

Part IV

Conclusions

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India has made remarkable progress in the areas of food production, industrial development, energy generation, socio-economic conditions and other fields, since it gained independence in 1947. On the socio-economic front, life expectancy improved, the infant mortality rate declined, and literacy rate improved. India is a biomass-based country where about two-thirds of the population depends on agriculture for subsistence. India is self sufficient in food. India has a place among the ten most industrialised nations of the world. Rapid population growth has been exerting heavy pressure on India's finite natural resources. While the annual growth rate of the population is a major concern, rapid economic growth has led to many undesirable consequences and unanticipated environmental problems.

The chapter includes the conclusions and recommendations for each priority issue. The major policy, knowledge and information gaps are discussed and policy recommendations made are also included in the chapter.

Land degradation

Policy/ knowledge/information gaps

- There is no well-defined integrated land use policy. This lacuna has largely been responsible for the current phase of land degradation.
- There is no rural fuel wood as well as grazing and fodder policy that results grazing far beyond the carrying capacity and extraction of fuel and fodder from forests far beyond the sustainable limits, creating enormous negative impacts on the forest and land.
- Information on severity of area affected by various forms of degradation is limited, highly variable, and sketchy.

Policy recommendations

- A well-defined integrated land use policy should be developed. Rural fuel wood and grazing and fodder policies are to be developed to guide management of land and forest scientifically and sustainably.
- A National Land Use Commission should be instituted to lay down such policies, implementation strategies and monitoring guidelines with support from the existing All-India Soil and Land Use Survey, National Bureau of Soil Survey and Land Use Planning and the Forest Survey of India under the stewardship of the Planning Commission to address most land-related issues.
- A Land Capability Classification should be developed for Indian conditions to ensure that land is put under the right kind of use according to its capability.
- A correct assessment of the nature and extent of the existing degraded land needs to be carried out using remote sensing techniques and GIS with scientifically sound criteria and indicators.
- Application of soil nutrient results in serious soil health and ecological problems, which needs urgent attention. Integrated Plant Nutrient Supply (IPNS), have to be adopted to improve fertiliser use efficiency and reduce the potential danger of pollution from higher nutrient use in agriculture.

- A systematic monitoring mechanism needs to be developed to assess the balance between input and withdrawal of nutrients to guard against possible nutrient depletion. There is a need also to define the threshold values for such additions and for promoting a balance in the use of organic manure, chemical fertilisers, bio-fertilisers and agrochemical to ensure sustainability and increased production.
- A multi-level stakeholder approach for the planning process is essential to ensure improvements in sustainable land use and development. In a multi-stakeholder approach, three principles must converge—good land husbandry, sustainable land use, and an enabling institutional environment. Local knowledge systems, norms and values must be given due importance while developing any such planning.
- The major challenge in the agriculture sector is checking fragmentation of land holdings, which can be achieved by providing security of land rights and land tenure, encouraging efficient use of marginal lands, developing areas of untapped potential thereby correcting uneven utilisation of land, and using the irrigation potential efficiently.
- The agricultural extension system of the country needs revamping to make it more efficient. Multidisciplinary technical information, viable land use options and alternatives identified for various agro-ecological and socio-economic units and crop combinations and crop rotations need to be passed on to land users for achieving effective land management results.
- Lacunae in the economic policy, institutional and governance systems is also responsible for the loss of biodiversity in India.
- Inadequate implementation of existing laws and various schemes
- Poor implementation of Wildlife Protection Act 1972 as amended in 1991 and inadequate implementation of eco-development programmes are policy gaps resulting in the destruction of biodiversity.
- Inadequate participation of NGOs in the process of completion of various schemes of the government
- The financial outlay provided in the budget for forestry sector is minimal. There is a need to enhance the financial outlay for forestry and biodiversity sector for preservation of valuable biodiversity in the country.
- Documentation of biodiversity is an urgent requirement as the latest statistics and data on floral and faunal biodiversity of India have not been compiled and documented.
- Lack of knowledge of the magnitude, patterns, causes and rates of deforestation and biodiversity laws at the ecosystem and landscape level.
- Information on poaching trade and trade routes is sketchy and current wildlife protection and law enforcement measures are inadequate and inefficient.
- Biodiversity Act /Bill should not override the provisions of Wildlife Protection Act.

Bio diversity

Policy/information/knowledge gaps

- Lack of policies for protection of wetland grasslands, sacred groves and other areas significant from the point of view of biodiversity.

Policy recommendations

- Most of the legal provisions are focussed on use and exploitation of biological resources, than their conservation. Even Wild Life Protection Act 1972, have focussed on protection rather than conservation. Hence a greater thrust should be given to the conservation aspect in the rules pertaining to biodiversity.
- A comprehensive legislation on biodiversity conservation and uses should be promulgated

- There is a need for formulation of policies for protection of wetlands, grasslands, and sacred groves significant from the point of view of biodiversity.
- Biodiversity bill should be passed on immediate basis.
- The presence of a biodiversity Cell in all development departments impinging on land and water
- There is a need to document biodiversity
- Increase allocation of financial resources for conservation of biodiversity
- Integrating conservation with development
- Incentives and disincentives for improper use of biodiversity
- Biodiversity Act/Bill should not override the provisions of Wildlife Protection act.
- There should be continuous monitoring of biodiversity use for review of results of implementation of policies and programmes.
- Lack of private/community participation in monitoring activity
- Emission factors relevant for India are not available for various activities
- Mapping for emission loads for various pollutants is not available
- Air pollution modelling as a tool can be applied for forecasting and urban planning
- Effectiveness and impacts of various policy measures are not assessed
- Strengthening of information on number of vehicles on road, vehicle usage, etc.

Air pollution with special reference to vehicular pollution

Policy/information/knowledge gaps

- Lack of land use planning and its implementation are leading to unplanned settlements and industrial growth in cities and towns, in turn, affecting public health.
- No separate transport policy exists at the national and state levels. No well-defined policy laid out to promote private participation in public transport. Also there is a lack of coordination between various government agencies to improve the transport services leading to rapid increase of personal vehicles in cities and towns.
- Monitoring at problem areas, hotspots and traffic intersections is lacking; more stations to be established and frequency of monitoring to be increased.
- There is a need to monitor additional air quality parameters such as ozone, benzene, PAH, PM_{2.5}, dry deposition of sulphates and nitrates
- Vehicular pollution control in metropolitan cities and other cities deserves top priority. A practical strategy should be devised that reduces both emissions and congestion. Various strategies need to be adopted including augmentation of public transport system, promotion of mass rapid transport system, traffic planning and management, taxes on fuels, and vehicles, further tightening of emission norms and fuel quality specifications, promotion and use of alternative fuels like CNG/LPG/propane/battery operated vehicles, replacement of two-stroke engines, and strengthening of an inspection and maintenance (I & M) system.
- Thrust also should be given to the control of industrial pollution through measures including promotion of cleaner technologies, strengthening of emission standards, introducing economic incentives, and strengthening of monitoring and reporting system. Emphasis should be given to waste minimisation and waste utilisation. Appropriate siting of industries will help minimise the impacts of activities on ecosystem and human health.
- Emission standards for various categories of industries need to be strengthened. In addition to concentration based standards, load based standards also should be developed.

- A comprehensive urban air quality management strategy should be formulated that includes information related to urban planning, ambient air quality, emission inventory, and air quality dispersion models. Strengthening of the monitoring network and institutional capabilities would facilitate an improvement of the enforcement mechanism.
 - Use of cleaner fuels like LPG in households would reduce indoor air pollution.
 - Air quality standards should be developed based on local dose-response relationships for which appropriate environmental epidemiological studies should be undertaken.
 - Development of land use planning incorporating environmental considerations and strictly adhere to the planning need to be given priority to safeguard human health in urban areas.
 - Economic instruments need to be put in place to encourage industries to adopt cleaner technology and other conservation practices and to discourage over utilisation of natural resources.
 - Promotion of renewable energy sources such as hydro, wind, and solar
 - The monitoring network requires a massive quality control programme and expansion of its operations to cover new stations as well as more pollutants (e.g., RPM_{10} , $\text{RPM}_{2.5}$, O_3 , Pb, CO, and hydrocarbons such as benzene and PAHs) on a regular basis. Smaller cities should also be covered so that preventive measures can be taken before the pollution problem becomes acute.
- water resources in India. As many as eight agencies are involved in collecting water related data, which results in duplication and ambiguity of functions and discourages.
- States are empowered to frame water policies. Many states do not have water policies though the Ministry of Water Resources (MoWR) has prepared water policy for the country.
 - A proper legal framework for regulating withdrawals of groundwater is not in place. Though efforts have been made to check the overexploitation of groundwater through licensing, credit or electricity restrictions, these restrictions are directed only at the creation of wells. Even the licenses do not monitor or regulate the quantum of water extracted.
 - Water cess has not been very effective in inducing abatement since the rates of raw water are so low. Market based instruments to encourage resource conservation mainly in the agriculture and domestic sector have not been really tried. This accompanied with the subsidy regime in these sectors has resulted in poor resource usage efficiency.
 - It was realised during the later stages of implementation of the Ganga Action Plan, that the local authorities were not able to operate and maintain these assets due to inadequate resources and skills. The level of commitment required from the state agencies was also missing. The pollution resulted from a number of diffused sources either urban or rural.
 - Water quality monitoring by CPCB reports the maximum, minimum, and mean value of the parameter and the percentage violations for select parameters. However, specific information is not available for water quality in these water bodies for seasons with lean flow. The frequency of monitoring and number of monitoring stations also is not representative of the quality of water body specifically in the non-monsoon period.

Fresh water management

Policy/information/knowledge gaps

- Lack of institutional mechanism and overlapping of responsibilities are the major bottleneck in the effective management of

- The CWC monitors the water quality for 47 parameters three times in a month but published information is not available. Information is available only at the regional office levels and that too, on request.
- Information on availability of groundwater and its quality is limited. Though groundwater availability maps have been prepared for certain locations, extraction rates have not been defined.
- Much of information—quantitative as well as qualitative—on water supplied, coverage of population, quality of service and sanitation both in the urban and rural areas is not available. Besides information gaps on water consumption and effluent discharge patterns for industries also exist.

Policy recommendations

- A river basin approach or sub-basin-based approach is suitable to integrate all aspect of water management namely water allocation, pollution control, protection of water resources, and mobilisation of financial resources. An apex level body can be created to coordinate the functioning of different agencies.
- State-specific water policies need to be prepared. Revision in the National Water Policy, 1987 also needs to be finalised at the earliest. Groundwater legislation needs to be promulgated in all states to promote sustainable water uses and development. Incentives under the Water Cess Act, for instance, have to be made more attractive to make the industries undertake pollution control measures.
- Emphasis should be given to developing surface irrigation sources and take measures for rainwater harvesting to increase water resource availability. The concept of watershed development has also to be adopted more rigorously. Micro-watershed development provides a medium for revival and integration of traditional water control measures. People's participation is the essential prerequisite for water shed development and to this end, public education and training to local people is to be given.
- Appropriate tariff structure for water services will have to be evolved to encourage wise usage of the resource and generate additional support for the fund-starved service providers as well. There is a need to have a fresh look at the existing water pricing structure. There is also a need to develop and implement cost-effective water appliances such as low-flow cisterns and faucets and formulate citizen forum groups to encourage and raise awareness on water conservation.
- Technological intervention is required to enhance effective treatment of wastewater. Many low-cost and effective technologies for waste water treatment, e.g. UASB, duckweed ponds, and horizontal filters have been developed in other parts of the world but their application is to a limited extent in India. Adoption of cleaner technologies by the industry would help to safeguard surface water bodies.
- Data on water supply and sanitation for both urban and rural areas needs to be collected to formulating strategies and prioritising the action plan. Performance measurement of the service provider, specifically in the urban areas need to be undertaken to benchmark operational efficiencies related to water treatment and distribution. Similarly, information on water consumption and effluent discharge patterns for industries could be used to benchmark resource consumption and increase the productivity levels per unit of water consumed.
- A basin-wise analysis of the availability of utilisable water resources, demand levels and consumption patterns needs to be made. Such an analysis would help in developing a Water Zoning Atlas to guide decisions related to siting of industries and other economic activities.

Hazardous waste management

Policy/information/knowledge Hazardous waste management

- Provision of incentives for waste reduction/minimisation efforts are missing in the rules promulgated by the MoEF in the year 2000
- No standards for clean up of contaminated sites and no limits for disposal of waste on land.
- Inventory of hazardous waste carried out by various states needs to be constantly updated to devise appropriate waste management strategies.
- System to assess the impacts of hazardous waste on human health, and ecosystem is missing.
- There is lack of infrastructure facilities for proper treatment and disposal of hazardous waste in India largely due to lack of enforcement mechanism.

Municipal waste management

- Rules on management of municipal waste and biomedical waste do not clearly identify the role and responsibilities of the CPCB and SPCBs.
- No state/nation-wide waste inventories available at the city levels to identify and quantify municipal waste and biomedical waste except for a few places. Preparation of waste management plan becomes difficult without such inventories.
- Most of the municipal or biomedical waste are currently dumped on open low lying areas with no provisions for liners, leachate collection and treatment system or gas collection system.
- In absence of segregation of waste at source, waste treatment alternatives such as recycling, waste-to-energy projects and or composting become uneconomical to operate. Most infectious biomedical waste is disposed at municipal waste dumpsites in absence of dedicated waste disposal facilities for biomedical waste.

Policy recommendations

Industrial and hazardous waste management

- Strategies need to be developed to ensure scientific management of hazardous waste encompassing all the aspects of waste management cycles starting from generation of waste to its handling, segregation, transportation, treatment and disposal. In addition, the strategy should target waste minimisation/reduction as its primary focus.
- Efforts are required to quantify and characterise the volume of waste residues generated by industries and the information needs to be constantly upgraded.
- Capacity building for SPCBs to deal with analytical and monitoring requirements regarding tracking of hazardous waste movement and management. Training for critical industrial sectors generating hazardous waste to address their responsibility in its handling, storage, transportation, treatment, and disposal.
- EIA tool can be introduced to carry out environmental and social assessments of hazardous waste management operations to assess the risks and health impacts of inappropriate disposal of hazardous waste on surrounding ecosystem and communities.
- It is necessary for the government to set up standards not only for disposal of waste on land but also for clean up of contaminated soils and groundwater.
- Ways and means to be worked out to create facilities and infrastructure for proper treatment and disposal of hazardous waste. Issues need to be addressed are willingness-to-pay issue by participating industries, type of ownership, financial mechanisms to finance such ventures and extent of private sector participation.

Municipal solid waste management

In order to achieve a satisfactory, efficient, and a sustainable system of solid waste management, the following aspects to be covered.

- Setting targets for waste reduction. Reduction at source can be accomplished in three ways (1) fees and tax incentives to promote market mechanisms to effect source reduction, (2) mandatory standards and regulation, and (3) education and voluntary compliance with policies by business and consumers
- Technological interventions. Two technical components need urgent consideration, namely collection of waste and treatment and disposal of waste.
- Collection of waste. One immediate measure to revamp the existing collection service structure is to provide community waste bins conveniently placed for the people to deposit domestic waste. The second measure should entail separation of waste at source into biodegradable and non-biodegradable components.
- Transportation of waste. Waste should be carried in covered vehicles. Infectious and hazardous waste from health care facilities should be carried strictly in separate covered vehicles. Hospital waste of some categories, e.g. biomedical waste consisting of human parts, body fluids, etc., has to be incinerated but for other categories of waste, methods such as microwaving and autoclaving are possible.
- Treatment and disposal. Proper segregation would lead to better options and opportunities for scientific disposal of waste. Recyclables could be straightaway transported to recycling units, which, in turn, would pay. The organic matter could be disposed of either by aerobic composting, anaerobic digestion or sanitary landfilling.
- Institutional and regulatory reforms. The 74th Constitutional Amendment empowered the local bodies to apply power to impose taxes, duties, tolls, and fees for services including public health, sanitation, conservancy, and solid waste management.

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Part V

Annexes

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I

Acronyms and abbreviations

Acronyms	Abbreviations	Acronyms	Abbreviations
ADM	Administrative Pricing Mechanism	ENVIS	Environmental Information System
AEQM	Area-wide Environment Quality Management	EPA	Environment Protection Act
AEZ	Agro Ecological Zone	EPTRI	Environmental Protection Training and Research Institute
ARWSP	Accelerated Rural Water Supply Programme	ESCAP	Economic and Social Council for Asia and the Pacific
BCM	Billion Cubic Metres	FAO	Food and Agricultural Organization
BIS	Bureau of Indian Standards	FBC	Fluidized Bed Combustion
BOD	Biochemical Oxygen Demand	FSI	Forest Survey of India
BPC	British Petroleum Company	FYP	Five Year Plan
BSI	Botanical Survey of India	GAP	Ganga Action Plan
CETP	Common Effluent Treatment Plants	GDP	Gross Domestic Product
CGWB	Central Ground Water Board	GEMS	Global Environmental Monitoring Systems
CIER	Centre for Industrial and Economic Research	GIS	Geographical Information System
CII	Confederation of Indian Industry	GLASOD	Global Assessment of Human-induced Soil Degradation
CMIE	Centre for Monitoring the Indian Economy Pvt. Ltd	GoI	Government of India
CNG	Compressed Natural Gas	GTZ	German Technical Co-operation
CNH	Central National Herbarium	HDI	Human Development Index
CO	Carbon dioxide	HSD	High-Speed Diesel
CPCB	Central Pollution Control Board	HUDCO	Housing and Urban Development Cooperation
CPHEEO	Central Public Health Environmental Engineering Organization	IAA	Impact Assessment Agency
CRSP	Centrally Sponsored Rural Sanitation Programme	ICAR	Indian Council of Agricultural Research
CSD	Commission on Sustainable Development	ICFRE	Indian Council of Forestry Research and Education
CSE	Centre for Science and Environment	ICPC	Indian Centre for Promotion of Cleaner Technologies
CSO	Central Statistical Organization	IDRC	International Development Research Centre
CSWCRTI	Central Soil and Water Conservation Research and Training Institute	IFA	Indian Forest Act
CZA	Central Zoo Authority	IGCC	Integrated Gasification Combined Cycle
DM	Dutch Marks	IIP	Index of Industrial Production
DoAC	Department of Agriculture and Co-operation	IMD	Indian Meteorological Department
DoFW	Department of Family Welfare	IPCL	Indian Petrochemical Corporation Limited
DoT	Department of Tourism		
EIA	Environmental Impact Assessment		
EMS	Environmental Management System		

Acronyms	Abbreviations	Acronyms	Abbreviations
IPM	Integrated Pest Management	NIUA	National Institute of Urban Affairs
IPNS	Integrated Plant Nutrient Supply	NLCP	National Lake Conservation Plan
JFM	Joint Forest Management	NO _x	Nitrogen dioxide
JNU	Jawaharlal Nehru University	NRAP	National River Action Plan
kWh	Kilo Watt Hour	NRSA	National Remote Sensing Agency
LPCD	Litres Per Capita Per Day	NSSO	National Sample Survey Organization
LPG	Liquefied Petroleum Gas		
MHA	Million Hectare	NWC	National Water Commission
MINARS	Monitoring of Indian National Aquatic Resources	NWMC	National Waste Management Council
MNES	Ministry of Non-conventional Energy Sources	NZC	National Zoological Collection
MoA	Ministry of Agriculture	PAHs	Polycyclic Aromatic Hydrocarbons
MODVAT	Modified Value Added Tax	Pb	Lead
MoEF	Ministry of Environment and Forests	PCCs	Pollution Control Committees
		PKM	Passenger Kilo Meter
MoF	Ministry of Finance	RGNDWM	Rajiv Gandhi National Drinking Water Mission
MoI & B	Ministry of Information and Broadcasting	RPM	Respirable Particulate Matter
MoPNG	Ministry of Petroleum and Natural Gas	SC	Supreme Court
		SDNP	Sustainable Development Networking Programme
MoRD	Ministry of Rural Development	SIAM	Society of Indian Automobile Manufacturers
MoST	Ministry of Surface and Transport		
MoUAE	Ministry of Urban Affairs and Employment	SII	Sanders International Incorporation
MoWR	Ministry of Water Resources	SO ₂	Sulphur dioxide
MRTP	Monopolies and Restrictive Trade Practices Act	SOM	Soil Organic Matter
MSW	Municipal Solid Wastes	SOTER	Soil and Terrain Database
MT	Million Tonnes	SPCBs	State Pollution Control Boards
MTOE	Million Tonnes of Oil Equivalent	SPM	Suspended Particulate Matter
MW	Mega Watt	TERI	Tata Energy Research Institute
NAAQM	National Ambient Air Quality Monitoring Network	TKM	Tonne Kilo Meter
NAEB	National Afforestation and Eco-development Board	TPPs	Thermal Power Plants
NBSAP	National Biodiversity Strategy and Action Plan	TRYSEM	Training of Rural Youth for Self-Employment
NCERT	National Council of Educational Research and Training	TSDF	Treatment, Storage, and Disposal Facility
NCR	National Capital Region	TWh	Trillion Watt-hour
NCT-Delhi	National Capital Territory-Delhi	UNDP	United Nations Development Programme
NEAA	National Environmental Appellate Authority	UNEP	United Nations Environment Programme
NEERI	National Environmental Engineering Research Institute	WHO	World Health Organization
NGOs	Non-Governmental Organizations	WII	Wildlife Institute of India
NIP	New Industrial Policy	WTTC	World Travel and Tourism Council
		YAP	Yamuna Action Plan
		ZSI	Zoological Survey of India



Components of the National SoE

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Chapter name

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- Industry
- Institutional mechanism and environmental policy
- Conclusions and recommendations

- Human development

- Energy sector
- Tourism
- Natural disaster

- Agriculture
- Land degradation

- Biodiversity

- Air pollution

- Management of fresh waters

- Solid waste management

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Organisation

- Central Pollution Control Board
- Central Pollution Control Board
- Ministry of Environment and Forests
- Ministry of Environment and Forests
- Ministry of Environment and Forests
- Central Water Commission
- Central Water Commission
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