based on proxy responses) (Mll.)	**26.8**
* Passed worms in stool in past one month	12.1
* Diarrhoea lasting more than two days in past one month	13
* Jaundice in past two years	4.6
III. Economic burden of water related diseases (Rs.Mll.)	**41850**
* Expenditure on doctor's fee per year	17571
* Expenditure on medicines per year	6190
* Expenditure on hospitalization per year	5988
* Expenditure on special diets per year	12101
IV. Average days lost in a year due to illness (Mll. days)	**1484**
V. Valuation of days lost (Rs.Mll.)	89046

Source: Parikh and Radhakrishan 2005:91)

Table 3.4 Economic Burden of Respiratory and Eye Diseases

Items	Estimates
I. Adults	
Respiratory diseases (adults: 15 years and above age)* (Mn)	
Self-reported respiratory symptoms	72.6
Self-reported any serious respiratory disease symptoms	54.1
Respiratory disease cases identified as per MRC symptoms (Mn)	**30.5**
Bronchial asthma	4.5
Bronchitis	15.6
Pulmonary TB	9
Chest infection	8.1
Economic burden of respiratory diseases (Rs. Mn)	**45399**
Expenditure on doctor's fee of adult sufferer per year	8977
Expenditure on medicines of adult sufferer per year	25503
Expenditure on hospitalization of adult sufferer per year	2876
Expenditure on special diets of adult sufferer per year (Rs. Mn)	8043
Days lost due to illness of adult sufferer in a year (Mn days)	777
Valuation of adult days lost (Rs. Mn)	46597
Reported eye irritation in past 1 year (adults-direct response) (Mn)	44
Expenditure on doctor's fee adult per year (Rs. Mn)	5700
Expenditure on medicines adult per year (Rs. Mn)	11106
Prevalence of LRI/ARI among children below 5 years (Mn)	12.22
Source: Parikh Kirit S and Radhakrishan R (2005, p-90)	

3.7 Minerals

Currently, 20000 known deposits with as many as 87 minerals (including 4 fuels, 11 metallic, 50 non-metallic and 22 minor minerals) are exploited in the country (MoEF 2002: 7).

Mining activities necessarily lead to land degradation. Data related to area actually affected by mining and quarrying are not available. The mining lease area is about 0.8 million hectares in India (MOEF 2001:4). Mining activities adversely affect the environment i.e air pollution, water pollution, land degradation, loss of vegetation, and noise pollution, etc.

SD aims at meeting the needs of the present without compromising with the ability of future generations to meet their own needs. Thus "sustainable development requires that the rate of depletion of new renewable resources should foreclose as few future options as possible. 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 order to achieve a harmonious equilibrium between the imperatives of mineral development and those of preservation of the environment, India's National Mineral Policy, 1993 has spelt out protection of environment as one of its major objectives (Suri and Rawat 1996:10-17).

3.8 Biodiversity

In India, many plant and animal species are threatened by a destruction of their habitat and an over-exploitation of resources. A large number of species are either endangered or on the verge of extinction, both of which can be attributed to a lack of policy and institutional mechanisms (MoEF 2001:2). Biodiversity supports human survival through health, food and industry and it has social, ethical, cultural and economic values (Joshi and Joshi, 2004:19).

India ratified the International Convention of Biological Diversity (CBD) on 18th February, 1994 and became party to the Convention in May 1994. The CBD is an international legal instrument for the conservation and sustainable use of biological diversity taking into account "the need to share cost and benefit between developed and developing countries and the ways and means to support innovation by local people". It was resolved to evolve an international regime on access to genetic resources and benefit sharing with the aim of adopting an instrument/instruments to effectively implement the provisions of CBD (MOEF 2004-05:21).

The Biological Diversity Act 2002, implemented by the Indian Government incorporates provisions laid down for the conservation and protection of our rich biological diversity.

The Ministry of Environment and Forests had constituted **nine expert groups** for preparing reports in order to accelerate the process of conservation and sustainable use of natural resources through programmes on scientific lines. These groups cover the following specific areas:

- Survey, identification and monitoring
- In situ conservation
- Ex situ conservation
- Sustainable use
- Access to and transfer of technology
- Research, training and cooperation
- Legal measures
- Strengthening impact assessment measures

In addition, **a comprehensive status report on biological diversity in India is under preparation**, since as of now no such report is available for the country. The Indian Institute of

Public Administration is compiling the status report, which would cover the various facets of biodiversity conservation, for the Ministry. (Joshi and Joshi 2004:32).

S e c t i o n - III

State of Natural Resources in India

The growing population of India (1.03 billion in 2001) is posing greater pressure on natural resources of the country. There is decline in per capita availability of land and fresh water. The self-sufficiency in food grains production is attained at the cost of land degradation and depleting water table and water quality. As Cassen (2000 cited in MoEF 2001:2) puts it 90% of the increased demand for food comes from population increase while only 10% comes from an increase in income. The National Population Policy, 2000 warns that "India's current annual increase in population of 15.5 million is large enough to neutralise efforts to conserve the resource endowment and environment" (MoHFW 2000). A brief about the state of prime natural resources of the country is presented in this section.

3.1 Land Use Pattern

Agriculture constitutes the major use of land in the country. Nearly 70% of the population is dependent on agriculture for the livelihood. It contributes about 25% of Gross Domestic Product (GDP). The land under agricultural use has increased to the extent of 9% during the period 1958-59 to 1999-00. The proportion of land under forests, as per legal status during this period has increased to 31%. The area under non-agriculture use has also increased to a larger extent. This does not mean that the area under the forest cover has increased. There is a significant decline in the area under barren and uncultivable land, miscellaneous trees and groves, cultivable waste, permanent pastures and grazing and other fallows. The following Table:3.1 shows land utilization pattern of India.

Table 3.1 Land Utilization Pattern of India

Land Utilization.	Area in '000 Hectares			% Change		
	1958-59	1993-94	1999-00	1958-59 to 1993-94	1993-94 to 1999-00	1958-59 to 1999-00
Forest	52675	68421	69024	29.9	0.9	31.0
Non-agricultural Use	13563	22035	22967	62.5	4.2	69.3
Barren & Uncultivable Land	32879	18975	19440	-42.3	2.5	-40.9
Miscellaneous Trees & Groves	5711	3657	3618	-36.0	-1.1	-36.6
Cultivable Waste	20610	14468	13828	-29.8	-4.4	-32.9
Permanent Pastures & Grazing	13112	11176	11040	-14.8	-1.2	-15.8
Other Fallows	12286	9703	10108	-21.0	4.2	-17.7
Agricultural Use	143136	156428	156029	9.3	-0.3	9.0
Total Geograhical Area	293972	304863	306054	3.7	0.4	4.1

Source: ISEC 1999:273-75; CMIE 2004: 8

3.2 Forest

India is having 675538 sq km of forest cover and it constitutes 20.55% of its geographical area. The dense forest constitutes 416809 sq km (12.68 per cent) and open forest 258729 sq km (7.87). It is surprising that the forest cover has increased to an extent of 38245 sq km (6 %) during the year 1999 and 2001 (Government of India, 2004:257). According to the State of Forest Report 1997 India has lost 0.548 million hectares of forest cover during 1993 –1995. Again during 1995 and 1997, the forest cover went down from 63.89 million hectare to 63.34 million hectare. Dense forests (forests that have a tree canopy cover of more than 40%) decreased in the two-year period between 1991-93 and 1993-95 by 1.78 million hectare to 36.76 million hectare. On December 12, 1996, the Supreme Court banned felling of trees in all natural forests to prevent illegal felling of trees (except those under state working plan). According to The State of Forest Report 1995, *Jhum* cultivation and non-regeneration of degraded forests are the main causes of depletion of forests in the country. But, the 1997 report does not analyze the causes of forest destruction (Agarwal et. al.1999:111-12).

3.3 Land Degradation and Wastelands

The increasing population of human and livestock, poverty, and rapid economic development are exerting heavy pressure on the land. This has led to very significant land degradation. According to Sehgal and Abrol, 1994 (cited in MoEF, 2001:1) 57% of the total geographical area of India has been degraded.

From the point of view of ecological development, it is important to understand the extent and magnitude of wastelands (Kadekodi 2004:39). According to National Remote Sensing Agency (NRSA), the total all-India wastelands in 1999 stood at 64 million hectares, as against 44 million hectares in 1998-99. This amounts to a sharp rise in wastelands by almost 44% over ten years (Kadekodi (2004:47). The following table shows extent of wasteland in India.

Table:3.2 Extent of Wasteland in India: Data From Remote Sensing Agency, 1999

Sl No	Type of Land	Area (Sq. Km)
1	Gullied/ravinous land	20553.35
2	Land with or without scrub	194014.29
3	Waterlogged/marshy land	16568.45
4	Saline/alkaline area	20477.38
5	Shifting cultivation area	35142.20
6	Degraded notified area	140652.31
7	Degraded pastures/grazing lands	25978.91
8	Degraded land under plantation lands	5828.09
9	Sands-islands/coastal	50021.65
10	Mining/ industrial wastelands	1252.13
11	Barren rocky area	64584.77
12	Steel sloping area	7656.29
13	Snow/glacier area	55788.49
14	Total wastelands	638518.31
15	Total geographical area	3166414.00
16	Percentage of wastelands to total geographical area	20.17

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3.4 Water Resources

India's land and water mass account for about 2.4% and 2.5% of those in the entire world (respectively) on which 1.03 billion (2001 census) people constituting 16% of the world population are dependent for domestic and non domestic purposes. In India, the average run-off of water in the river system is 1869 km3 (cubic kilometers) whereas its utilizable portion is about 690 km3. The potential is estimated at 432 km3. The annual per-capita availability of water fell from 6008 cubic metres in 1947 to 2464 cubic metres in 1990 to 2266 cubic metres in 1997 (Pachuari and Sridharan 1998:44) and 1869 cubic metres in 2001 with great variation in water availability in different river basins (Government of India 2004: 667-8). At the end of the Ninth Plan India's irrigation potential had been increased to about 93.98 million hectare from 22.6

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Public Administration is compiling the status report, which would cover the various facets of biodiversity conservation, for the Ministry. (Joshi and Joshi 2004:32).

S e c t i o n - IV

National Policies and Legal Environment: Approach towards Conservation and Protection of Natural Resources

In India the existing policy framework for environmental protection rely largely on command and control approach while the developed countries favour market-based instruments. A series of environmental legislations were introduced after the UN Conference on Human Environment held at Stockholm in 1972. Until then the awareness and concern on environmental issues was negligent among the public and policy makers. Major initiatives taken by Government of India during the economic reforms period in the background of the Constitutional framework are presented in this section.

4.1 Natural Resources and Environment as enshrined in the Indian Constitution

***** Article 39 (B) of provides that the ownership and the control of material resources of the community are so distributed as best to subserve the common good.
***** Article 48A says that the State shall endeavour to protect and improve the environment and to safeguard the forests and wild life of the country.

* Article 51A specifies that it shall be duty of every citizen of India "to protect and improve the natural environment including forests, lakes, rivers and wildlife, and to have compassion for living creatures.
* 42nd Amendment makes forests a subject of parallel jurisdiction of central and state governments.
* The 42nd Amendment Act, section 10 says "The State shall endeavour to protect and improve the environment and to safeguard the forests and wild life of the country".
* The 73rd and 74th amendments to the Constitution recognizes the role of local bodies in environmental protection and includes protection of the environment and promotion of ecological aspects to be taken up by local bodies.
*** The Eleventh Schedule (Article 243G)** entrusts in addition to others (total 29), the following functions related to natural resource management to Panchayats

1. Agriculture, including extension
2. Land improvement, implementation of land reforms, land consolidation and soil conservation
3. Minor Irrigation, water management and watershed development
4. Animal husbandry, dairying and poultry
5. Fisheries
6. Minor forest produce
7. Drinking water
8. Fuel and fodder
9. Non-conventional energy sources
10. Maintenance of community assets

*** The Twelfth Schedule (Article 243W)** lists in addition to others (total 18), the following functions related to natural resource management to municipal bodies (Ministry of Law and Civil Affairs 1996:189);

1. Water supply for domestic, industrial and commercial purposes
2. Solid waste management
3. Urban forestry, protection of the environment and promotion of ecological aspects
4. Cattle pounds; prevention of cruelty to animals

Source: Ministry of Law and Civil Affairs 1996:14, 15, 188, 189.

4.2 National Policies/Programmes

1. National Forest Policy(NFP), 1988 lays down "village and community lands including those of foreshores and environs of tanks not required for other productive uses should be taken up for development of tree crops and fodder resources"

The Policy states that revenue gathered through such programmes should belong to panchayat where lands are vested in them. In all other cases such revenue should be shared by local community in order to provide an incentive to them [(para 4.2.3) (Singh Mridula and Lal Murari 2001:25). The National Policy was made effective from April 1992.

The NFP, 1988 recognised the needs of forest based livelihoods. It was felt that natural resource management is not single handed and involving those who depend on them in conservation would benefit both the livelihoods as well as development of resources. So the concept of decentralized management of forest resources got impetus.

The NFP states that "The holders of customary rights and concessions in forest areas should be motivated to identify themselves with the protection and development of forests from which they derive benefits. The rights and concessions from forests areas should primarily be for the bonafide use of communities living within and around forest areas, specially, tribals". Recognising the fact that forests sustain the livelihoods, particularly tribals whose life resolves around forest areas, the NFP states that the rights and concessions enjoyed by them since long should be fully protected, ensuring their domestic requirements of fuel wood, fodder, minor forest produce and construction timber.

2. The Ministry of Environment and Forest has come out with National Forestry Action Programme (NFAP) a framework providing guidelines for sustainable development of forests. NFAP thrusts on following issues:

- Protection of existing resources i.e. protection and conservation of soil, water and biodiversity.
- Improving Forest Productivity through rehabilitation of degraded forests
- Reduction of demand on forests through substitution and improvements through introduction of technology.
- Strengthening Policy and Institutional Framework through capacity building, forest policy, legislation, public forest administration, research, planning and budgeting.

Expansion of forest area through tree plantations and peoples' participation in development and conservation.

3. The policy statement for Abatement of pollution issued by the Ministry of Environment and Forests expresses concern over deterioration of environment, and

* Advocates a mix of instruments for environmental protection
* Recommends polluter pay principle
* Recognises public role in decision making
* Emphasize on market based instruments in fixing the cost of natural resources so that users realize their value.

4. By promulgating rule 14, under Environment (Protection) Act, 1986 the Government has made it compulsory for practically every industry to conduct an environmental audit and submit environmental statement to the concerned State Pollution Control Board (SPCB) every year (Bengeri 1995).

5. The report of the Technical Committee on Drought Prone Area Programme and Desert Development Program (1994) says that "Since the objectives of watershed development is ecological improvement and conservation of natural resources as well as socio-economic development of local population, watershed management efforts must incorporate soil and water conservation and land use planning into a broader framework that takes into consideration not only physical interrelationships but economic, social and institutional factors as well and appropriate arrangements should be made for distribution of benefits to watershed community from the government lands and watershed development"(Singh Mridula and Lal Murari 2001:25).

6. Water is a scarce natural resource and a basic human need. Therefore, it should be planned, developed, conserved and managed by the state. National Water Policy, 2002 (Ministry of Water Resources 2002:5-9) states that " In view of the vital importance of water for human and animal life, for maintaining ecological balance and for economic and developmental activities of all kinds, and considering its increasing scarcity, the planning and management of this resource and

its optimal, economical and equitable use has become a matter of utmost urgency. Concerns of community needs to be taken into account for water resources development and management". The Policy specifies the following factors with respect to sustainable development of water resources;

a. Water resource development projects should be developed as multipurpose projects with drinking water as priority so that they are sustainable.
b. Water quality monitoring
c. Principle of 'polluter pays' to be followed in management of polluted water
d. Drought prone areas should be treated with soil-moisture conservation measures, water harvesting practices, recharging of ground water and transfer of surface water from surplus areas where feasible and appropriate.
e. Exploitation of ground water resources should be regulated as not to exceed the recharging possibilities, as also to ensure social equity.
f. Management of water resources for diverse uses should incorporate a participatory approach by involving not only the various governmental agencies but also the users and other stakeholders in an effective and decisive manner, in various aspects of planning, design, development and management of the water resource schemes.
g. Water Users' Associations and the local bodies such as municipalities and gram panchayats should particularly be involved in the operation, maintenance and management of water infrastructures/facilities at appropriate levels progressively, with a view to eventually transfer the management of such facilities to the user groups/local bodies.
h. Extension of irrigation facilities to large number of families as possible
i. Adopting scientific water management/practices, sprinkler and drip irrigation
j. Reclamation of water logged/saline affected land by scientific and cost-effective methods
k. Subsidies on water rates to the poor and weaker sections should be well targeted and transparent.
l. Ensuring financial and physical sustainability by levying water charges for various uses at least to cover operation and maintenance cost of providing the service initially and a part of the capital cost subsequently.

7. India's perspectives on sustainable development have been presented in the study report EPSD 2002. The report was presented in World Summit for Sustainable Development (WSSD) in 2002. India's commitment to the process of sustainable development has been through strategies for overall development stated in five year plans. But, EPSD has evolved a holistic approach for Sustainable development casing all the sectors following a multidimensional approach. Conservation of natural resources is taken up as a priority issue as it sustains around two-third of the country's livelihoods and contributes to environmental sustainability.

The new strategies for ensuring the sustainable development in different natural resource sectors are evolved taking into consideration the issues specified below (MoEF 2002:1-22);

- **Issues Relating to Power:** The approach to energy sector takes in to account two aspects -access to energy and energy security. Problems identified are; inadequate power generation capacity; non-optimal utilization of the existing power generation capacity; inadequate inter regional transmission links; rampant power theft; skewed tariff structures; slow pace of rural electrification; inefficient use by end consumer, and lack of grid discipline. Currently, of the commercial power generated, 71% of the installed capacity is from thermal sources, 24% from hydel sources, 2.9% from nuclear sources and rest from wind energy.
- **Issues Relating to Renewable Sources:** The Ministry of Non-Conventional Energy Sources has initiated largest decentralized solar energy programme, the second largest biogas and improved cooking stoves programme, and the fifth largest wind energy programme in the world as a major step towards sustainable development.
- **Issues Relating to Coal:** Coal has been identified as a major fuel till 2012. To solve the problem of fly ash disposal, use of beneficiated/blended coal (with ash content not exceeding 34%) has been made mandatory with effect from June 2002 for all power plants located beyond 100 km from pit heads and those located in critically polluted urban and ecologically sensitive areas.
- **Issues Relating to Petroleum and Natural Gas:** The framework for guiding the approach and policies in the petroleum and natural gas sector has been presented in "India Hydrocarbon Vision 2025" brought out by the Government of India. The Government

dismantled the Administrative Price Mechanism (APM) for petroleum and natural gas products on April 1, 2002 enabling market to play a role so as to increase efficiency in their use and for pricing their real value.

- **Issues Relating to Forests and Biodiversity** : Deforestation, extraction for fuel wood and fodder, forest fires, diversion of forest land for developmental purpose pose a threat to sustainable use of forest resources. The new initiatives are; in situ conservation of protected areas (national parks and sanctuaries), biosphere reserves, forest preservation plots, mangroves conservation programme and Indian coral reef monitoring programme, and ex situ conservation of botanic gardens, zoological parks, establishment of gene banks for storing genetic material and germplasm, research and training on wild life and more importantly the introduction of the Biodiversity Bill, 2001, which addresses both in situ and ex situ conservation issues and other important aspects such as bio prospecting, patents, community role, etc.
- **Issues Relating to Marine Resources**: The standards for effluent discharge into marine waters are laid down in the Environment Protection Act, 1986. The Central and State Pollution Control Boards are the agencies responsible for monitoring and protecting the marine areas. But, marine resources are under constant threat due to discharge of untreated municipal and industrial waste, sand mining, aquaculture, port development activities, etc. The Coastal Zone Regulation Act, 1991 sets limit on the construction and development activities that can take place along the coastal line.
- **Issues Relating to Water Resources**: The main pressures in water resource sector are depletion of ground water resources, deteriorating quality of surface and ground water, inefficiency in distribution and use of water, uneconomic water pricing, inadequate measures for recharging, and lack of institutional mechanism to monitor and implement water resource use, pollution and management. Many of these pressures have been addressed to in the National Water Policy in 2002 brought out by the Government of India.

The new approach to empower people for sustainable development relies on certain innovative factors as specified below;

- Framing policies for grazing and livestock management and common property resource lands

- Conferring ownership rights to landless labourers from surplus land
- Regeneration of wastelands in common property regime with the help of NGOs and people.
- Computerization of land records initiated in 582 districts of the country
- Reduction of subsidies and shift to market prices
- Focus on increasing investment on capital
- Rural infrastructure
- Integrated Pest Management
- Conservation of forest and biodiversity
- Setting up an appropriate Institutional Framework

Ministry of environment and forests, agriculture, water resources and industries have been playing important role in implementing policies related to sustainable development. For effective implementation of the policies Government is also trying to involve the NGOs and local people.

S e c t i o n - V

Planning for sustainable development: A look into the Five Year Plans

The guiding principles of Indian planning (Planning Commission: a) are provided by the basic objectives of growth, modernization, self-reliance and social justice. But, ecological issues have not been adequately incorporated into our development strategy, and the biological wealth of the nation has not been nurtured and utilized for the welfare of both our people and humanity at large to the extent it should have (Planning Commission 2003:4 b). However, of late there is a shift in the focus of development planning from the mere expansion of production of goods and services and increase in per capita income, to planning for enhancement of human well being. To ensure sustainable development, it is felt necessary to link economic prosperity with social development reflected by increased rate of literacy, longevity, low birth rates facilitated by access to health care and education services, and more importantly the environmental sustainability. Social indicators are considered as inputs to sustain development in the long run, hence the current focus of development is social justice with equality of opportunity. In addition, the notion of national security has been broadened to include energy and food security apart from well built defence system.

Water resource development has received priority in Five Year Plans as evident from numerous major and medium irrigation projects constructed in the post independence period resulting in an increase in irrigated potential from 22 million ha in 1950 to 94.7 million ha in 2000, which is about 68% of the ultimate irrigation potential (MoF 2001-2002:193).

In the First Five Year Plan the top most priority was given to agriculture, as well as to basic services like power and transportation. For the forest sector the priorities identified were; strengthening the forest administration, renovation of the exploited areas afforestation in areas affected by soil erosion, development of forest communications and development of village plantation. The Government laid the foundation for mineral development by announcing the Mineral Policy, expansion of Geological Survey of India and by establishing a Bureau of mines for securing coordinated development with due regard to conservation of mineral assets.

The second Five Year Plan focused on increasing the national income so as to raise the level of living in the country. Forest programmes included proposals for afforestation and improvement of poorer areas in the forests, formation of plantations of species of commercial value, conservation of wild life, amelioration of the conditions of staff and labour in forests, increased tempo of forest research and increased provision of technical personnel.

The objectives of third Plan were also to set to secure an increase in national income of over 5% per annum. The purpose was to achieve self-sufficiency in food grains, increase in agricultural production, expansion of basic industries like steel, chemicals, fuel and power, utilization of the man power resources of the country and greater equality of opportunity.

A unit for Natural Resources was set up in the Planning Commission for studying problems relating to the assessment and development of natural resources and for assisting various agencies engaged in the survey and investigation of these resources to link up their work with the requirements of the rapidly growing economy. It was proposed not only to intensify some of the programmes initiated under the first and the second Plans but also to put special emphasis on measures which will help meet the long term requirements. Some of the important programmes were, economic plantations, village and extension forestry, development of minor forest produce, survey and demarcation, forest research and training of technical personnel.

The greater emphasis laid on the expansion of industry during the third Plan called for an intensified programme of mineral exploration and development. The main objectives with reference to minerals were, locating workable reserves of minerals and metals, proving additional reserves of minerals like iron ore, bauxite, gypsum, coal, etc., and establishing new mines for production purpose.

Fourth Five Year Plan, focused on the achievement of self reliance, price stability, enlarging income of the rural population, enlarging supplies of essential mass consumption goods to enable spending of additional incomes, ensuring continued growth in the metals, machinery, chemicals, limiting the growth of population and, development of human resources. Forestry programme included plantation schemes focusing on quick growing species and economic species. Mineral projects included development of the limestone deposits in the satna area, mining and beneficiation of fluoride deposits in Gujarat and development of magnetite deposits in Almora.

The removal of unemployment, an appreciable rise in standard of living of the poorest sections, achieving a higher rate of growth of the economy and moving towards a significant reduction in present disparities of wealth were the general objectives during the Fifth Five Year Plan. The main thrust of the forestry programme was be to accelerate production forestry and social forestry including farm forestry giving attention to the need for maintaining the ecological balance and protecting the environment. The objective of forestry development was to meet the economic demand for forest products and maintain and improve the quality of the environment as well as provide substantial employment. States and forest development corporations were set up in several states. Social forestry was proposed to be taken up by creating forest raw material on degraded forest areas.

The removal of poverty was the foremost objective of the Sixth Plan. It was realised that the pace of movement towards the long-term objective of removal of poverty and the achievement of self-reliance were influenced by current economic situation and the constraints operating in the economic system. Environmental protection became one of the explicit objectives of the Sixth Five Year Plan.

In the light of the oil crisis it was felt necessary to intensify the exploration for oil for establishing additional reserves and measures to curb consumption of petroleum products through their substitution by alternate fuels to meet the situation. Development of substitute materials derived from renewable resources, wherever possible was proposed to be encouraged.

The forestry programme continued to be focused on the conservation of existing forests and launching of country-wide afforestation and social forestry programmes. The Sixth Plan specified that the Forest policy has to fulfill three sets of needs (a) ecological security; (b) fuel, fodder and other domestic needs of the population; (c) the needs of village, small scale and large scale industries. In conformity with this objective the major area of thrust was placed on promotion of a peoples' forestry movement. The programmes aimed at popularization of appropriate management system integrated with rural development, developing national living resources, restoration of degraded habitat and depleted fauna and to rehabilitate the endangered and threatened species.

Social forestry programme comprising of schemes viz., (a) mixed plantation of waste lands, (b) reforestation of degraded forests and raising of shelter belts and treated as centrally sponsored programme, was transferred to the state sector with effect from 1979-80.

It was proposed that for proper functioning, the Forest Survey of India (FSI) should have links with various organizations for continued updating of the technology of mapping, inventory and presentation of planning data. Forest Research included all-India coordinated research projects in bamboo, neem and leguminous trees and shrubs. This covered (a) survey and exploration of major areas where neem and leguminous trees occur (b) selection of suitable eco-type and assembling various in germ plasm banks; (c) studies on vegetative propagation techniques; (d) breeding and improvement work, provenance and progeny trials (e) cytological and chemical studies.

New programme proposed were;

(a) "Tree for Every Child Programme", by assisting for training and supply of relevant seedlings to all the schools willing to join the programme. Those schools that had the necessary land and water facility were to raise nurseries of appropriate seedlings within the school compound itself with the participation of the children.

(b) "Eco-Development Force": An Eco-Development Force consisting predominantly of ex-servicemen was proposed to be formed for the purpose of restoring damaged hill eco-systems through afforestation and soil conservation.

(c) " Eco-Development Camps" to enable college students drawn from different universities of India to take up extensive tree planting work in suitable areas, such as hills, desert and coastal regions.

(d) " Agro-Forestry Programmes" with the joint collaboration of Forestry Departments and the Indian council of Agriculture Research in order to develop suitable systems of land management, which involved integration of silviculture with horticulture, agriculture, animal husbandry, etc.

The Seventh Plan emphasized on policies, which accelerated the growth in food grain production, increase in employment opportunities and productivity. The governments concern for preservation of forests was reflected in the creation of a separate department of Forests and Wildlife at the centre and also in terms of conservation of ecologically fragile ecosystem, increasing substantially the vegetative cover by massive afforestation, meeting the basic needs of the people in respect of fuel wood and fodder.

The basic approach to the Seventh Plan was based on sustainable development in harmony with the environment. Attention was given to policies concerning the use of natural resources and the state of the environment drawing linkage between environment and poverty.

The Seventh Plan Programmes attempted to remove some of the weakness in the then existing environmental planning system. The direct goals relating to the subject of environment, as a whole were,

- Institutionalizing the process of integrating environmental management and development.
- Inducing organization at the central, state and local levels to incorporate environmental safeguards in their plans and programmes.
- Securing greater public participation in environmental management.
- Establishing a strong science and technology base for environmental research and development activities.
- Pollution Monitoring and control
- Environmental Impact Assessment (EIA) as an exercise to evaluate the potential of a project, which may cause damage to environment.
- Natural living resources Conservation
- Eco-development to restore already degraded eco system
- Environmental research promotion to ensure scientific support for environmental management programmes
- Environmental education training and awareness for creating and intensifying environmental awareness at all levels
- Environmental information for environmental management
- Coordination and liaison with State Government and Union Territories to achieve centralized implementation of environmental management programmes

Eighth Plan was implemented with the objectives of generation of adequate employment to achieve near full employment level by the turn of the century, containment of population growth through peoples' co-operation, universalisation of elementary education, provision of safe drinking water, growth and diversification of agriculture, and strengthening of the infrastructure. It was felt that environment, ecology and development must be balanced to meet

the needs of the society. In the interest of sustainable development it was felt necessary to take measures to preserve, conserve and critical eco system.

Important tasks laid down were:

- To protect the natural environment
- To regenerate and restore degraded ecosystems and increase their productivity
- To decentralize control over nature and natural resources
- To develop and share an understanding of nature and natural resources
- To formulate a national policy for environment
- To monitor the state of environment
- To ensure a coordinated and integrated governmental action aimed at conserving nature and sustainable use of natural resources
- Development and sharing of an understanding of nature and natural resources
- Formulation of national policy
- Co ordination in government action

The National Watershed Development Project for Rainfed Areas initiated in the earlier Plan was continued during this period.

Forest and wildlife policy included;

- National forest policy 1988 to ensure environment stability
- Modern Forest Fire Control Project assisted by UNDP implemented in Maharastra and Uttar Pradesh
- Establishment of the Indira Gandhi National Forest Academy
- Pasture development through peoples institution
- Assistance in the implementation of Tree Patta Schemes

The Ninth Plan for environment and forests embodies the spirit of the Rio Earth Summit, 1992 initiative called as Agenda 21 in recognition of a basic premise i.e. environmental management and economic development are mutually supportive (Planning Commission 2000:327). The principles of Agenda 21 find reflection in the policy statements of the Government of India on forestry, abatement of pollution, national conservation strategy and environment and development (Sury 2001:172).It was proposed to have social mobilization at all levels to ensure environmental sustainability of the development process. Ninth Plan focused on

agriculture and rural development to ensure food and nutritional security for all, providing the basic minimum services of safe drinking water, health care facilities, education, shelter, etc., ensuring environmental sustainability of the development process, empowerment of women and socially disadvantages groups.

In the ninth Plan period the focus of the Ministry of Rural Development was on land reforms. The new strategies such as the promotion of women's land rights to benefit socially excluded groups and issuing passbooks to land owners were taken up. The main objective was to ensure environmental sustainability of the development process through social mobilization, and to place the strategy for environment sector in accordance with measures to protect the environment in such a way to achieve sustainable development.

A number of attempts were made for incorporation of natural resource accounts into income accounts. In order to make a beginning, an expert group under the Ministry of Planning and Programme implementation was constituted for giving technical directions for the preparation of natural resource accounting.

Some initiatives were,

- Strengthening the central pollution control board
- Industrial pollution control and prevention projects
- Environmental statistics and mapping
- Environmental education, training and information
- The National Environment Tribunal act, 1995
- Forestry and wildlife afforestation
- Waste land development

The Approach Paper to the Ninth Five Year Plan states "The most important methodology for preventing undue depletion of natural resources is by ensuring their efficient use at all levels. This has two important dimensions. First, exhaustible or vulnerable natural resources should be priced appropriately in order to prevent over exploitation. In India, since a large proportion of natural resources are subjected to administered prices there has been a tendency to under-price resources quite significantly. This approach needs to be changed

urgently. Secondly, technologies which conserve the use of natural resources need to be developed and promoted vigorously" (Planning Commission 2000:36).

Tenth Plan lays not just the objectives, but sets specific targets that make it essential to fulfill the objectives as indicated below:

- Reduction of poverty ratio by 5% points by 2007 and by 15% points by 2012
- Providing gainful and high-quality employment
- All children to be in school by 2003 and complete 5 years of schooling by 2007
- Reduction in gender gaps in literacy and wage rates by at least 50% by 2007
- Increase in literacy rates to 75% within the Plan period
- Reduction in the decadal rate of population growth between 2001 and 2011 to 16.5%
- Reduction of infant mortality rate (IMR) to 45 per 1000 live birth by 2007 to 28 by 2012
- Reduction of Maternal mortality rate (MMR) to 2 per 1000 live birth by 2007 and to 1 by 2012
- Increase in forest and tree cover to 25% by 2007 and 33% by 2012
- All villages to have sustained access to potable drinking water within the Plan period
- Cleaning of all major rivers by 2007 and other notified stretched by 2012.

One of the primary objectives of the Tenth Plan is to strive for regional balance. It is imperative to tackle the development problems of those areas which, despite significant efforts, continue to be characterised by high poverty, low growth and poor governance to have an equitable growth.

Against this backdrop, the first **National Human Development Report (NHDR)** was bought out as a prelude to the Tenth Plan. It is expected that the NHDR will provoke debate among states & encourage introspection on the development strategy that each state has to follow.

The tenth Plan states that environment has an over-arching effect on all aspects of economic and social life. It is in the tenth Plan that the problem of water availability both in terms of quantity and quality is emphasized as many regions in the country are experiencing water stress. Some initiatives that are proposed to be taken up in the Tenth Plan that aim at sustainable use and development of natural resources are:

- Regulation of ground water use
- A coordinated approach to land use policy and development of waste lands and proposal to set up Lok Nayak Jai Prakash Narayan Land and Watershed Mission
- A new scheme of Greening of wastelands through people's participation
- Community participation in maintenance of irrigation projects
- Dismantling and deregulation of APM in the oil and natural gas sector- all petroleum products prices to be market determined and the subsidy on kerosene and LPG to be phased out during tenth Plan period.
- Private sector participation in coal mining
- Universalisation of JFM
- An action plan for controlling pollution in rivers and lakes.
- Optimal use of natural resources and adoption of pollution prevention and cleaner technology projects.
- Conservation of bio-diversity in ecologically sensitive areas.
- Setting up of an International Institute on Science and Technology for Tropical Areas to handle climate change related issues.

In Summary

India has completed nine Five Year Plans, and is in the phase of implementing the Tenth Plan. We have outlined above how the focus of planning for development has changed from current generation only to current and future generations. With the liberalization process there is also a shift in the management from state to people and from public to private, and from controlled to market intervention in development, management, distribution and pricing of natural resources. On the one hand, the initiatives taken are promising as they result in recognising the value of our natural resources ensuring efficient and sustainable use of resources. But, on the other hand, the proposals to reduce subsidies on kerosene and LPG, private sector entry in power and energy sector and possibilities of private sector role in water resources management and distribution may not ensure equity as well as equal opportunities as specified in the Tenth Plan document. However, it may increase efficiency in their use due to market pricing and stable management. There are possibilities for improvement or enhancement of the state of natural resources in future, particularly forests, land and water due to proposed involvement of community, tribals and Panchayats in management of forests, water bodies and watershed development. The main thrusts for improvement or enhancement of forest, land and water resources consist of programmes such as Joint Forest Management and Watershed development programmes.

S e c t i o n - VI

Teaching Modules on Natural Resources and Sustainable Development

The teaching in economics before mid nineties focused on macro and micro economics centering around basic economic theories and models, planning, international trade, economic thought, monetary economics, the Indian economy, industry, agriculture and rural development with basics of statistics and econometrics. Environment, health and education were not looked as part of economics. The debates on the challenges that the whole world including India is facing due to changes in environment, stock of natural resources and growing population and the increasing awareness and research on environmental aspects induced the academia to study and introduce the concepts of natural resources and sustainable development in university courses. Technical institutes and research centres took the lead in introducing these subjects in teaching and research.

Classes in environmental and natural resource economics are offered at Master's course in environmental studies to students from a wide range of disciplines viz. economics, commerce, agricultural economics, business administration, environmental engineering and forestry. The post graduation courses in economics generally include in addition to core subjects, basic readings on environmental and resource economics, exhaustible and renewable resources, extent, causes and consequences of degradation of land, water, forests and air, theories related to environment, soil and land management and ecology.

Universities, research centres and technical institutes including engineering colleges began to introduce degrees and diploma courses in environmental engineering, environmental economics and environmental management. So from being a component of the basic economics course, environment, natural resources and sustainable development emerged as independent courses for the award of degree. TERI has introduced M.Sc. programme specifically for Natural Resources. The Department of Agricultural and Natural Resource Economics in Indira Gandhi Agricultural University, Raipur was the first department to introduce teaching and research on natural resource economics in India under the State Agricultural University system.

The School of Environmental Sciences at the Jawaharlal Nehru University was the first to start M.Sc./M. Phil. Programme in Environmental Sciences in the country in 1975, which underwent periodic changes in the curriculum in the following years. The current semester course on Environmental Science as of 2005 includes in addition to basics, papers on natural resources and sustainability related topics such as environmental conservation, water resources, ecology and sustainable development, environmental (air, water) pollution, environmental impact assessment, natural hazards, forest grasslands, arid lands, wetlands, dominant species, species diversity, concept of habitat, etc. The paper on Pollutions Biology includes topics such as pollutants vs. resources, cycling of materials, tolerance ranges, carrying capacity, bioaccumulation, response of plants and animals to changes in pysico-chemical characteristics, etc. The course paper on Ecology and Sustainable Development includes the concept of SD temporal and spatial dimensions, currencies for evaluation of SD, global change and sustainable issues, ecosystem and social processes in rehabilitation of degraded rural landscape, unbalanced soils, specialized habitats such as water bodies, mangroves, rehabilitation of mined area, participatory research and education and, environmental decision making with peoples' initiatives.

Environmental Economics is an optional paper at the post graduation level in Gujarat, Shivaji (Kolhapur, Maharashtra) Universities. In Himachal Pradesh (Simla) University, one paper in the fourth semester course of the MA in Economics is on Environmental Economics. Environmental Economics is a compulsory subject for the MA in Economics at North-Eastern Hill University (Shillong, Meghalaya), Berhampur University, Karnataka University and universities in Andhra Pradesh, Delhi and Utkal University.

The Madras School of Economics is one of the recognized Environmental Economics Node (i.e. Environmental Information System-ENVIS) centres in the country. ENVIS Information System is a decentralized system with a network of distributed subject oriented centres ensuring integration of national efforts in environmental information collection, collation, storage, retrieval and dissemination to all concerned. ENVIS centres have been set up in the areas of pollution control, toxic chemicals, central and offshore ecology, environmentally sound and appropriate technology, bio degradation of wastes, environment management and environmental economics. The school has been recognised as a Centre for Excellence in Environmental Economics by the Ministry of Environment and Forests, Government of India.

Goa, Karnataka, Bangalore, Mangalore Universities have recently (i..e. in late nineties) have introduced courses on environmental economics at the post graduation level. Courses of other social sciences also include natural resource conservation and developmental aspects in their post graduation syllabus for example the Sociology of Environment offered in Karnataka University at Dharwad (Karnataka) includes; environmental problems, interrelation between environment and society, pollution and their effects, deforestation, developmental projects, displacement and rehabilitation, population growth and environmental problems, approaches to the study of environment: Marxian, Gandhian, eco-feminism, environmental conservation, environment and development, Constitutional provisions and environmental laws, environmental movements- Chipko, Narmada, Save Western Ghats and, the role of the state and international agencies and NGOs in environment conservation and development.

Most of the Indian Universities have not included environmental issues in their Post graduation courses. The old courses of micro/macro economics, public finance, quantitative methods, economic thought, Indian economy, international, agricultural, banking, labour, industrial economics continue to be the core subjects.

TERI [The Energy Research Institute] School of Advanced Studies offers Semester programmes leading to the award of M.Sc. in 'Environmental Studies' and M.Sc. in 'Natural Resources' and M.A. in 'Public Policy and Sustainable Development'. These programmes are designed in the background of the environmental challenges that exist in the 21st century, particularly to share and spread the experiences and findings of research work taken by TERI on preservation of biodiversity and ecosystems and sustenance and protection of forests. The courses intend to throw light on methods of translating scientific knowledge in to policy/decision making and integration of environmental issues into development. The purpose of these programmes is to educate and train students to become natural resource/environmental managers, scientists, researchers, and policy makers. The Centre for Environmental Science and Engineering (CESE) of IIT, Mumbai, conducts three courses related to natural resource and sustainable development out of its total 41 courses. Course on Environmental Change and Sustainable Development in addition to basic components of environmental economics includes issues of sustainability, debates on it and design for environment and sustainability. Course on Environmental Ethics focuses on sustainable society. Course on Principles of Environmental Management teaches strategies for management of resources. IIT, Delhi's Centre for Energy

Studies awards degrees in M.Tech. in 'Water Resource Engineering' and 'Environmental Science and Engineering' , which include some basic readings on water resources, projects, systems, water conservation and management, air pollution, environmental legislations, etc.

At the Indira Gandhi Institute of Development and Research (IGIDR), Mumbai the focus of the courses is on development aspects. IGIDR offers M. Sc in Economics, wherein energy and environment is introduced as compulsory subject in the second year. Optional subjects include energy and environmental economics, environmental science and technology and environmental management. For M.Phil and Ph D. also energy and environ is a course from which sub courses have to be selected.

The M.Sc. programmes on Environmental Studies and Natural Resources and M. Phil and Ph.D. courses offered at research centres like IGIDR, Mumbai; IITs; TERI, New Delhi; IEG, Delhi; MIDS, Madras; etc., include readings and case studies leading to submission of dissertations on the project work.

The knowledge on the concept of natural resources and sustainable development has been floated through distance learning also. The Indira Gandhi National Open University (IGNOU) a premier and predominant distance learning institute offers Certificate course in 'Environmental Studies', P.G.Diploma in 'Environmental and Sustainable Development'.

The components relating to natural resources and sustainable development as offered in different academic courses of universities, technical institutes and research centres under the disciplines of economics, environmental economics, natural resources, agricultural economics, sociology, business administration, agricultural economics, etc., are presented below.

Taxonomy of course contents on natural resources and sustainable development

M.A. in Economics **[A]**	M.A./M.Sc/M.Tech.M.Phil/Ph.D. in Environmental Economics and Natural Resources [**B]**
• Basic course in Environmental and Resource Economics • Resource Taxonomy • Economics of Exhaustible and Renewable Resources • Extent, causes and consequences of degradation of land, water, forests and air • Soil and Land Management • Hotelling's Theory of Optimum Depletion and Recent Developments • Pricing of Resources • Ecology and Biodiversity • Soil and Land Management • Energy and Environment • Community Organisation	• Components of **[A]** ***plus*** • Natural Resources Policy and Management • Challenges for sustainable development and policy making • Water conservation and Management • Sustainable Resources Management • Governance and Management of Natural Resources Grasslands, arid lands, wet lands • Environmental Law and Policy • Environmental Journalism • Geomatics for Natural Resource Management • Forest Protection • Environmental Impact Assessment • Remote Sensing • Participatory Research and Decision making • Issues of sustainability:food, materials and energy resources • Earth Resources • Eco system Dynamics: abiotic and biotic components

S e c t i o n -VII

Doctoral Studies on Natural Resource and Sustainable Development in Indian Universities [1990–2002]

In this section we present the research areas in the broad domain of natural resources and SD (direct and indirect linkages) taken up by students for the award of doctoral degrees in different universities from the disciplines of economics including environmental economics. Since the focus of this monograph is mainly on review of research in economics, we have not listed doctoral studies, which are on impacts of environmental pollution, use of science and technology for identification of natural resources, etc. registered under the disciplines of geology, environmental science, earth science, etc. as they concentrate more on technical aspects rather than economic indicators. If we take into account all such studies, we find that there is emerging interest in addressing to the problems of environmental degradation, particularly the effects of pollution on water quality, land and air.

The information was collected from the University News, a weekly journal of higher education published by the Association of Indian Universities, New Delhi. The University News, publishes every week under the title 'theses of the month' the details of studies accepted by Indian universities for the award of doctoral degree.

The study of natural resources has been an important subject for research in India. The focus was mainly on water resources before the 1992 Rio Summit, but from 1995 onwards the term sustainability and SD appear in the research topics of the doctoral studies. During 1995 to 1998, studies on watershed management and sustainable agriculture were completed and submitted for the award of doctoral degree. This was the period of completion of many watershed development projects taken up by government in different parts of the country. Studies on watershed focused on evaluation in terms of resources management and impact of the programmes, particularly for sustainable agriculture. In the later period studies were taken up on common property resources, economics of forest resources, social forestry and impact of environmental degradation on resources and economy. Recent studies focus on the crucial aspect i.e. the need for environmental planning, management and conservation and, the role of stakeholders in sustainable development.

The number of studies promoted on natural resources and sustainable development is highest from the School of Environmental Sciences in Jawaharlal Nehru University, New Delhi. Researchers in agricultural universities, particularly in Maharashtra and other universities in Andhra Pradesh have taken up more number of studies on the natural resources and SD. Annex-I to this monograph gives details of topics registered and completed by students for the award of doctoral degree in different universities during 1990 to 2002.A brief idea of the research flow in the relevant field is depicted by the information presented in Table: 7.1 below.

Table: 7.1 Completed Doctoral Studies on Natural Resource and Sustainable Development in Indian Universities (1990-2002)

Sl.No	Areas	No. of Studies
I.	**Environmental/Natural Resource Assessment**- Water resources; Ground water,	3
II.	**Water Resources-** Economics of water resource management; Impact of water resource management on irrigation; Integrated ground water studies; Conjunctive use of ground and surface water; Ground water quality and quantity assessment; Drinking water supply; Impact of water quality –on drinking water, on spread of weeds; Water requirement for crops	15
III.	**Watershed Management**- Watershed development for dry land agriculture and semi arid regions;	11
IV.	**Forests**- Forest resources; Social forestry; Forest resources and rural development; Impact of vegetation cover on land and water resources	8
V.	**Common Property Resources-**	2
VI.	**Land Resources**- Land resource management; Management of degraded soil for sustainable agriculture using remote sensing; Sustainable agriculture development	4
VII.	**Development and Environment**-Environmental and economic implications of industrialization in tribal areas; Waste disposal and water contamination;	3
VIII.	**Mining**- Environmental evaluation	1
IX.	**Energy Resources**-Industrial thermal energy	1
X.	**Pollution**- Water Pollution	1
XI.	**Coastal Resource Development-** Development, environmental problems and management	1
XII.	**Environmental Planning and Management**- Planning for sustainable power system; Environmental conservation and management; Environmental planning and management for sustainable growth	6

S e c t i o n - VIII

Research Trends and Issues [1990-2002]

The developmental process initiated in the country soon after the independence focused on industrial growth on the models laid down by the British. Natural resources were exploited for industrial growth with high investment, sophisticated technology and extensive exploitation of natural resources. Though the strategy addressed to the issues of poverty and unemployment, there was increased inequalities and environmental degradation. Deforestation for industrial purposes deprived the villagers and tribals of their livelihood. For survival, people made a transition from constructive to destructive dependence on forests and cut trees working as labourers under timber contractors or smugglers and for sale of fuel wood (Fernandes 2001:40).

The studies carried in early eighties focused on India's under utilization of natural resources. India's capacity to meet food requirements of the growing population due to country's fertile land and water resources was taken for granted. It was felt that the existing capacity was not utilized optimally (Chaudhary et. al. 1994:1) due to lack of irrigation, low yielding capacity, single cropping and unharnessed water resources.

Commenting on the national conservation strategy and policy statement on environment and development of the Indian government, Nayar (1994: 1329) notices global thinking on environment being merged in to Indian environmental policies, which neglect to take account of the incompatibility of the existing models or development with the sustainability of environment. Further he says that the politics of SD is visible in the models advocated by the developed countries, which is anti south, anti poor and thereby anti ecological.

Though the concept of SD is included in almost all initial policy documents and programmes of governments in reality they do not fulfill the objectives of SD. As rightly put in by Gadgil and Guha (1995:15) "the process of development has come to be equated with the channeling of an ever more intense volume of resources, through the intervention of the state apparatus and at the cost of the state exchequer to subserve the interests of the urban and rural elite". This was mainly because of the approach that was adopted in developing the economy focusing on the following aspects, which made it difficult to come easily out of the accepted path.

- Major concern earlier was simply to accelerate economic growth
- No distinction was made between growth and development with increasing emphasis laid on more equitable distribution of the benefits of growth and also creating conditions in which growth will become automatic.
- Depletion of stocks of non-renewable resources lead to reduction in the income generation potential of the future generations.
- Focus was placed on material welfare.

But, of late there is increasing concern being expressed in terms of SD i.e. present vs. future with a change in the focus from "sustained growth" to "sustainable development". For a rational social planner, the objective of SD is to maximize the total present utilities of two generation (or the social welfare function) subject to the fact that present utility of current generation should be no more than that of the next generation over the infinite planning period (Chen and Tsai 2000: 16). Chen and Tsai have used dynamic optimization theory to formulate and get a theoretical model linking the economic growth and environmental protection, which explains how much growth is compatible with SD. They put forth that growth in Gross Domestic Product (GDP) or consumption is not equivalent to growth in welfare because of the effect of the environment on welfare.

8.1 Natural Resource Management and Equity and Efficiency

Equity has to be the basic value of natural resource management and cooperative management of the natural resources works best when it caters to the needs of the various segments of society and leaves much to their initiative (Fernandes 2001:51). Cooperation breaks if profits becomes motive and can sustain if there is equity and justice (Shah and Bhattacharya 1996:158).

Inefficiency in the utilization of natural resources arises firstly, because of differences in social and private prices and distortions in the market. Secondly, non-exclusive, incomplete and non-enforcive property rights lead to unsustainable and inefficient utilization of natural resources. Moreover, when the natural resources are under-priced, there is little incentive on anyone's part to develop technologies that economize on their use (Dasgupta 2001:348). Sen (1981) observes that the entitlements of agrarian producers may act as incentives for them to operate at sustainable levels.

Box 8.1 Natural Resources as Livelihood

- Marx defined nature as "man's inorganic body" pointing out that "man lives on nature" taking from nature all the means necessary for his existence [Mishra 2001:56]
- Forests are not just trees and timber and non timber forest produce with commercial value, but are people's livelihood as such one has to go beyond trees to the bushes and other produce that give protection to human beings and animals [Gadgil and Guha 2000]
- Land is not a commodity giving place to agriculture and building, but a livelihood of all its dependents [Rawat 1993]
- Water is prime natural resources, a basic human need and a precious national asset sustaining all life forms [National Water Policy, 2002:1]
- Forests are a source of sustenance to 100 million forest dwellers in India, more than half of them tribals, as they provide non-timber forest products (NTFPs), small timber, fuel wood and fodder (Planning Commission 2000:331).
- Chambers (1994) presents irrigation as livelihood supporting base rather than production increasing base. Irrigation enables increase in income through increased employment, reduces migration and ensures better quality of life.

According to Fernandes (1996:264) "for any SD to be meaningful, the principles of equity, conservation orientation and renewability have to be re-established. Controlling over consumption and dealing with the question of the ownership of resources at the international as well as national level becomes crucial for this to be realized. Tribal communities have to re-acquire control over the resources in which their regions abound. Ownership has, therefore, to be shared with them as equals. They cannot continue only as subordinates to the mainstream that has marginalized them".

8.2 Poverty and Natural Resource Dependence

The goal of SD according to UN is to alleviate current poverty without creating future poverty. Sustainable natural resource management and poverty alleviation are compatible as poor are largely dependent on natural resources for their livelihood. The degradation of natural resources viz. land, water, forests and air and the resulting environmental factors such as indoor and outdoor air pollution, waterborne diseases and exposure to toxic chemicals in water and air is threatening the health and survival of people all over the world.

The dependence of poor on natural resources for their livelihood needs is brought out by many studies. Agrawal and Narain (2002:116) observe that ecological poverty prevents the poor from helping themselves to improve their economic condition. By "ecological poverty" they mean "the lack of ecologically healthy natural resource base that is needed for a human society's survival and development". A study by Beck (1998) in West Bengal revealed that the dependence of poor on CPR was 44.27% and 24.63% in Radhaballavpur and Matha villages respectively. It was also found that the poor household's access to the resources were declining.

Shiva (1998:31-32) based on a review of related studies presents the economic importance of NWFPs in India, details of which are provided in box:

Box 8.2 : Dependence on Non Wood Forest Produce in India

1. Around 80% of forest dwellers in Orissa, Madhya Pradesh, Himachal Pradesh and Bihar depend entirely on (Non Timber Forest Produce (NTFP), 17% landless depend on daily wage labour, mainly on collection of NTFPs and 39% are involved in NTFPs collection as a subsidiary occupation (Negi, 1993).
2. NTFPs provide 50% of the income to about 30% rural people (Gupta and Guleria, 1982).
3. An estimate made in West Bengal indicates that an average return of Rs. 2720 ha/year is obtained from NTFPs, which is 25% more than the polewood harvest which fetches Rs. 16,000 per hectare after 10 years (Malhotra et al 1992).
4. Over 505 of the revenue earned by the Forest Department comes from NTFPs and the growth of revenue from NTFP have generally been 40% higher than timber (Gupta and Guleria, 1982).
5. Many village communities derive 17-35% of their annual household income from the sale of NTFPs (Tewari 1994).

Source: Shiva 1998:31

8.3 Forest Resources

The government policy on forests till 1990's was to encourage use of forest resources for industrial and developmental purposes. But, after the Rio Earth Summit of 1992, the importance of forests in the development and protection of environment is recognized. Forests role in poverty alleviation i.e. meeting the subsistence needs of the forest dwellers/tribals is considered by policy makers as a notable issue in framing forest development programmes.

Forest resources are depleting due to commercial logging, conversion of forest land into agricultural land, grazing of domestic livestock, fuel and fodder collection, forest fire and development projects. Moreover, the collusion of forest officials and commercial interests supports much pilferage, which remains unaccounted for and such pilferage also provokes subsistence users to lose interest in regeneration (Rao and Storm 1998:237).

Sustainability of forest ecosystem is an essential component of the environment conservation efforts and any degradation of forests have an adverse impact on various systems such as water reservoir, agriculture, biodiversity, environment, climate and human health besides the subsistence living of tribals and other communities living in and around forest areas (Tewari 2000:14). Ninety percent of the communities that live in and around India's forest areas of 63.3 million hectares, constituting 19.3% of the landless of the country are mostly tribals drawing their sustenance and income from the Non-Wood Forest Produce (NWFP) of the forest, which is estimated to generate Rs. 3 billion annually and 70% of employment in the forestry sector (Ramji and Bhatnagar 2000:10).

In India the forest management and practices have been traditionally oriented towards timber development and its marketing, excluding a SD programme of NWFPs in India's planned development effort and the research on NWFPs was not given due importance by institutes and universities (Shiva 1998). Ramji and Bhatnagar explore the ineffectiveness of cooperative societies set up to stand by the tribals in getting the leases from the forest department as they are in chronic financial distress. In the case of non nationalized NWFPs, forest departments lease out the right to collect the produce every season to the highest bidder through a system of auctions or through invitation of bids in a tender system. This the researchers observed encourages private

traders and is intended towards revenue maximization, denying tribal peoples' participation in NWFP marketing- a concept emphasized in the government's policy pronouncements.

A weak link in the cooperative chain has been the absence of a viable village level network of cooperative societies, which could organize tribals at the village level and link them to tribal Large Scale Multi Purpose Society (LAMPS), State Tribal Development Cooperative Corporations (STDCCs) and Tribal Cooperative Marketing Development Federation of India Ltd. (TRIFED) at the block, state and national levels respectively (Ramji and Bhatnagar 2000:12)

8.4 Land Resources

Seventy percent of India's population residing in rural areas is dependent directly on the basic natural resource i.e. land for their livelihood. In India, the cultural and religious courses of the population hold land in a high position and the ethics that follows is to take care of the motherland and worship it. Deforestation causing soil erosion, water loss and climatic disruption, water logging, salination, laterization, mineral depletion, heavy metal toxicity and increasing acidity of soils and poisoning of soils through heavy use of fertilizers and pesticides are reducing the production potential of our basic capital of soil (Jayal 1994:7) thus affecting food security in the country. The average annual loss of plant nutrients due to soil erosion is estimated to be accounting for 30 to 50 million tons of agricultural production (Neena 2000:286). The carrying capacity of our soil is also affected by the ecological destabilization caused by disrupted water cycle, floods, droughts and human intervention in changing land forms and structure. Economic reforms in India are heading towards transforming Indian agriculture from survival needs to agro-business and agro-industry governed by market forces. This has encouraged monoculture and increased production of cash crops neglecting crop diversity, which is essential for increasing fertility of soil and sustaining human life on earth through food production. Moreover, the reform process in agriculture has not benefited small and marginal farmers due to their size of land holdings and lack of irrigation. Only the large farmers capable of investing on irrigation, mechanization and adopting research developments in bio-technology backed by domestic and export market are benefiting from the liberalization process.

In 1958-59, agriculture accounted for 48.7% (taking together net sown area and fallow land) while land under forests was 14.4% of total geographical (ISEC 1999). In 1999-00, the

recorded land used for agriculture was 156029 thousand hectares accounting for 51% of geographical area and forest land was 69024 thousand hectares accounting for 22.5% of geographical area (CMIE 2004:8). There is increase in forest land due to increased plantation and afforestation programmes as well as development of waste land and barren/degraded land.

Per capita land availability in India has declined from 0.89 ha in 1951 to 0.3 ha in 1951, and in the same period the per capita availability of agricultural land has declined from 0.48 ha to 0.14 ha (MoEF 2002:2). In addition to decline in availability of land there are serious problems of land degradation and decline in common pool land, which affects more the small and marginal farmers and landless poor people depending on common property resources.

8.4.1 Sustainable Development and Agriculture

Agriculture plays a crucial role in addressing the needs of a growing population and is linked to poverty eradication. Sustainable agriculture and rural development are essential to the implementation of an integrated approach to increasing food production and enhancing food security and food safety in an environmentally sustainable way.

Sustainability of agriculture has been interpreted in a number of ways in the recent literature. It is not a new concept. SD is not another technological fix, but involves the nurturing and protection of biodiversity and encouraging diverse agricultural practices, which are ecologically sound. It is argued that the new trade regimes, and dominant trends in biotechnology are emerging as potential threats to sustainable agriculture (Srinivas 1996:1922).

Generally, organic farming, which respects the integrity of the soil and relates ecological systems has been referred to as ‘sustainable’.

A few definitions of sustainable agriculture development are as follows;

1. Parikh and Ghosh (1991)) (as cited in Chopra 1993:527) consider soil in particular to be an important resource base and think it should be treated as the reference point for defining sustainability.
2. According to Conway (1995) (as cited in Chopra 1993:527) “an agricultural system that can over come a stress, defined as a discontinuity in the situation to which it is subject, can be referred to as sustainable”.
3. The FAO (1989) (as cited in Chopra 1993:527) defines sustainable agriculture as the successful management of resources for agriculture to satisfy changing human needs while maintaining or enhancing the quality of environment and conserving natural resources.

4. According to Jodha (2001:66) “sustainability is the ability of a system to maintain a certain well-defined level of performance over time, and, if required, to enhance the same, including through linkages with other systems, without damaging the essential ecological integrity of the system”.

In his inaugural address at the Indian Ecological Society Conference in 1997, Manmohan Singh, the current Prime Minister of India said that to increase agricultural production in a sustainable manner it is essential to base our agricultural practices on economic and efficient use of scarce land and water resources with a holistic approach involving judicious mix of ecology, economy and technology as the patterns of production and consumption have led to serious ecological imbalances, which if not corrected now will seriously affect the sustainability of economic development (Singh 1998: 28). From an interdisciplinary development research perspective, it is argued that sustainability of Indian agriculture and food crop production may depend more on environment governance than on biotechnology and globalization in the form of trade related intellectual property rights (TRIPS). Without ecological institutions to govern agriculture, privatization of genetic constructs may simply distort the trajectory of agricultural technology (Henrick 2000: 342). The existing policies in India both from a perspective of poverty alleviation and natural resource management, encourage waste of natural resources and discourage incentives to develop sustainable technologies. Jodha (2001:86) opines that in fragile areas (with high pressure) sustainability in agriculture is not possible through traditional measures. It requires application of modern science and technology blended with the rationale of indigenous practices.

The use of resources beyond a predictive capacity results in degradation often beyond the possibility of recovery for many generations to come. Intensification of general agriculture is necessity and this can be availed at an ecological price. Government intervention and market failure are causing sustainability problems. Failure to balance resource use and pricing leads to resource degradation and depletion. Sustainable land management in agriculture sector involves;

- Improvement is soil fertility
- Integrated nutrient management
- Integrated pest management
- Crop rotations
- Use of bio-fertilizers
- Ensuring participatory development
- Watershed management
- Enhancing ground water resources by recharging and rain water harvesting
- Applying research findings

- Appropriate pricing, subsidy, credit and trade policies

Box 8.3

Often it is argued that some developments in agriculture sector are mutually conflicting, hence trade off becomes necessary. And the trade-offs need to be made more benign for all the segments of population and different parts of eco system.

The conflicts facing Indian agriculture are;

- Production and sustenance
- Green Revolution- productivity may decline after some satiation point
- Production and inequalities [number of marginal farmers is increasing due to sub division of land holding, indebtedness, failure of rains, sale of land, etc]
- Production and resource decline [water, soil, forest, livestock]
- Fertilizer use and pollution
- High yielding vs. low yielding technologies
- Centralized vs. decentralized decision making
- Sectoral and eco system degradation
- Agricultural activities in the past have not adequately recognized integrated nature of different parts of eco system for ex: integrated nutrient and pest management and crop rotations within the carrying capacity of the environment.

Convey et. al. (1987 cited in Reddy, 1995:A-21)) group the objectives of the SD under 4 properties of agro-eco-systems. They are; productivity, stability, sustainability and equitability. These properties cannot be maintained at an equal scale and a trade off does take place between these in order to achieve the objectives. Tisdell (1988 cited in Reddy 1995:A-21) observes that all the objectives of sustainability cannot be achieved simultaneously and hence trade-offs between these objectives are necessary. In this regard perceptions and attitudes of the people towards environment and sustainability play a vital role.

Reddy (1995:A-26) argues that people's awareness, attitudes and perceptions towards environment should be changed to achieve the sustainable agricultural development. Change in the perceptions of the people towards environment can be attained through literacy, market forces, technologies, and institutional changes in terms of agrarian reforms.

Climatic factors also play an important role in agricultural sustainability. The threat to agricultural sustainability is more conspicuous in the countries (Asian and African), which are located in topical regions where rainfall is capricious. Adding to this the population pressure is leading to extensive dependence on CPRs and the resulting land degradation (Reddy 1995:A-22).

For overcoming the limits to agricultural growth, Rao and Jeromi (2000:99-100) suggest ensured market, institutional and policy environment conducive to conservation-oriented and judicious use of land and water resources.

8.4.2 New economic policy and Agriculture Development: Macro economic policies can considerably affect the sustainability of development in agriculture. India introduced its new economic policy (NEP) in July 1991, which aimed at higher economic growth. It did not make any major reference to unemployment, poverty, illiteracy, ill health, environmental degradation, and so on. Its major emphasis is on deregulation of domestic industry, privatization, liberalization, increased competition, reduction in regulation of foreign trade, increased exports, and enhanced foreign investment (Singh 1999:8). The experience with such policies, particularly with structural adjustment programmes (SAPs) in most of the countries has not been encouraging so far and there is no likelihood that it would be so in near future (Singh 1999:8).

The new economic policy can create both positive and negative impacts on agriculture (Nadakarni, 1993:525). It is expected that the reduction in subsidies would lead to more resource use efficiency. The opening of economy also helps in adopting new, clean and efficient use of technologies. But, it is felt that the economic reforms are being implemented half-heartedly. Economic reforms may also adversely affect the agricultural growth. This is mainly because the new economic policy intends to make the agriculture more export-oriented. Export orientation of agriculture should not be at the cost of self-sufficiency in food grains as it induces farmers to grow more cash crops. It is found that plantation crops are more export oriented and these crops are being raised at the cost of natural forests (encroachment of forest). The initial stages of plantations such as for tea also involve significant amount of soil erosion since the ground has to be cleared of all other plants including grass. The cultivation of commercial crops involves use of more pesticides and fertilizers, which can create soil and water pollution. The increase in the mining activity can further lead to loss of forest and agricultural area. The decline of the state and its regulatory power in the course of economic liberalization can also have adverse environmental implications, if monitoring and implementation of environment laws are strict. Thus agriculture sector needs special protection during the economic reforms. According to Alagh (1999), India should adopt appropriate export policy, which suits to soil conditions, water

availability, climate and cropping strategy. Vyas (2003:274) suggests that the policy of food-self sufficiency should not be abandoned during the process of economic reforms.

Since the mid-1990s the government of India has adopted several policy measures to achieve higher agricultural growth. Policy documents addressed a broad range of constraints facing the sector, while others dealt with subsector-specific issues (see box 8.4).

Box 8.4 GOI Major Policy Documents 1998-2002

Sector-wide

- Recommendations of the Prime Minister's Economic Advisory Council 2001 (PM-Council)
- National Agricultural Policy 2002 (NAP)a
- Draft Approach Paper to the 10th Plan 2001 (DAP-10th Plan)
- Export Import Policy 2001-2002 a (EXIM)
- 10th Plan 2002-2007

Subsector-focused

- Mahajan Committee on Sugar Industry 1998 (MC Sugar)
- High-Powered Fertilizer Review Committee 1998 (HP-Fertilizer)
- Expenditure Reforms Commission Report on Rationalizing Fertilizer Subsidies 2000 (ERC-Fertilizer)
- Policy framework for agricultural extension 2000 (PF-Extension) a
- National policy on handling, storage, transportation of foodgrains 2001 (HST-Foodgrain) a
- National seed policy 2002 (NP Seeds) a
- Plant variety protection and farmers' rights act 2002* (PVP)
- National water policy 2002 (NP Water) a
- Report of the Inter-Ministerial Task Force on Agricultural Marketing Reforms 2002 (ITF-Marketing)
- High-level committee report on long-term Grain Policy 2002 (LT-Grain)
- Model Act for State Agricultural Produce Marketing (Development and Regulation) 2003 (MAPM Act)

Note: a. Policies officially adopted by GOI.
Source: World Bank, 2005:13

8.4.3 The role of institutions in sustainable agricultural development: Positive and Negative Aspects

"The role of institutions in economic activity is that of defining the parameters and processes through which agents use technology, natural and human resources to increase human well-being. Development, in other words, is designed by resources, technology and institutions. Institutional change in development has been treated variously as exogenous to the process of production and alternatively as endogenous altered with a demand and supply for institutional innovation determining the rate at which it occurs" (Ruttan and Hayami, 1984 as cited in Chopra

1998:424) Institutional change is a slow process. The task becomes more difficult when the objective is that of SD.

The role of Panchayat Raj Institutions (PRIs) in natural resource management is emphasized in many studies (Singh and Lal 2001:28; Kumar 2000:183; Jodha 1997:345; Banerjee 1998).

In India development was aimed for within the existing institutional structure, i.e. by the market and the state. It is expected that the market would allocate the resources efficiently, and in the case of market failure the government would interven. But, if government also fails then it leads to complete failure of the system. Some analysts identified this as the leading cause for lack of development (Chopra 1998:424 -25). Thus need for the new institutions (which can take certain decision rules) for the SD is felt (Opschoor, 1992 cited in Chopra 1998:425), without saying that other institutions have no role to play in SD (Chopra 1998:438).

Singh and Tewari (1998:464) assessed the impact of institutional management on the use of ground water resource for sustainable agriculture development in Uttar Pradesh. As per Central Ground Water Board (CGWB) Uttar Pradesh has maximum ground water potential of 18 million hectares out of 80 million hectares for the country. They found that the CGWB, State Groundwater Organisation (SGWO) and NABARD have been playing important role in monitoring the exploitation of groundwater. Shah (1993) also refers to the role of NABARD in restricting the use of ground water in over exploited areas. Banks provide loans to farmers only when the availability of water is certified by SGWO, which categorises blocks into white, grey and dark areas. Specifications are also made for minimum spacing between drilling of new borewells to prevent interference between two wells/tubewells while pumping. Electric connection is available only in certified areas. But, these organizations have no control on the private investment. As a result of this there has been substantial increase in the number of private tube wells. The decreasing supply of ground water increases the cost of irrigation. This also reduces the command area. Presently, administrative measures are adopted for controlling the use of ground water. It is felt that in the absence of any law these measures are not effective.

Currently, the planning for ground water development is being done on the basis of volumetric availability of ground water for irrigation and the grossed cropped area that can be irrigated taking an average applicable water depth of 0.65 cm (Singh and Tewari 1998:458). As further noted the concept of net water balance is used for the clearance of minor irrigation works

by NABARD where ground water development is taken as the ratio of the net draft to the net recoverable recharge.

According to Banerjee (1998:519) for SD, agricultural organizations and institutions should be reformed. He suggests to take action for reforming tenancy, inheritance, marketing and financial institutions. The new institutions and organizations like water management, flood and drought control, panchayat system needs to be developed. Prakash et. al. (1998:527) while examining the role of co-operatives in marketing and processing, felt the need of well functioning co-operatives for sustainable agricultural development.

Reddy (2003:63, 67, 68,71) examines the performance of eight tree growers co-operative societies (TGCS) spread over four states in India. It is found that the plantation activities brought prosperity to the local people and equity among various strata of the society. These plantations not only provide fuel wood and fodder but also mitigate CO2 emissions by removing carbon from the atmosphere and sequestering it. These activities are found financially and economically viable. Thus, self help and the involvement of local people, especially women, is necessary for the survival of cooperative institutions even in a market-driven economy. It is evident that there should be good interaction among the members to avoid the conflicts among the members. And there should not any political or outside interference in decision-making. Reddy's study emphasizes that this type of institutions (participation of local people) play an important role in environmental protection, which is essential for sustainable development.

On the other hand studies have shown that state intervention in the management of CPRs has led to their degradation (Santhakumar 1997; Shah et.al. 2002; Shiva 2002). The inability of the government to look into the resources, which are widely spread across regions has led to degradation of water bodies. Santhakumar's study (1997) on Kerala shows that overestimation of irrigation needs by the state government lead to inefficiency blocking value addition to water resources of the state also depriving public investment in other sectors, which were more beneficial to the state. He argues that 'lock-in' or 'path dependence' is visible in the institutional framework of the water resource management in Kerala. An indirect assessment of the demand for irrigation based on the existing land use pattern in the command areas of Kallada and Vamanapuram projects showed that the institutional projected demands were 62% and 65% excess of the respective potential demands respectively.

8.4.4 Cropping Pattern Vs. Sustainable Agriculture

Singh and Singh (1998:562) reveal that in Haryana, the crop production is heading towards crop specialization (especially wheat and rice) rather than diversification, which induces soil degradation and agro-ecological imbalance. As a result of increased area under High Yielding Varieties (HYVs), the use of modern inputs like chemical fertilizers, pesticides and water has increased considerably. The cropping pattern and crop rotation have changed to maximize the farm income. The exploitation of natural resources and increased use of modern inputs have induced problem of agro-ecological imbalance. This requires a fresh look on cropping pattern/rotation, and causes and effects of variability in crop production.

Jalali and Jalali (1998:355-63) find that the use of HYV seeds and practice of monoculture has increased the possibility of crop diseases. This has led to more use of pesticides and these have many side effects. For sustainable management a holistic approach has to be rigorously followed by integrating appropriate and yet safety and environment-friendly alternatives to targeted pesticides.

8.4.5 Punjab Model of agriculture development: *Sustainability Suspect ?*

Sidhu (2002:135) found that the Punjab model of agrarian transition is fast becoming economically as well as ecologically non-sustainable.

According to Gill (1993:306-7), the scientific approach to agriculture and government's administrative policies and decisions enabled to achieve the higher growth of agriculture in Punjab. The Punjab Agriculture University has played a very important role in the transformation of agriculture through integrated research and extension and development programs. Now, in Punjab much attention is being paid for developing future strategy of agriculture development. The crop diversification is now being advocated. Efforts are also being made not only in sustaining and stabilizing the present productivity but to increase the productivity further.

Singh, Dhaliwal and Randhawa (1998:93-94) observed that in Punjab, the agricultural development plans laid more stress only on increasing agricultural production and achieving high growth rate. No efforts were made to maintain ecological balance. Research concentration

was only on wheat and paddy and neglecting other crops. The study feels the necessity for diversification of cropping pattern in the state by adopting crops with less water requirements.

Deol, Kumar and Dhaliwal and Sangha (1998:233-234) studied the land use pattern of Ludhiana. A sharp rise in residential, commercial and industrial area over the last three decades was found to be a threatening factor disturbing the ecological balance of the city. They suggested planting of suitable trees and shrubs around the industrial areas, broad leaved plantations along roadsides and pollution-tolerant plants along the streams in which sewerage waste and industrial effluents could be disposed off frequently.

8.5 Water Resources

A synthesis of the sector-wide programs in water resource management and distribution undertaken by Government of India (GOI) in partnership with the World Bank (and contributions from the Governments of UK, Netherlands and Denmark) presents water as a scarce resource, yet inefficiently used in India by all the sectors (World Bank 1999:xi). Scarcity of water has led to conflicts between sectoral uses viz. domestic sector in rural and urban areas, agriculture, industry, power, ecological balance, navigation, fisheries, recreation, transport, religious purposes, ceremonies, hospital sector, etc. Hence the question of prioritization, efficiency and rationing arises.

Provision of safe drinking water and proper sanitation has greater impact on development. Millions of Indian lack access to safe drinking water. Gastroenteritis a waterborne disease is the number one cause of death in India next being TB and AIDS.

Efficient use of water is simply not possible, unless it is managed in an environmentally-sound manner. Thus, environmentally-sound water management is an essential requirement for future development of developing countries, and will become an even more important consideration in the future than it was in the past (Biswas 1990:57).

The World Bank (1999:xiii-xiv) report presents five main issues related to water sector in India;

- Lack of institutional arrangement in comprehensive water allocation, planning and management backed by lack of accountability and weak user orientation
- Lack of capacity management and effective mechanism for implementation neglecting social, economic, legal aspects of water resource management
- Lack of economic incentive for efficient water use and conservation
- Absence of appropriate water pricing
- Lack of information base and technical personnel
- Inadequate financial allocation to operation and maintenance of projects and distribution system

Ground water is one of the most valuable natural resources in rural India and a source of potable water in rural and urban India, meeting domestic needs, sustaining agriculture, industrial, transport and construction activities, etc. Ground water being a common pool resource is generally used by all the farmers. In India the ground water resource development and use is largely a private activity dominated by the rich while surface water use for water supply, irrigation and power generally vests with the State government. The use of ground water resources, particularly for agriculture is dominated by large farmers due to skewed ownership of water extraction mechanisms because of the lumpiness in the investment, fragmented holdings and the scale bias built in to modern water lifting technologies (Shah 1993:3).

The report of the Ground Water Estimation Committee (1984) revealed the critical state of ground water resources in certain parts of the country. As a result there were increased debates on ground water exploitation attracting the attention of researchers and policy makers. Regional rural banks restricted the lending for drilling of borewells and purchase of pumpsets in areas declared as dark and grey. And the State Electricity Boards (SEBs) delayed the power connection to pumpsets in such areas.

The National Water Policy, 2002 states that exploitation of ground water should be so regulated as not to exceed the recharging possibilities, as also to ensure social equity. The Policy also calls for periodic assessment of ground water, regulation of overexploitation in coastal areas to prevent ingress of salt water into sweet water aquifers and integrated development of surface and ground water. The Karnataka and Tamil Nadu governments have come up with Ground

Water Bills, which make provisions for issue of license to drilling of borewells and/or propose restriction of borewell drilling for agriculture within 500 mts radius of drinking water source. However, it should be borne in mind that spacing regulations, which have come in recently exclude the poor who are late entrants from access to ground water tending to single out the poor to bear the cost of maintaining the ecological balance (Shah 1993:131).

The new policies towards SD of ground water resources as summarized by Shah (1993) include;

- Prioritizing the problem and setting action points in water policies
- Issue of license to drill borewells and tubewells
- Restriction for drilling borewell within certain limit of existing ground water source or maintaining the distance between sources of ground water
- Restricting credit finance for setting up ground water source in specified areas
- Measures for recharging of wells at point of source
- Focus on watershed management to increase ground water resources
- Incentives for rainwater harvesting in urban and rural areas
- Encouraging industrial sector to use recycled water
- Promoting establishment of Water User Associations/ Water User Co-operative Societies for water resource management

The interventions in development process that brought in benefits and prosperity in the short run leading to disaster in long run with reference to ground water resources in two villages of Junagadh district in Gujarat is clearly brought out by Shah (1992). The intensive groundwater irrigation with the onset of the modern pumping technologies and encouraging government policies with subsidies and credit flow has led to private ground water development and wells with diesel engines or electric pumps resulting in replacement of traditional crops, multiple crops, 10-15 times increase in lifting of water from coastal aquifers. This ultimately resulted in development of cracks in coastal ground water balance in upper lying areas and intrusion of sea water in to wells in low lying areas. Shah's (1992) study reveals that government response to such problems in terms of physical structures such as bandharas and tidal regulators did not result in expected outcome due to free and open access to ground water resources and due to hard ware based strategy of the government.

Though on a national scale, there is still considerable potential for future development of ground water, but when viewed at the micro level, a critical stage appears to have been reached in certain pockets with very high level of development (Singh and Tewari 1998: 460).

8.5.1 Water Markets

Though economic theory says that competitive markets can efficiently allocate resources among competitive uses over time, this is difficult to be followed in the case of water as the nature of the resource presents problem for establishing and relying on unfettered water markets, therefore the manner and ease with a region deals with increasing water scarcity depend largely on the institutions i.e. the policies, laws, organizations and norms governing the allocation and use of water (Kneese 1995:132).

The State indirectly plays a major role in overexploitation or unregulated extraction of ground water and inefficient use of surface water resources through subsidized rural electrification, flexible and cheap credit and subsidies on fertilizers, pesticides and overseeing crop violation in command areas. The details of factors accounting for emergence of ground water markets hence the exploitation of poor farmers is brought out by Shah (1993) in his pioneering study on ground water markets.

Water markets existed in some or the other form even before independence in the State of Punjab, Haryana, Uttar Pradesh, West Bengal, Assam and Gujarat (Shah 1993:47). Shah describes seven forms of water markets;

- ***Spontaneous*** i.e. coming into existence due to spontaneous action initiated by private individuals to exploit a mutually beneficial opportunity
- ***Informal*** i.e. without any legal sanction behind the agreements
- ***Unregulated*** by public agencies
- ***Localized*** market limiting to a village
- ***Fragmented*** water markets wherein physical and topographical conditions can insulate a seller from other sellers
- ***Seasonal*** i.e. in dry regions water markets become more active during peak irrigation period and in times of delayed monsoon, whereas in water resource abundant region, water markets encourage multiple cropping and are active throughout the year
- ***Impersonal*** water markets exist without any special considerations towards buyers on the basis of caste, political affiliation, social or family relations, economic and social status.

Study by Shah and Ballabh (1997) points out the underlying causes of emergence of water markets. Firstly, the poor farmers' need for irrigation; secondly poor farmers do not have resources to construct borewell or set up electric pumps for their fields; thirdly fragmented holdings are not economically feasible for high investment and, fourthly the non availability of alternate sources such as CPWRs. This indicates the importance of natural resources, particularly water resources to the poor farm community.

8.6 Energy Sources

India is endowed with abundant renewable energy resources, including sun, wind, biomass, small hydro, etc., with a total potential of the order of 1,26,000 MW (Chopra 2001:43). Energy not only sustains human life, but also that of the nation and its economic well being. Therefore it is rightly said that energy is to the economy what food is to the human being (Chopra 2001:35). The TERI Energy and Data Directory and Yearbook (TEDDY) brought out yearly by TERI, highlights the absence of regulatory changes and reforms in the energy sector as a major barrier to making large scale investments that substantially increase India's capacity to fuel its economy (TERI 1999:1).

India's efforts to conserve energy began in 1970s, but at a very low phase. The expansion of industries and service sector due to economic reforms has resulted in increased demand for energy. This has resulted in increased awareness on the value and scarcity of energy sources, hence the look out for alternative sources as well as efficiency in use and conservation measures.

Currently, demand for energy has exceeded supply. We are still relying (1998) on coal (66%) next to oil (32%) to meet our energy needs. Per capita energy consumption is very low (338 Kwh) as compared to developed countries and inspite of increased production of coal, crude oil, natural gas and nuclear power, India is not self reliant in the energy sector (Chopra 2001:36). India currently depends on imports for 25% of its total commercial energy needs with increasing share of hydrocarbons in energy supply and use **(**Planning Commission 2001: 36).

Table 8.1:Energy Consumption by Fuel Source (%)

Sector	**Fuel Source**			
	Coal	Natural Gas	Petroleum	Power
Agriculture	00.00	1.27	9.51	89.22
Industry	73.10	2.36	13.61	10.93
Transport	00.00	00.00	13.61	10.93
Residential	00.00	1.12	71.32	27.56
Others	00.00	33..90	60.88	5.22
Adapted from MoEF 2002:5				

Coal is the cheapest fuel option for power generation in most regions of the country, hence, increase in coal supply is essential for the expansion of power generation to meet the demand from an expanding economy (TERI 1999:2). Government took decision to allow private investment in power sector with the on set of liberalization process. But, privatization without the power of distribution would not set in an efficient and competitive market. The major reforms set in by the Central Electricity Regulatory Commission Act, 1998 are not visible in power sector due to extension of subsidies to agriculture and free power supply introduced for political interests in states like Andhra Pradesh, Tamil Nadu and Gujarat.

8.7 Biodiversity

India is one of the 12 countries identified as mega-centres of bio-diversity. It has 45000 species of plants and 81000 species of animals (Planning Commission 2001:331). Biodiversity of the country is under constant threat due to loss of habitat, legal and illegal harvesting, exotics, weakly planned developmental projects, floods and droughts.

Biodiversity is important to the sustainability of economic development. It enables ecological systems to absorb and adapt to the stresses and shocks imposed by economic change. Thus it acts as a insurance against environmental failure. Therefore biodiversity should be conserved everywhere and not just in the protected areas (Perrings Charles, 1997:332). Biodiversity, which plays a critical role in overall SD and poverty eradication, is essential to our plant, human well being and to the livelihood and cultural integrity of people (World Summit on Sustainable Development 2002:18). The World Summit recognizes that biodiversity is currently being lost at unprecedented rates due to human activities, which can only be reversed if the local

people benefit from the conservation and sustainable use of biological diversity in particular in countries of origin of genetic resources.

Developing countries though rich in biodiversity are essentially poor in the biotechnology necessary for utilization of this important resource. Agricultural crops have high diversity and low productivity in these countries. Therefore, efforts should be made to improve the productivity by using appropriate technology. Presently, the developing countries lack management, scientific and technical infrastructure. This needs to be created to make them self-reliant and help all of humankind in future (Khoshoo 1997:434).

"India, which occupies hardly 0.5% of the earth, has one-fifth of the world's plant species. Within India, three-fourths of the plant species are found in the Western Ghats, the rest being in the Himalayas. Endowed with plentiful rainfall and a suitable climate, the Western Ghats have a luxuriant range of biodiversity" (Raman 1997:538).

"Global Biodiversity Assessment (1995) estimates the total number of species to be between 13 to 14 million, out of which only 1.75 million species have been described. In India, so far 81000 species of animals and 49000 species of plants have been described by the ZSI and BSI, respectively. Since in nature no organisms live in isolation, each species is dependent on other species as also on ecosystems. As there is complete inter-dependence in nature, change in habitat affects the diversity of the species contained in it. Conversely, any, change in number and assemblage of species also affects the nature of the habitat" (Kushwah and Kumar 2001:243). A list of selected studies in India on biodiversity as reviewed by (Kushwah and Kumar 2001) and Shiva (1998) are presented in Table 8.2 below.

Table 8.2 Studies on Biodiversity

Author	Description
1. Lal (1990)	Calculated economic value of India's forests (both tangible & intangible). The total value of India's forests were estimated to be Rs. 15710 billion.
2. Rodgers (1990)	"Considered that the future of biodiversity conservation in the tropics lies in a network of inviolate Pas of adequate size to maintain key species and communities, surrounded by buffer zones of productive resource, for use by local people and industry".
3. Swaminathan (1991)	Highlights the importance of biodiversity and strategies for its preservation, particularly of endangered species in India.
4. Damodaran (1992)	Attempted to explain why India's present-day local self-governments cannot conserve the country's biodiversity, unlike their traditional predecessors.
5. Gadgil (1994)	Local communities should be given rights to natural resources for sustainable exploitation of biodiversity.
6. Kothari (1994)	Government alone cannot conserve the biodiversity. People's participation at all levels of management is required.
7. Chavan (1995)	Discussed the problems, constraints of management of Pas in Gujarat State exploring the possible solutions to enrich the biodiversity through active involvement and attitudinal change of people living nearby.
8. Gadgil et al (1996)	Suggested that we should follow our old tradition of respecting all life to protect biodiversity.
9. Kothari (1997)	Recommended measures for conserving India's Agro-biodiversity.
10. Gadgil (1998)	Enacting a progressive piece of legislation on the right to information may in the long run be one of the most useful contributions to conserving India's natural resources.
11. Gadgil (1998)	Conservation of biodiversity must be made a people's movement. The efforts of biodiversity conservation should shift from protected areas to the entire country. Local communities should be encouraged to manage the private lands in a biodiversity-friendly fashion by enhancing their capacity to add value to biological resources.
12. Shiva M P (1998)	Prepared inventory of forest resources for sustainable management and biodiversity conservation and listing of multipurpose tree species yielding both timber and non-timber forest products and shrub and herbs of NTFP importance.
Source: Adapted from Kushwah Kumar 2001:279-91; Shiva 1998:13	

National Biodiversity Action Plan for India, 1997 specifies that "every country has the responsibility to conserve, restore and ensure sustainable use of the biodiversity within its jurisdiction. The challenge before India is not only to sustain the efforts of the past but also further add to them in accordance with a national need assessment such that they are to the advantage of the country and humankind while maintaining and accelerating growth and development to alleviate the living standards of Indian people".

Box 8.5 The main goals of the National Policy and Action Plan on Biodiversity are;

1. Achieve conservation and sustainable use of biodiversity through consolidating ongoing efforts and initiating new steps, wherever necessary. This would include regeneration and rehabilitation of threatened species.
2. Realise consumptive and non-consumptive value of biodiversity through necessary investment in research, development and biotechnology development.
3. Secure participation of communities, people, NGOs, industry and other stakeholders in the conservation and sustainable use of biodiversity.
4. Ensure consideration of biodiversity concerns in other sectoral policies and programmes.
5. Ensure benefits to India as country of origin of biological resources and to local communities and people as conservers of biodiversity, creators and holders of indigenous knowledge systems, innovations and practices.

As an effort to maintain, preserve and develop our biodiversity base and to document the availability and use of existing resources in the country a number of institutes (11 main institutes and university centres) are engaged in survey of biodiversity and creation of national database.

8.8 Gender dimensions of sustainable development and natural resources

The National Water Policy, 2002 states that necessary legal and institutional changes should be made at various levels for enabling participatory approaches to water resource management ensuring appropriate role for women (MoWR 2002:5).

Environmental degradation has negative social impact. A study on an irrigation project area carried out in UP reveals that women suffer most due to degradation of natural resources. As pointed out in the study high rates of male out migration from villages affected by land degradation puts increased labour demand on women (Morvaridi 1997:240) say weeding, harvesting in addition to domestic chores.

A study on mining in the Kumaon in Uttaranchal (Sudarshan 2001:206) examines gender issues in natural resource management. Women's protest against mining in the study region makes the point that the disruption of traditional livelihoods has weakened the ecosystem leading to ecological poverty, which means the lack of healthy natural resource base that is needed for a human society's survival and development. An uncultivated land in the ecosystem is especially important to women as it is the source of fodder, fuel, medicinal herbs, etc.(Sudarshan 2001:209). The role of women in chipko movement of the Kumaon to prevent further deforestation is seen as an example of the feminine impulse for resource conservation. While there are other views that indicate the reason for chipko to be the womens' need to prevent the complete clearance of their forest as a functional livelihood strategy (Mawdsley 1998:46 cited in Sudarshan 2001:210).

8.9 Collective Action for Sustainable Natural Resource Management

Natural resources cannot be managed and preserved properly without involving the rural communities, which derive their sustenance from the natural resources (Mishra and Bajpai 2001:9). Participatory natural resource management was a part of community life in the past. The community maintained and preserved 'sacred groves', village tanks/wells and 'gomal' (pasture land), though these are traditionally owned by the state. But, later the increased government's intervention added by its' failure to preserve the natural resources and their exploitation for the sake of development projects and unregulated use as free good by the commons led to environmental degradation. The worsened situation has compelled people, particularly the villagers and tribes to come forward for the conservation of natural resources for sustainable development because ultimately it is they who suffer due to loss of natural resources.

Community sets the foundation for sustainability as economic development of a particular place depends on local's response towards natural resources, environment and people. A bottom-up approach for water resource management was initiated by the Rajiv Gandhi Watershed Management Mission in 1994 in Madhya Pradesh, wherein government and non government agencies played a catalyzing, facilitating and coordinating role. The Mission aims at improving land and water resources in environmentally degraded villages with community

participation. This is an innovative programme involving politicians, bureaucrats, technical experts, NGOs and beneficiaries (Planning Commission 2003a).

Murthy (1994) observes that in developing countries, the people's capabilities to harness the preserved common and the fairness in the appropriation of benefits from them are the limits on the voluntary collective action. He argues that collective action is possible if an outside agency plays the role of a catalyst in mitigating these limits. However, population growth turns common and state property resources into open access resources. A participatory approach to development is essential as it ensures the proper identification, utilization and preservation of resources and also the reduction of the alienation of the people from the developmental process (Sethi 1996:155). Further, it also helps to reduce the power of the bureaucracy and makes developmental planning people inclusive.

The documentation of the recent initiatives in participatory management of natural resources indicates that there is increasing pressure for conserving natural resources for the common well being. Examples of such initiatives particularly with reference to water and forest resources as documented in research studies in India are;

i. Van Panchayats
ii. Pani Panchayats
iii. Sukhomajari Experiment
iv. Joint Forest Management initiated by Forest Department.
v. Ralegaon Siddhi Experiment
vi. Phad System
vii. Jhabua Watershed Experiment

8.9.1 Forest Resource Management by Community

Community based conservation of natural resources is necessary from the view of both conservation and social justice, and local people, because of their day-today interaction and dependence on natural resources are often at the forefront of protest against the degradation caused by communal interest (Kothari et al 1998: 26)

8.9.1.a Joint Forest Management (JFM)

The JFM was initiated throughout the country after introduction of NFP,1988. Currently it is operative in 27 states of India through 62,890 Forest Protection Committees covering 14.25 million hectares accounting for about 18% of the total forest area (MOEF 2002:6).

The Joint Forest Management (JFM) was initiated in 1990. This program promotes sharing of products, responsibility, control and decision-making authority over-forest lands between the forest department and local users. JFM indicates fundamental shift from centralized management to decentralized management of forest, revenue generation to resource development orientation, single benefit to multiple benefits, monoculture to multiple cropping, and above all unilateral decision to participatory decision-making (Poffenberger, et. al, 1996; Dhanagare, 2000). So far 27 states have implemented the JFM program and now, over 18% of the country's forestland is under this programme. **In absolute terms, the area under JFM is more than 14 million hectares are 62890 JFM groups are involved (Sehgal, 2001).** There is evidence from several studies on JFM that the programme has resulted in the improvement in the condition of the forests. It has been reported that incidents of illicit felling declined sharply. In several areas, introduction of JFM has resulted in reduction in area under encroachment and fall in the rate of fresh encroachment. It has also resulted in increase in the income of participating communities at several places. Several externally assisted projects laid emphasis on employment generation and creation of productive community assets as part of the entry point or development activities (Sundar et al, 1996).

The study by Hill and Shields (2001) examines the economic and financial incentives for various groups of forest users in India, to participate in JFM arrangements that is the management of forest resources by government forest departments and local communities. An analytical method is developed and applied to case studies of communities managing a mixed teak forest system and a Sal Coppice Forest System. The study shows that with the introduction of JFM the net worth of forest areas has increased substantially. In the Mixed Teak Forest System the increase is substantial, amounting to 58%, largely due to better management of the natural forest. In the Sal Coppice Forest System, the introduction of JFM provides a small increase of 4%. The contribution of non-timber forest products (NTFPs) to net worth of both forest systems is significant. Without JFM it amounts to 26% in the Mixed Teak Forest System, and 50% in the Sal Coppice Forest System. **With JFM these proportions change, rising to 34% in the Mixed Teak Forest System and falling 20% in the Sal Coppice Forest System, largely due to reduced *Tendu* production, as the canopy cover built under JFM.** JFM provides a substantial source of revenue for Forest Protection Committee (FPC). The actual flow of funds to the FPC depends on the sharing arrangements, the size of the area handed over, and

the number of members of the FPC. In the mixed teak forest system, the FPC revenue share from harvest amounts to Rs.9300 / household (HH)/ annum. In the Sal coppice forest system it was Rs.550 only. However, there are significant reductions in income for head loaders and non-timber forest produce (NTFP) collectors, amounting to the equivalent of 40 days paid labor per HH. The gains in harvest revenue to the FPC in the mixed teak forest system are greater than in the Sal coppice forest system, mainly because in Gujarat the FPC obtains a 50% share of revenue from harvest, as opposed to only 25% in West Bengal. It was also found that the overall revenue benefits of JFM to state would be substantial.

JFM involves partnership between Forest Department and Local community and both have different perspectives and interests, which may lead to conflicts. Many foresters see JFM primarily as a means to ensure forest regeneration, whereas communities tend to see JFM as a solution to the growing shortage of fuel, fodder, food and other non-timber forest products. They also see the programme as a way to increase their family incomes. It seems that the partnership between the forest department and local people is unequal one (Iyengar and Shukla, 1999:318). Since neither the community nor forest department is a homogenous group, a number of conflicts can also emerge. Conflicts related to caste, class and gender issues threaten JFM institution at the village level. The conflicts within community institutions often arose due to inadequate representation of certain subgroups like women and landless laborers, and their interests and the inequitable sharing of the costs and benefits of forest protection. The forest department faces number of internal conflicts also as it tries to adjust to its new role under JFM. Within the forest department these program, which involve sharing management decisions with the community, are viewed as diluting the power of the forest department. The department is still largely oriented to commercial timber production and there is resistance to reorienting to include the needs of the community. Several policy questions related to the JFM mode, have arisen and these need to be addressed to ensure the long-term feasibility of the program. The powers of the forest protection committee are restricted and therefore more favorable produce sharing arrangements need to be worked out. Opinions are expressed that thoughtful and creative attempts need to be made to resolve the conflicts over resources and address the shortcomings of the JFM model (Poffenberger et al, 1996).

It is learnt that the participatory development can be achieved with the favorable political will. In Jhabua, the JFM and the watershed programmes have together completely changed the complexion of natural resource management (TERI, 2000:167).

However, Sunder et. al (2001:233) opine that JFM is too diverse to allow generalized conclusions about whether it is successful or replicable.

8.9.1.b Van Panchayats (Forest Panchayat)

These are another form of local community management of forest resources, which have legal basis and clearly defined duties and powers. They were evolved in Uttar Pradesh in 1920s and 1930s out of bitter conflicts between and local communities and the forest department. People's interests in the forests around them were restricted by policies of the government. British India forest policy encouraged exploitation of forests to fulfill the imperial interests. The people resisted this, some times by violent and destructive means. Van Panchayats (VPs) were created to give elected representatives of local people a well-defined role in the management of civil (unreserved) forests under the overall supervision of district magistrates. The VPs have responsibilities for maintenance and upkeep of forests, distribution of produce on the basis of local demand and forests departments' approval, and execution of forest department plan. The VPs are under the administrative and technical control of the revenue and forest departments respectively, though both of them take only marginal interest in their functioning. The VPs have only partial control over the use of their surpluses, and can levy fines on offenders only with latter's consent. It is reported that VPs are managing about 15% of the forest area in the UP hills. Despite their remarkable growth and good record in the village forest management, the VPs are hampered in their functioning by unnecessary administrative controls and are not able to reaslise their full potential for the development of forestry in the hills. Earlier the VPs had substantial autonomy in forming rules relating to use, appropriation, and regulation. Most of them were taken away by the 1976 amendments. In present form VPs cannot take any independent decisions. They have to seek approval of either the Deputy Commissioner or Divisional Forest Officer (DFO). Though further revision in the VP rules was made in 1989, the final authority of the government officers over the VPs decisions was not altered in any significant way (Singh, 1994, cited in Iyengar and Shukla, 1999). Despite significant curbs on the control over the forests vested with the VPs people have offered to continue with them. The success of VPs in the hills

has been attributed to their ability to meet people's basic needs from forests on an equitable basis, the homogeneity of caste composition amongst hill people, and fairly egalitarian distribution of land among the families in the village.

8.9.2 Watershed Approach to Sustainable Development

Watershed is a basic hydrological unit and an important source of drinking water with a topographic boundary and water outlet comprising of soils, landforms and vegetation. Fresh water use worldwide was about 1,500 km^3 year in 1940 and is projected to be 5,000 $km^{3/}$year in 2000 with increase in the number of water-scarce countries from 7 in 1955 to 20 in 1995 and projected increase of 34 in 2025 (Mishra 2001:1). Paul (1998:484) views that the current strategy for rainfed agriculture in India is based on the concept of scientific conservation of rainwater for holistic and integrated development of watersheds and promotion of farming systems approach with a view to evolving models of sustainable agriculture in rainfed areas. A study in Andhra Pradesh showed that installation and administration of small ponds for run off collection and supplementary irrigation as part of an overall village water resource development project (Doherty 1994: 144) was beneficial.Based on this strategy, a centrally sponsored scheme 'National Watershed Development Project for Rainfed Areas (NWDPRA) was launched in October 1990, which has been under implementation during eighth Plan and is being continued.

It has been realized that major difficulties to people's involvement in watershed development programmes are managerial and technical skills in community mobilization, conflict resolution and institution building (Gawande (2001:116). Raina (2004:93-96) based on the study of Doon valley project (Uttranchal) suggested that the watershed developmental projects should aim at the promotion of watershed development as a viable means of people oriented SD. The mountain areas have specific developmental challenges due to complexity of rural livelihoods and supporting biophysical resources depicted through the adoption of specific farming systems. The human adaptation mechanism to these complexities is so interwoven that it is not possible to address ecological threats without touching the farming based rural livelihoods. Therefore, on farm watershed development should be adopted as one of the strategic issue. The

conventional watershed development approach should deviate towards community watershed whereby immediate food and livelihood needs are satisfied first.

Singh and Kumar (1998:173-77) suggest that conservation and better utilization of rainwater is the best strategy in the hilly area since the topography of the region is not suitable for the construction of dams. The concept of watershed management is to play a major role in developing agriculture in hilly areas. Efforts should be made to stop the runoff water by constructing farm ponds and check dams. It is suggested that watershed development works should be planned, designed and executed on the basis of ground realities.

Sukhomajri Experiment a government program initiated in 1981 by the efforts of the community by forming Water User Society (WUS) recorded success in watershed management. Chopra et al (1990) have studied the functioning of this model of collective action in watershed management. Under this experiment, the common property resources were transferred to village society and the WUS managed and distributed water on equal rights with active participation of beneficiaries. Sukhomajri is a Gujjar village in the Shiwalik Hills. People living in the Shivalik range of the Himalayas, in and around the catchments of Sukhna Lake of the city of Chandigarh witnessed severe environmental degradation with its effects on their living conditions. Soil erosion, forest denudation and rise in poverty continued unabated in the region till the so-called 'Sukhomajri model' emerged in 1981. The term "Sukhomajri model' indicates peoples' participation in the management of common property resources in the region with the objective of preservation and self-sustaining development.

Under the leadership of Shri. P.R. Mishra, several measures were undertaken to improve the environment. Dams for water storage and irrigation were constructed. Equal rights and equal shares of water were given to each household with the option to sell the surplus. Collective decisions were taken to ban open grazing, to do stall-feeding, to improve cropping patterns and livestock breeds, to cooperate in protection of forestlands and to obtain exclusive fodder collection contracts from the forestlands. Chopra et al report that this community-based management has regenerated the degraded hills, and has made the village self-sufficient in food grains, milk and fodder. They examined theoretical and empirical aspects of people's participation in the management of CPRs in selected five villages. The study also finds that establishing effective 'non-governmental, non-market institution' is the real solution to the tragedy of commons. It is found that the degree of success depends upon the distribution of

private asset, social structure, existence of catalysts, such as committed leadership and support from government and other agencies, and employment and income situation.

The Ministry of Rural Development, Government of India has introduced new guidelines to watershed programmes on the lines of Sustainable Rural Livelihoods Approach (SRL).

8.9.3 Participatory Management of Water Resources

The National Water Policy, 2002 emphasizes the role of Water User Associations (WUAs) and Panchayat Raj Institutions (PRIs) in the operation, maintenance and management of water resources infrastructures and facilities. It gives direct impetus to community participation in all facets of water management. The policy recognises the need to "harness every drop of rainwater" as a national priority with special emphasis on decentralized harnessing of water resources with active community participation.

Sustainable water resource management rests on adopting a comprehensive water resource management with due considerations to environmental management, viewing water as an economic good and introduction of technological developments in water resource management (Raju 2002:87).

Water management initiatives can be successful only if all category of farmers accept responsibilities and ownership of the interventions. WUAs which perform agriculture related functions in addition to water management and undertake some group activity on their own before getting any assistance from government are likely to be more sustained, active and effective (Hooja 2002:6). The approach of the international funding agencies and the introduction of 73rd and 74th amendments to the Constitution have brought in changes in government policies in many sectors. Decentralisation, devolution of powers, participatory and bottom up approach are the new words found in recent government reports, policy documents and manuals.

A large number of studies have established the potential of the communities to organize and manage their own water resources (Singh 1994; Patil 1994; Fernandes 2001; Agrawal and Narain 2002; Ballabh and Thomas 2002; Hooja 2002; Raju 2002). Prior to the canal and other surface irrigation systems, tank irrigation was predominant method of irrigation in ancient India.

They were by and large constructed and maintained as commons by the user communities under a system called Kudimaramath (voluntary village labour). Later, there is clear evidence of a breakdown of some of the traditional institutional arrangements of water management by communities, which is mainly due to withdrawal of customary rights and rules, imposition of revenue motivation, privatization in the management and emergence of state control (Kadekodi 2002b). Shiva (2002) has described the niceties of Kudimaramath as a system and the process of its decline. According to Shiva, the compulsory Labour Act of 1858, which mandated farmers to provide labour for repair maintenance of tanks failed to mobilize community participation as Kudimarmath was originally based on self-management and not on forced labour.

Sengupta (1993:10-11) scientifically documented wide variety of traditional techniques used in irrigation systems, most of which are reported to be highly decentralized. He feels that the existing bureaucratic management is not efficient or even viable in terms of cost considerations and personnel requirements. According to Sengupta the modern engineering knowledge could have appropriated and improved these varieties of traditional techniques if only our engineers had learnt to facilitate people's participation.

Kadekodi et al. (2000) give an account of Kumaons (of Uttaranchal) managing the water distribution and exercising their water rights quite effectively even today. The traditional ***Ahar*** system practiced in the Gangetic plains and Johad system in Rajasthan are some examples of indigenous water management systems that are highly relevant even today. The experience of Ralegan Siddhi under the leadership of Anna Hazare teaches us that it is possible to break the nexus between dry land and dry life through full contribution from the community itself whose life is going to be changed (Kadekodi 2002a:17) on account such contribution.

Pani panchayats as cooperatives based on the concept of managing water resources at the community level on the principle of equal sharing and distribution were initiated in Maharashtra after the 1972 drought that hit the state. Similar exercises are currently underway in other states like Gujarat (*Piyat Mandalis*), Orissa (*Pani Panchayats*), Andhra Pradesh (Water User Associations), Karnataka (*Water User Societies*), etc.

Balnad and Platteau (1996:302) point to three main sources of heterogeneity that can affect the capability or motivation of resource users to participate in collective action relating to (i) ethnic, race or other kinds of culture divisions; (ii) difference in the nature of individual interests or objectives; and (iii) inter individual variations in endowments that get reflected in

differing intensities of interest. According to Balnad and Platteau, the first two causes of heterogeneity are a strong impediment to collective action. Singh and Firdausi (1991:74, 90) study the working of traditional ('Phad') irrigation system in Maharastra. It is found that Phad system has no bribes, no tail enders' problems, apathy, and excess use of water by some users. An analysis of the Phad system of Maharashtra suggests the ground rules required for a more fruitful relationship between the irrigation agency and the water users in large irrigation projects.

Deshpande and Reddy (1994) have studied the working of pani panchayats (water councils) in Naygoan and neighbouring villages of Purandar taluk of Maharashtra, which as recommended by them provide a framework to model a group dynamics woven around resource sharing under the philosophy of coming together on their own to find solutions to their problems. Initiated by an engineer in the region, a trust named Gram Gaurav Pratisthan was formed before forming a formal water user society. The realization that rainfed agriculture can be made sustainable through in situ moisture conservation by impounding water down the stream and water conservation in the up stream areas, farmers came together voluntarily and formed Pani Panchayat (PP). PP is supposed to be the result of several days of discussions among farmers, which made them realize that water resource conservation, distribution and management is not an individual activity, but needs community effort. The success of PP were based on the factors of homogeneity (belonging to same region with similar social-economic conditions), cost efficiency (cost of lift irrigation, which was less than Rs. 3000), commitment (mandatory collection of 20% share from farmers) and equal distribution of water.

Closely linked to the equity issue is the emerging policy paradigm that **seeks to involve users in the management of water resources**. In the past few years, a number of state governments in India have carried out in varying degrees institutional reforms in the water sector, particularly in relation to irrigation. In Andhra Pradesh, since 1997 there has been a massive effort for the simultaneous and uniform application of a particular model of participatory management in irrigation systems throughout the state.

A detailed study of Mohini Water Distribution Cooperative Society, Gujarat (Kakrapara irrigation system) and Siddheswar Water Distribution Society (SWDS) (Bhima project), Maharashtra carried out by Patil (1994) stresses the fact that financial viability of the society or individuals is a must for setting up WUAs. The study found that it is feasible to levy water rates

on the basis of members, non members and cropping pattern or crop area rather than on volumetric basis. WUCs were charged by irrigation department on volumetric basis while society charged its members on crop area basis. Mohini Society was successful as 85% of the area was under sugarcane. The study observed that though SWDS also levied on crop area basis, it was at loss as cropping intensity was less than the planned target. However, it should be noted that the success of Mohini Cooperative Society depended on the experienced farmers in Gujarat who were leaders in irrigation and members of sugar cooperatives and therefore familiar in organization. In Maharashtra also Command Area Development Authority (CADAs) did the preliminary work of organization for water users in the case of SWDS. Though the organization for water distribution and management helped farmers, it should be noted that the levy of water rates on crop area leads to crop violation hence leading to water logging.

Andhra Pradesh(AP) government was a pioneer in introducing reforms in irrigation sector on a large scale with Andhra Pradesh Farmers' Management of Irrigation Systems Act, 1997, though the initiation in Participatory Irrigation Management (PIM) began in Gujarat and Maharashtra. AP model of WUAs rests on the models of irrigation reforms introduced in Mexico and Turkey (Peter 2002:80). In the AP model the district collector is authorized to delineate every command area for each irrigation system on hydraulic basis and declare them as water users' areas for which WUAs should be established. All those who use water and pay water charges are members of WUA. Many states are trying to follow the AP experiment in water resource management. PIM is that which involves a Water User Association (WUA) taking over management including operation and maintenance of at least one level of canals above the outlet and also being closely associated in efforts at improved water management and not just mere participation of farmers in irrigation (Hooja 2002:3). PIM has been successful in AP setting example for other states because of five main factors; (i) political will and support (ii) legal environment (iii) supportive role of irrigation department (iv) financial incentives to sustain the reforms (v) devolution of powers to users' associations (Pangare 2002:43-49).

The Andhra model of PIM suggests that the political will and an enabling legal environment form the institutional conducive for the implementation of irrigation reform process (Pangare 2002:29). Government's role in strengthening WUAs and timely funding from the World Bank under AP Economic Restructuring Program boosted the take off (Peter 2002:80). However, there are apprehensions regarding the functioning of the AP model in the long run. In

the process of implementation there is fear about WUAs becoming mere contracting agencies/tax collecting agencies depending on government funding for functioning, without enough manpower and linkages with line departments and lack of capacity building in spite of government efforts in circulation of manuals, training, etc. (Pangare 2002: 49-52).

The Karnataka Irrigation and Certain Law (Amendment Act, 2000) enables the formation of Water Users Societies or Cooperatives (WUCSs) to develop irrigation infrastructure, procure water in bulk, operate and maintain canals, levy and collect charges, mobilise resources, create awareness etc. It is expected that problems of crop violation, illegal utilization and over utilization would reduce with the active participation of WUCSs in the near future.

In Karnataka the Government has taken positive step to strengthen WUCSs by allowing them to retain @ Rs. 40 per hectare per annum (G.O. No. ID 69 CAM 97 dt.6.1.1999) towards maintenance and repairs. Now water rates are supposed to be levied on volumetric basis on water allocated by Niravari Nigam. WUCSs have to collect chargesfrom farmers and pay back to Nigam.

Involvement of Community/user groups in water resource management, distribution, utilization and in sharing financial burden in terms of both cash and kind is becoming necessary in the era of scarcity privatization and globalization. This is a major component incorporated in terms of references and in the agenda of sponsored prgrammes focusing on water supply and water resource management and development, particularly in externally assisted projects. This is expected to increase accountability, competition and efficiency in water use. In Karnataka Jal SamvardhanaYojana Sangha (JSYS) have been set up for implementing the task of rejuvenation of tanks and initiating peoples' participation. Community contribution for rejuvenation of tanks is sought to the extent of 15%.

Many researchers have tried to identify the circumstances under which farmers have a motivation to participate and cooperate in common property resource management. The factors considered by most of the authors to be significant for encouraging or discouraging peoples' participation are, resource availability/ scarcity, degradation of CPRs on which the dependence is high, homogeneity of groups involved, dependence of the community on the resource, alternative sources of water available to private individuals, availability of exit options into non-farm activities, proximity to the market and more importantly the perceived benefits from collective

action (Shah et al. 2002; Palanisami and Balasubramanian 2002; Dinar et al. 1997; Kadekodi 2002a; Deshpande and Reddy 1994; Meinzen-Dick et al. 2002).

8.10 Natural Resource Valuation

Measuring SD involves valuation of environmental resources, damages due to exploitation and pollution and the costs of preventing and restoring the natural resource. Valuation of environmental resources and pollution effects is needed for setting policy priorities and their implementation. In the absence of proper valuation, resources may be misallocated. Prices of goods indicate the scarcity of the resources. But, due to common property nature of environment, there is free rider problem associated with their use. Those who do not pay cannot be excluded from its use.

The imperatives of SD warrant maintenance of a constant natural capital stock (Sahu et. al. 2000:5). The valuation of natural resource is based on estimating its conservation value. The total economic value of natural resources include present use and non-use value and future use and non-use value. Natural resource valuation involves techniques of contingent valuation, travel cost method and opportunity cost method. Use value can be estimated by using revealed preferences in conventional markets or in surrogate markets. Non-use value estimation is difficult as this is derived on the basis of stated preferences of individuals in hypothetical markets. These preferences have to be elicited either by questionnaires or by interviews.

In Table: 8.3 we provide a list of available studies on natural resource valuation and their findings. The studies mainly relate to valuation of forest resources

Table 8.3: Valuation of Forests

Author	Methodology	Findings
1. Lal, J B (1990)	Estimated the total economic value of India's forest stock. It includes direct and indirect use values and non-use values.	The total value of the forest is estimated to be Rs.785.5 billion per year, i.e., 27% of GNP. Net present value of the Indian forests is Rs.15910 billion.
2. Chopra, K. (1993)	Estimated the value of NTFPs for tropical deciduous forests in India.	The financial CBA of non-timber benefits per hectare for tropical moist (37% of total forest area) and tropical dry (28.6%) deciduous forests. The direct and indirect use value is

		between US$220 and $357 per hectare per year.
3. Chopra and Kadekodi (1997)	Estimated ecological values of Yamuna Basin. Used contingent valuation method.	Intangible benefit of forests of Yamuna Basin is Rs.624 per hectare/annum.
4. Appasamy, P P (1993)	Conducted a case study of NTFP extraction from Kadavakurichi Forest Reserve.	Value of NTFP extraction was Rs.2090 per hectare per year.
5. Kadekodi & Ravindranath 1997 (in Mathur & Sachdeva 2003)	Estimated value of Carbon store at the All India level using indirect estimates.	Value of carbon store of Indian forests is Rs1.2 lakh per hectare.
6. Haripriya (1999) (in Mathur & Sachdeva 2003)	Using species miscellaneous forest inventory data estimated value of carbon store.	Estimated value of carbon store at Rs.20125 per hectare and aggregate of Rs.1292 billion from Indian forests.
7. Chopra (1998) (in Mathur & Sachdeva 2003)	Valuation of recreation/eco-tourism of Keoladeo National Park using travel cost method.	The consumer's surplus for entry to the park is estimated to be Rs.427 for Indians and Rs.432 for foreigners.
8. IGIDR, Mumbai (1999)	Conducted study on forest resource accounts. Estimated direct benefits of forest.	Forest resources contribute around 2.9 % to the adjusted Net Domestic Produce for the country as a whole.
9. D.V.Singh (1996) (in Mathur & Sachdeva 2003)	Identified the role of the forests in livestock rearing, vegetable farming, fruit farming and food grain production in Himachal Pradesh.	Number of livestock is determined by the available forest & grazing land. The inputs provided by forests constitute 19% of the total cost of food grain production.
10. Madhu Verma (2000) (in Mathur & Sachdeva 2003)	Estimated total economic value of forests of Himachal Pradesh	Rs.2.89 lakhs per hectare of gods/services in terms of total geographic area of forests, and Rs.7.43 lakhs per hectare of goods/services in terms of area under tree cover and scrub forest. Indirect benefits: Rs.53000/ hectare/annum. Direct benefits: Rs.21000/ hectare/annum.
11. Murthy & Menkhuas (1994) (in Mathur & Sachdeva 2003-table by Manoharan 2000)	Valuation of recreation/eco-tourism of Keoladeo National Park using contingent valuation method.	Rs. 20944/hectare (Rs.519/Indian visitor and Rs.495/foreign visitor)
12. Hadker et.al	Estimated recreation/eco-	Rs. 23300/hectare (Rs.90 per

(1994) (in Mathur & Sachdeva 2003-table by Manoharan 2000)	tourism and other benefits of Boriveli National Park, Mumbai, using contingent valuation method.	household per year)
13. Manoharan and Dutt (1999) (in Mathur & Sachdeva 2003-table by Manoharan 2000)	Estimated the value of eco-tourism benefit of Kalakadu Mundanthurai Tiger Reserve, Tamil Nadu, using contingent valuation method.	Rs. 2.95 million (Rs.34.68 per local visitor)
14. Manoharan (1996) (in Mathur & Sachdeva 2003-table by Manoharan 2000)	Estimated the value of eco-tourism benefit of Periyar Tiger Reserve, Tamil Nadu, using contingent valuation method.	Rs.676/hectare (for locals(Rs.9.5 per local (Keral visitor)
15. Chathurvedi (1992) (in Mathur & Sachdeva 2003-table by Manoharan 2000)	Estimated water supply benefit of Almora forests, using indirect methods.	Annual rental =Rs.4745/hectare
16. Kumar P (2000) (in Mathur & Sachdeva 2003-table by Manoharan 2000)	Estimated the soil conservation benefit of Doon Vally, using replacement cost approach.	Cost of soil erosion Rs.21583/hectare.

8.11 Natural Resource Accounting (NRA)

The Government of India Policy statement on Environment and Economic Development of June 1992 emphasizes that economic growth indicators like GNP and GDP would include depletion costs of environmental resources and the government would prepare each year a natural resources budget reflecting the state and availability of land, forests, water, etc. and these resources would be rationally allocated in keeping with the principles of conservation and sustainable development. Yet, no progress has been made in this direction since the policy statement. National income accounting without environmental accounting limits the information available to policy makers for gauging the impact of economic activity upon the environment in its role both as a "sink" for waste and a "source" for development.

……..Planning Commission 2000:327

It is felt necessary to develop ecological accounting and the integration of environmental aspects into national accounting procedures for understanding the existing stock of natural resources and the rate of their depletion. Natural Resource Accounting involves computation of national income by taking into account the existing stock of natural resources and the state of

depletion of resources. It is a system of monitoring based on methodically organized accounts, representing the size of economically valuable and limited reserves of natural resources.

As globally there is increasing awareness regarding the inadequacy of the national accounts system in measuring or accounting for changes in environment on income and welfare of population several efforts have been made in India to develop a framework for NRA. The current National Income Accounting is based on the concept of measuring income and wealth, without making any allowance for the depletion of natural capital or costs of environmental damage (water/air pollution, land degradation, loss of forests, etc.). NRA also known as Green Accounting is a measure of sustainable income level that can be secured without decreasing the stock of natural resources. The developmental planning process based on regional carrying capacity should take into consideration the fact that the environment with its biotic and abiotic components, provides the basic resources that support production-consumption activities and assimilates the residues produced during the course of these activities i.e. the natural environment is resource supplier as well as waste assimilator (Manonmoney 2000:259). It plays the role as a source as well as sink. There is need to develop an accounting system of renewable and nonrenewable resources, their quantity and quality, the nature of development activities that may be undertaken on the basis of resources available and the preparation of an action plan for SD including the abatement of pollution, managing drought and floods and the restoration of the health of natural resources, which can be used as an input in to national NRA and resource budget. (Tewari 2000:14).

The UN guidelines (and others that are similar) are being used in a number of countries to prepare environmental accounts, both at the monetary and non-monetary level. These include Brazil, Canada, Costa Rica, France, Germany, the Netherlands and Norway. Some attempts at adjusting national income accounts for environmental effects has also been undertaken in Australia, Japan, India, Indonesia, Mexico, New Zealand, Papua New Guinea, Sweden, the United Kingdom, the United States and Zimbabwe. The United Nations and World Bank have developed alternative macro-indicators for ‘environmentally adjusted’ and ‘sustainable national income and products’.

The approach to physical and monetary accounting of natural resources involves inclusion of accounts of existing stocks and flows, opening stocks and closing stocks, inclusion of natural resources in the input-output framework and national income accounting identity and conversion of physical accounts into monetary accounts.

Case studies in Natural Resource Accounting in India

Planning for SD requires an estimate of environmentally adjusted Gross National Product (GNP). The choice between preservation and developmental uses of environmental resources can be made so that environmentally adjusted GNP is maximized. The conventional system of national accounts takes into account the supply of all goods and services for which markets are present, including some goods and services supplied by environmental resources (Murty et. al. 1999:211). Most of the environmental resources, which are used in the production process, are left out from the imputation of GDP and they are also not accounted for depletion/degradation. United Nations Conference on Environment and Development (UNCED) held in the year 1992 at Rio de Janeiro recommended all nations and the United Nations to develop a system of Integrated Environmental and Economic Accounting (IEEA) (Kadekodi, 2004:337). As a part of the exercise of NRA the following studies have been conducted in India.

Chopra and Kadekodi (1997:357) conducted a study on NRA of forest resources of Yamuna river basin. Kadekodi and Agarwal (1998:360) deduce a formula to derive the adjusted SDP. They found that on account of excessive extraction of resources, the adjusted SDP of Himachal Pradesh, come down by as much as 21.64%. The estimates of SDP adjustments for other states are; 0.73% for Rajastan, -2.53% for Uttar Pradesh, and +0.04% for Haryana. The JFM and other community programmes attributed positive adjustments in Haryana. In Rajastan and Uttar Pradesh, the results were on account of fuel wood shortage and over extraction reported respectively.

Brandon and Hommann (1995 cited in Chopra and Kadekodi 1997:357)) estimated health effects due to water pollution at an all-India-level. Based on the Disability Adjusted Life Years (DALY) of the Indian population, they estimated the cost of water pollution in India between US$3076 billion to US$8344 billion.

Tata Energy Research Institute (TERI) estimated the adjusted income accounting for the state of Goa (2001). All natural resources including iron mining are included in the study. An estimate of iron-ore depletion and the corresponding adjustment in the SDP of Goa are Rs.25080203 lakh and Rs.24232276 lakh based on the User Cost method and Net Price method respectively.

The effect of air pollution on health has been studied by Parikh and Parikh (1997) Brandon and Hommann (1995), and Parikh (2000). Brandon and Hommann (1995) arrive at the cost of premature deaths, costs of hospital admissions and sickness, and several minor sickness, all due to air quality deterioration in India to be in the range of US$517-2102 million, which can be treated as first sets of satellite estimates for India (Kadekodi 2004:367).

Murthy and Kumar (2001:14) attempted accounting of industrial pollution in India. Based on the shadow prices of the pollutants environmentally corrected GDP have been estimated. The study is based on the data collected for a large number of polluting firms in India through two surveys, one conducted in 1995 and other in 2000, which are used to estimate the output distance function. Given the estimate of net national product (NNP) for India for the year 1997-98 as Rs.11731393 million at 1996-97 prices, the environmentally-corrected NNP for India, corrected for industrial pollution is estimated as Rs.11.6 crore millions (Rs. 11731393-Rs. 8778289) for the year 1997-98.

Murthy and Gulati (2005:13) estimated the shadow prices and cost of pollution of abatement of thermal power plants of Andhra Pradesh Power Generating Company (APGENCO). It is estimated that the maintenance cost or cost of pollution abatement in thermal power generation constitute 2.18% of GSDP of Andhra Pradesh. This cost does not account for the cost of CO2 reductions in thermal power generation.

8.12 Technology Application for Natural Resources and Sustainable Development

As Dasgupta and Heal (1993:80), present in their model of uncertainty, the exhaustible resources, which are essential currently may not be so in the future, if new sources are discovered as substitutes or alternatives to them. So there is need to consider the technological changes in addressing to the issues of natural resource use and sustainability.

A key consideration in approaches to achieve sustainability is to give serious thoughts to the possible impacts of technological advancements in short as well as long term perspective and their cross sectoral linkages (Rao and Saxena 1994:3). Biotechnologies should aim at increasing the productivity while conserving natural resources and without damaging environment and ecology. It should also ensure that food security and livelihood of the vast farming community dependent on agriculture is not threatened from monopolistic controls (Chopra 2002:56).

Agenda 21 of the UN Convention on Environment and Development identifies the need for studying and monitoring the environment and in this regard, the aero-space data provide a wealth of subject specific information to the users community in a cost effective manner (considering both time and economic aspects) with better quality than the traditional means of approaches (Chakrabarti (1998:238).

Harrison and Sharma (1996:148) observe that the concept of sustainability encompasses more than ecological considerations a range of economic and social factors that also need to be considered. Data relating to a large number of environmental and socio-economic variables are needed to plan and monitor SD. Geographical Information System (GIS) provides a powerful means of handling data, and can be interfaced with process models for prediction purposes. Substantial progress has been made in the development of resource databases and GIS for natural resource management. However, it is felt that the scope for use of natural resource GIS is still largely unexploited in India.

Information is being widely recognized as a strong weapon to combat environmental degradation and to our help the remote sensing and GIS technology have emerged as the tools for rapid, synoptic and accurate study on crops, soil resources, including growth, water potential, forests, environment, pollution, wastelands and land use, desertification, urbanization, geology, mineral resources etc.(Gupta 1997:237). Integration of socio-economic data and other collateral data in GIS environment for improving the information extraction potential is going to be a powerful tool for optimal resource utilization in the future.

Remote sensing technology is applicable to many practical areas of hydrology like (i) surface water mapping (ii) watershed survey (iii) determining potential zones of ground water (iv) irrigation area planning (v) snow-cover mapping and runoff prediction (vi) fold-plain mapping and flood damage assessment and (vii) water quality (Rammoorthy 1993: 63).

The Department of Space in India has taken up a project 'Integrated Mission for Sustainable Development' to consolidate all the information on natural resources derived from remote sensing with relevant collateral socio-economic data (Rao 1996:504).

The rise of environmental remote sensing technologies have raised new hopes for the evaluation and monitoring of the status of natural resources. Progress has been made in the application of remote sensing techniques, based on satellites to both research and operational problems in the management of natural resources such as land, forests and biodiversity. The importance of GIS through remote sensing for environmental management for sustainable development is slowly being recognized in India.

8.13 Natural Resource Degradation- Impact and Costs

The rising levels of production and consumption not only imply increasing resource flows (there by leading to exhaustion of resources), but also increasing discharges of residuals, which if accumulated beyond the carrying capacity of the ecosystem, then the resulting pollution impairs the ability of the natural environment to deliver useful flows of resources (Common 1996:15). Environmental degradation of soil, water or air for example is understood as decline in the quality and/or quantity of these resources in the structure of a locale's ecosystem thereby affecting the people's well being, in particular the livelihoods of the poor and their standard of living (Morvaridi 1997:231). Problems of water logging and salinization have been reported in many case studies on evaluation of irrigation projects (Morvaridi 1997; Chauddhary et al 1994). Though irrigation has played a major role in developing agriculture and improving income level of farmers, the rise in ground water level, excessive seepage from poorly lined canals and lack of drainage have contributed to water and salinization. An evaluation of the socio-economic impact of environmental change that the irrigation project induced after its completion and utilization is carried out by Morvaridi (1997) in Sultanpur district of eastern UP on the Sarda Sahayak Irrigation Project. It was observed that degraded lands have been abandoned by farmers as the costs of cultivating affected land proved to be higher than productive returns. The costs for different components of land reclamation are presented in Table: 8.4 below.

Table: 8.4 Costs of land reclamation: Unit cost for reclaiming 1 ha of salt –affected area for each component of work (1993) prices

Component Items	**Cost per hectare (Rs.)**
Cost of boring	3,000
Cost of pumpset	4,500
Drainage development	3,000
On-farm development	5,000
Cost of soil amendment	12,500
Cost of green manuring	1500
Total	**30,000**
Source: Moravaridi 1997:238.	

The above study (Table: 8.4) showed that the cost of reclamation of degraded waste land was Rs. 30,000 per ha for less severely degraded land to Rs. 50000 per ha for more severely degraded land. Further many farmers who could not make any investment on reclamation became landless by selling their land to large farmers.

According to NRSA, 20.17 per cent of the geographical area of the country is categorized as degraded or wastelands (Kadekodi 2004: 47). The following table shows cost of land degradation.

Table 8.5 Costs of Degradation (Based on Exprinemtal Data)

(In milloion rupees)

Costs of	NRSA (1998-89)		ARPU (1990)		Sehgal and Abrol (1994)	
	LP	RC	LP	RC	LP	RC
1. Erosion	67853	17997	124000	33290	361000	98270
2. Salinity and alkalinity	3350	3350	.---	42399	26600	26600
3. Waterlogging	4250	4250	.---	.---	61040	61040
4. Total Costs	75183	25597	124000	33290	448640	185910
5. As per cent of GDP	4	1.4	4.1	1.7 (2.1)	5.6	2.3
6. As per cent of agri GDP	11.4	3.9	18.5	5.0 (6.7)	17.11	7.1

Notes : LP = Loss of production estimate. In the case of salinity and alkalinity we do not have replacement cost estimates, hence we have taken loss of production figures. If replacement costs are taken, the estimates may be on the lower side, especially for 1994. * In the case of ARPU no separate estimates are available for salinity and alkalinity and waterlogging. Figures in brackets are treatment costs.

Source: Reddy (2003)

Studies have shown that irrigation projects have negative socio-economic impacts. Review of studies on development projects indicates that partial or only one-third of the total

affected populations have been rehabilitated in India (Mahapatra 1994:38; Fernandes and Arif 1997:135). A study in Orissa by Fernandes (2001:42-43) on development induced displacement reveals that the number of displaced persons between 1951 to 1990 was estimated to be around 30 million. While the 'patta' (document of ownership) holders were compensated, other dependents were displaced without compensation or any other alternative to their livelihood.

Chaudhary et. al. (1994) bring out the environmental and socio-economic impact of irrigation projects in India in terms of regional and social inequalities, changing cropping pattern, disruption in community life, low soil fertility and productivity due to land degradation and health impacts. Disruption of community life has been observed in Srisailam dam in Andhra Pradesh, Kali project in Karnataka, Pong dam in Himachal Pradesh and Sabarnarekha in Chota Nagpur.

TERI's report on Green India 2047 discusses problems of environmental damage and natural resources degradation in India. The report reveals that the pollution load on water resources is increasing due to the increase in population, industrial activities, and extensive use of pesticides and other chemicals for cultivation. Incidence of water- and sanitation-related diseases continues to by high and awareness of the importance of environmental sanitation is rather poor in the country. The river cleaning programmes, which laid emphasis on such capital work as setting up sewage treatment plants, development of bathing *ghats*, etc. have failed to yield the desired results due to the lack of holistic technical inputs and community involvement. The number of cases of violation of standards under the Water Act is also reported to be increasing. Most of the defaulting units are sugar mills, distilleries, and leather-processing units. In addition, the contribution from small-scale industries to the total pollution load is growing at an increasing rate. It is felt that so far, the approach to dealing with issues related to water pollution in India has been adhoc and sectoral (Pachauri and Sridharan 1998:240).

The amount of solid waste generated continues to increase at an alarming rate and problems associated with it become more and more serious. Solid waste, if not managed effectively, adversely affects all the three components of the environment, namely air, water, and soil.

The review of different studies highlights the impacts of environmental degradation that can be grouped under the following main categories;

- **Health impacts-** Management and conservation of natural resources is important for the maintenance of health in addition to the needs of food production and ecological considerations. Water pollution due to untreated sewage contributes to high coliform counts resulting in high infant morbidity and mortality. Gastroenteritis a waterborne disease is the first major cause of morbidity in India.
- **Economic impact:** Can be found in loss of availability of natural resources for the population, which is dependent on them for their livelihood. There could also be loss of productivity or reduction in crop production due to pollution or closure of industries to comply with air quality standards
- **Ecosystem impacts-** Contamination of ground aquifers, land degradation due to water logging, intrusion of sea water into ground aquifers, loss of water bodies, etc.
- **Displacement impact:** Environmental degradation and non availability of natural resources forces dependent livelihoods to migrate in search of alternate subsistence living.
- **Aesthetic impacts-** Loss of biodiversity –for example bird sanctuaries, lakes, etc., by visualizing, which people get pleasure.

8.14 Air Pollution

India ranks fifth in the world in terms of Greenhouse index ranking (1989) accounting for 3.55 of global emission (Perman et. al. 1996:343). The increase in vehicular population and industries is likely to increase the existing stock of Greenhouse gas accumulation. India needs to take into account the high reporting of respiratory diseases, which currently ranks third in terms of health problems in the country. While the level of gaseous pollutants in India are not so alarming, aerosols or suspended particulate matter (SPM) have high loadings often exceeding the limits prescribed by CPCB of India and WHO (Sharma 1997).

The effects of air pollution on human health, animals, plants and economic effects are brought out by Rao and Rao (1993) by analyzing air quality in Bangalore city. The study showed that the pollution caused by automobiles exceeded the limits specified by Central Pollution Control Board and was harmful to human health due to increased lead content in air. A study on pollution management, which addresses to air pollution in major cities (Agarwal 2002), reveals that Delhi is among the most polluted cities in the world. The study revealed that as per the survey carried out in 1987, an estimated 1172 tons of SPM, hydrocarbons, sulphur

dioxide, nitrogen oxides, carbon monoxides and other poisonous gases were emitted in to the air in Delhi by industrial units, vehicles and power sector. In Mumbai city the air pollutants let out in to the atmosphere daily were about 2971 tons of which 52% came from automobiles, 2% from the use of domestic fuels and the rest 46% from industries. The quality of air in Bangalore was found to be beyond permissible limits due to increasing vehicular emissions and burning of wood in houses and brick kilns.

8.15 Policy Issues for Sustainable Development

The action plan for SD should be based on environmental acceptability, technical feasibility and economic viability (Jauhari 2002:17). Subsidies, which encourage inefficiencies in resource allocation and sub optimal use of natural resources should be reduced or removed or rationalised (Gadgil and Guha 1995; Gulati and Sharma 1995; Srivastava et al 2001;Planning Commission 2000).

To internalize the externalities of pollution, collection of pollution tax from both the producer as well as the consumer is advocated for environmental protection in the spirit of social justice (Chen and Tsai 2000:15). Since the command and control strategies have proved to be ineffective instruments of SD, there is a need for the combined role of government, civil society and political actors for SD (Singh 1998: 32).

Sustainability of natural resources for development can be assured in by regulating the use through administration of various kinds of instruments and initiation of measures for conservation. For example;

- Removal of subsidies
- Conferring property rights on commons to community and panchayats
- Market intervention for fixing the value of natural resources
- Economic instruments
- Replacement of old Acts that were enacted before independence by New Acts [say Indian Forest Act 1927] making provisions for sustainable development with the involvement of

community, for the benefit of thousands of livelihoods as well as for the conservation of forests.

- Population stabilization
- Ensuring food security to all
- Meeting housing, water supply, sanitation and health care needs and planning for future needs
- Clean technologies in production system and development of natural resources
- Use of renewable energy sources
- Empowerment of weaker and vulnerable sections
- Conservation of biodiversity
- Law enforcement
- Economic incentives for conservation and efficient use
- People's participation
- Institutional reforms and support
- Technology improvement
- Mixed role of government, private sector, NGOs and People.

In the case of water resources, there is felt need for efficient use of water resources and their allocation among competing users in a way that gives priority to the satisfaction of basic human needs and meeting the requirement of preserving the eco systems and their functions. The new forces in water resources management are recycling of water, water harvesting, desalination of sea water, private management and participatory management. Since it is unlikely that the institutional intervention can answer major issues of sustainability of natural resources at least in the short run, the major option for sustainable development of water resources is to create a platform for all the resource users to come together, to discuss and evolve norms for imposing restraint on resource use (Shah 1993:140). Sengupta (1993:10-11) advocates documentation and adoption of traditional water harvesting systems suiting to local conditions without homogenizing them. According to Biswas (1990:57) "Efficient use of water is simply not possible, unless it is managed in an environmentally-sound manner. Thus, environmentally-sound water management is an essential requirement for future development of developing

countries, and will become an even more important consideration in the future than it was in the past".

Protection of endangered species, identification and initiatives for hot spot areas, enhancing indigenous and community based biodiversity conservation efforts, promotion of eco networks and corridors are essential for conservation of biodiversity (World Summit 2002).

Stabilizing population is an essential requirement for promoting SD with more equitable distribution of poverty alleviation, as the rising population has serious implications on food and water security, health care, rural and urban services and sustainability of ecosystem (Tewari 2000:5).

Single regulator responsible for both prices of petroleum products and natural resources is favoured in the country as natural gas is a substitute for different petroleum products and pricing decisions will have to be consistent to ensure that the right mix of energy sources is used in the economy (TERI 1999:5). Moreover the responses of consumers as well as suppliers needs to be considered in price fixation so that the price does not result in any distortions, surpluses or shortages of one over the other.

Human resource development should occupy the center stage in the overall development of planning in order to achieve the objectives of sustainable agricultural development fostered by state policies like integrating environmental concerns with markets, promoting efforts towards developing appropriate technologies, which are sustainable economically as well as environmentally and removal of imperfections in the agrarian structure.

For achieving SD there is need to reduce the pressure on environment by preventing population growth, improving literacy, promoting environmental awareness drives and introducing poverty alleviation programmes. Dependence on these would reduce the burden on non-renewable and renewable (but, exhaustive) resources.

Jodha (2001:86) opines that "in fragile areas (with high pressure) sustainability in agriculture is not possible through traditional measures, it requires application of modern science and technology blended with the rationale of indigenous practices. Moreover, any progress in the suggested direction will depend on the reorientation of agricultural research strategies to suit the specific requirements of these areas. This in turn is largely an institutional rather than a technological problem".

Bansil (2004:20) specifies the role of the National Water policy, 2002 in water resource management, which emphasizes integrated water resources development and management for optimal and sustainable utilization of the available surface and groundwater.

Raghuvanshi and Sajwan (199439-40) opine that to improve the irrigation management in arid and semi-arid conditions more emphasis should be given to advanced scientific research in different scientific fields through inter-disciplinary plan of action. Scientists from technical sciences and social sciences can work together to identify the problems and simultaneously look for the solutions to tackle the problems. To minimize the disparities in agricultural growth between irrigated and dry land they recommend some bold polices for eg; declaring water as the national asset. It is felt that research should be concentrated in monsoon forecasting, water harvesting, productivity of arid and semi-arid agriculture, and sprinkler and drip irrigation, etc (Raghuvanshi and Sajwan (1994:39-40). Alagh and Kashyap (2000:18) highlight the role of social scientists in water resource conflict management. Adiseshaiah (1991:229) proposes that growth centred development plans should be replaced by plans aiming at sustainable development, which will address both to safeguarding and enriching the environment and meeting the basic needs of the neediest in the society.

Drawing a land management strategy, Muzammil (2001:137-138) pinpoints that participatory land management must be attempted with the consideration that equity in land distribution would help to produce more food. In the national interest, institutional and equity considerations should not be thrown out of the economic agenda and commercialization of India agriculture under the dictates of the SAP should not be encouraged at the cost of food production. All these goals can be better achieved through participatory management of land.

Gawande's study (2001:116) found that major difficulties to people's involvements in watershed development programmes were managerial or technical, and skills in community mobilization, conflict resolution and institution building.

Since many of the existing laws on protected areas, wildlife, forestry, etc. promote conservation of biodiversity but not its sustainable utilization (TERI 1998:167), the laws on biodiversity should take into account various interconnected activities. An intersectoral approach and an audit of all developmental activities are essential to ensure a balance between sustainable development and conserving biodiversity for the benefit of the humankind.

To increase the productivity of wastelands an integrated village ecosystem planning and management is required. The task of planning for every Indian village can be achieved, rapidly and judiciously, only if it is participatory. Due to lack of people's participation many development programmes have failed. Now, we can see many instances of village regeneration through people's participation (Agarwal et al 1999:3).

According to (Jodha, 2001:86) "Any progress in the suggested direction, will depend on the reorientation of agricultural research strategies to suit the specific requirements of these areas. This in turn is largely an institutional rather than a technological problem".

Sengupta (1993:11) calls for learning from the experience of traditional …….

"Unless they are compared and categorized according to their basic similarities, modern knowledge cannot make much headway. Improvement and extension will, therefore, remain only a distant dream. At the same time, it is also important to study the differences, and the local adoptions of the basic designs. It will be dangerous to homogenize them all. The comparisons must be extended to a wider scope, with other techniques and with techniques in other countries. The first task is to document this wide variety of techniques.

Swaminathan (2002:208-209) feels that agriculture in most developing countries is not just a food-producing enterprise, but the backbone of sustainable ecological and livelihood security systems. In addition, it is the foundation for national sovereignty. Agricultural progress represents the best safety net against hunger and deprivation because of the greatest good it confers on the largest number of people. Therefore, national and international public policies should recognize that food is a powerful tool for socially meaningful development. At the national level, prime farm land should be conserved in the same manner as national parks and protected areas. Agri-reserves are as important for safeguarding food security as biosphere reserves are for conserving biodiversity. Unfortunately, the importance of conserving prime farm land for food production is yet to receive the attention it needs and deserves. Swaminathan calls for declaring all good farm land as agri-reserves putting in regulations, which make it difficult to convert prime farm land for non-farm uses, without convincing reasons. He suggests agri-reserves and biosphere reserves can become mutually supportive-agri-reserves being the guardians of food security and biosphere reserves of ecological security.

McNeely (1997:35) argues that without support from all sections of society, the goals of the biodiversity convention cannot be realized. Kothari (1997:41) reported that India has not taken proper steps to protect our biological resources. The approaches to Biodiversity conservation should be based on the realistic view (Wells 1997:480). The NGOs can also play important role in biodiversity conservation. The NGOs can help in protecting the biodiversity where government expertise and infrastructure do not exist. These NGOs can be briefed in assessing and reporting to the government (Prasad 1997:506).

Research should focus on the suitable strategies, which would harmonise compulsions of economic development with imperatives of ecological reservations (Nambiar 1997:463).

Pachauri and Sridharan (1998:57) identify some areas that need to be addressed by the water policy in India in the years to come; "The emerging issues in the management of water resources in India are chiefly of identifying and examining alternative institutional and policy arrangements for example in the context of groundwater, the real issue is not overexploitation but management of groundwater to address a wide array of environmental, equity, and sustainability concerns. On the one hand, there is a need to identify local institutional arrangements for the management of water resources by users themselves that ensure equitable and sustainable use of water and on the other, we need to look at the role of improved technology in augmenting the carrying capacity of water resources. While much is known in terms of the savings that are possible in the use of water by alternative technologies, there is need to examine the applicability of these technologies to Indian conditions, as also to identify policy instruments for influencing technology choice".

For SD we need to rely on renewable as well as non-exhaustible resources such as solar energy and wind in areas and sectors wherever it is feasible to extract and use them. The consumption of these resources by one does not reduce the magnitude of resource flow to others using or non using these resources. This would reduce the burden on non-renewable and renewable (but, exhaustive) resources.

Rai and Yadav (2002:917) specify few policy imperatives for achieving SD as follows.

1. Incentives and regulatory policies to compensate for externalities related to natural resources, e,g., water pricing, watershed management and problem soils.
2. Adjustments/changes, e.g., diversification, crop rotations in crop plans to be facilitated in order to achieve a balanced crop-mix to make progress towards profitable and environmentally sustainable production systems.
3. Effective enforcement of procedures for review and approval of the safety of existing and new agricultural chemicals and other agents used in agricultural production.
4. Information about sustainable agricultural practices and new policies to encourage wider adoption to be disseminated to farmers to strengthen the cause of sustainable agriculture.
5. Region-wise centers for sustainable agriculture to be established with multidisciplinary teams of physical, biological and social scientists for creation of data bank on sustainable parameters which will help make more informed choices.

Greater collaboration and interaction among international agencies, crop and animal research institutes and exchange of expertise is emphasized for achieving still higher global food production for human well being. Increased allocation of resources for research and development of agricultural sector is imperative, besides incentives to increase productivity and means to transfer the technological innovations to the door step of the farmer for quicker adoption

The industries that produce solid wastes need to be comprehensively identified and brought under pollution control laws. The existing laws are weak and not strictly enforced as a result of which there is mismanagement leading to serious impacts on the environment.

According to the report presented by TERI (Pachauri and Sridharan 1998:201), it is possible to de-link the increase in economic activity from pollution. This requires an effective environment management plan, which includes environmental strategy, regulation, institutional capacity-building, and economic incentives and penalties. Besides regulatory and economic tools, such support measures as training and education for the industry, governmental agencies, and the public, as well as greater coordination among institutions, are also important for implementing the plan to put India on the road to sustainable development. In country like India, which faces severe resource constraints, a community-based approach appears to be the only viable option for improving water quality and better environmental management (Pachauri and Sridharan 1998:240), and conservation of natural resources.

Section –X

Research Gaps and Need for further Research: Challenges and Identified Areas

Studies in India taken up before 1980s reflect India's strategy towards exploitation of natural resources for industrial production and development projects. The focus was on growth. A review of the recent studies shows a shift in the thinking in the country from State to people, from dependence to self-reliance, from exploitation to conservation, from common to our approach, from free to priced concept and, from present to future. Macro and micro studies indicate this change in the management of resources as well as governance. But, it is the beginning as we find such thinking being realized only in few areas, states and sectors. There still exists exploitation of natural resources for commercial interests. There are conflicts over use of natural resources products freely by the people residing around them, particularly tribals and villagers.

Many Indian economists are working on SD issues, and are involved in attempting to design policies to promote its attainment. Thinking is emerging on creating a suitable environment for introducing price incentives type of instruments for market failure in environmental goods and correcting or abandoning policies, which do not comply with environmental protection on the grounds of equity and justice.

The research studies have brought in the following issues to limelight;

- The negative role of government in exploiting natural resources for the benefit of corporate sector, rich and urban sector
- Role of PRIs in natural resource management and SD
- Relevance of participatory management of natural resources for SD
- Need for development and conservation of natural resources as support to livelihoods of poor and for SD
- Need for continued role government in protecting and managing natural resources and environment through regulations
- Role of NGOs in catalyzing the movement and actions for conservation of environment for the well being of the people and maintenance of ecology.
- Lack of environmental modeling in planning
- Public-private partnership needed
- Developing sound database and information system

Research Gaps

However, we find that there is need for further investigation in many virgin areas, which are essential for developing a long term policy framework as well as to address to the current micro level issues.

- Studies fail to identify natural resources and human resources linkages
- Documentation of the state of the displaced households affected by development projects
- In India and elsewhere, Environmental Impact Assessment (EIA) studies are taken up before a project is initiated. These studies indicate the likely impact. The real impacts occur after project is implemented. The Ministry of Environment and Forests should consider EIA studies before and after implementation of projects in beneficiary and affected areas for understanding the status of affected persons and to review the sustainability of the projects.
- There is absence of studies on the behavioural and economic parameters determining water demand, and water assessments as a part of land and climate or agro-climatic regimes (Alagh 2003:31).

Impact assessment of watershed management projects is required in view of the objectives of sustained and stabilized employment, poverty reduction, vegetation cover, siltation stoppage, and other bio-physical aspects. Nair and Chattopadhyay (2001:13-14) list down the issues that could be taken up for research in watershed development, which are as follows.

1. As adequate baseline data are not available, comparative assessment of watershed management projects in various stages of implementation
2. Integration of water needs and availability in various sectors like irrigation, drinking, domestic use, and industrial use for the present and for the future.
3. Analysis of upstream-downstream conflicts in the matter of water use, in terms of land use practices, and community requirements.
4. Tradable and non-tradable benefits of augmented water resource.
5. Documentation of traditional property rights and management practices
6. Natural resource accounting to assess impact of watershed management practices
7. Panchayat resource mapping methodology with required modification according to biophysical zones may be considered for data generation, evaluation, analysis, and monitoring.
8. Development of watershed management information system at different levels
9. Scope of watershed management for urban water use and on rural urban conflicts in water resource utilization.

There is need for research to be carried out on the interaction between the irrigation technology and the social relations in a region i.e., the impact that irrigation has (or may have) on the conditions of production and accumulation of the different categories of users and the implications of this on the dynamics of development of the region as a whole (Bharadwaj 1990:51).

Katyal et. al. (1998) identify research gaps for SD in agriculture as follows:

- Research on an integrated policy framework on population management and sustainable growth to address to the problems of pressure on land from man and animals
- Research and development activities on developing resource saving technologies and efficient use.
- Integrated nutrient management harmonizing chemical and natural nutrient sources in agriculture.

Singh (1993:307-8) suggests that researches in the next phase must focus attention on stabilizing production and productivity through developing varieties of field crops with multiple resistance to pests and diseases, tolerance to stress conditions, developing crop hybrids, suitable for multiple cropping and high yield, coupled with conservation of germplasm and upgrading the genetic yield potential. Researches in veterinary and animal sciences have to be strengthened to provide health care and improve the livestock and poultry wealth of the developing state to contribute to availability of high quality protein, specially for the vulnerable sections of the population. The researches in basic sciences need to be integrated to support still higher agricultural productivity in the developing countries.

For air quality management, Sharma (1997) identifies gaps in monitoring programmes, insufficient data on pollution damages, lack of source identification (SI) and source apportionment (SA) exercises, and institutional gaps where in many agencies are involved in air quality monitoring (for example Mumbai) without proper linkage for further action plan in this regard.

In India regeneration programmes of wastelands and regeneration of CPRs has been undertaken on a selective basis, which act as demonstrative models but, given the extent of wastelands and the CPRs, there is a need for systematic study of the manner in

which a programme of regeneration of these lands can be undertaken at the national scale (Kadekodi and Perwaiz 1997: 63).

Natural resources are India's life and blood, hence good management of these resources and environment is essential to the health of the economy (Kerr and Swarup 1996). In addition, as Professor Amartya Sen proposes we need to reduce poverty and inequality by efficient distribution of the available resources rather than relying on supply side measures.

Measures suggested for sustainable use of natural resources

- To internalize the external costs of exploitation of natural resources through proper pricing of the resources
- Management of natural resources by community based institutions through discharge of incentives, penalties, contribution, fixation of shares, user charges, etc.
- Environmental protection is intra sectoral and trans-boundary issue, hence cooperation from public, different sectors, national government and international cooperation, particularly from the neighbouring countries is essential for framing a sound environmental policy.
- There is need for decentralization in decision making relating to local environmental problems, resource use and management.

On the research publication aspect two important points to be considered are;

Firstly, there is tremendous research output of ground level realities, social and policy relevance based on empirical and scientific investigations undertaken by research institutes in the country. But, most of them lay as project reports. They do not come into limelight either because of delay in approval by the sponsoring agencies or because of lack of finance to publish on the part of institutes, particularly smaller organizations, which work on non-profit basis.

Secondly, we find that there is lack of effort and initiative on the part of researchers to publish their doctoral studies. Once the degree is awarded the copies are sent to the libraries of respective universities or remain with guide and the student.

This calls for forming an agreement with identified publishers in India by collaborative effort of UGC and ICSSR to bring to limelight the research work of Ph. D. scholars and social science research institutes.

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