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Integrating environment, ecology and climate change concerns in the Indian fiscal federalism framework

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ABBREVIATIONS

APDRP	Accelerated Power Development and Reforms Programme
AQI	Air Quality Index
ATC	Aggregate Technical and Commercial
BIS	Bureau of Indian Standards
BOD	Biological Oxygen Demand
CAF	Compensatory Afforestation Fund
CAMPA	Compensatory Afforestation management and Planning Authority
CEA	Central Electricity Authority
CHT	Canada Health Transfer
CIL	Coal India Limited
CMIE	Centre for Monitoring Indian Economy
CMNA	Coal Mines (Nationalization) Act
CMNPP	Common Minimum National Action Plan for Power
CPCB	Central Pollution Control Board
CSS	Centrally Sponsored Schemes
CST	Canada Social Transfer
Cus	Conservation units
DDI	District Level Indicator
Discom	Distribution Company
DO	Dissolved Oxygen
DSSAT	Decision Support System for Agro-technology Transfer
EKC	Environmental Kuznets Curve
ENRM	Environment and Natural Resource Management
ENSO	El Nino Southern Oscillation
EPI	Environmental Performance Index
EPRI	Electric Power Research Institute
EPS	Environmental Protection Services
ESD	Environmentally Sustainable Development
FC	Finance Commission
GDP	Gross Domestic Product
GDSP	Gross State Domestic Product
GEMS	Global Environment Monitoring System
GIS	Geographical Information System
GIST	Green India
HDI	Human Development Index
ICAR	Indian Council of Agricultural Research
ICMS	Imposto sobre Circulacdo de Mercadorias e Services
kV	Kilovolt
LPG	Local Public Goods
MINARS	Monitoring of Indian National Aquatic Resources System
MMDR	Mines and Minerals Development and Regulation
MW	Mega Watt
MYT	Multi Year Tariff
NAAS	National Academy of Agricultural Science
NAMP	National Air Quality Monitoring Programme
NAP	National Afforestation Programme
NAPCC	National Action Plan on Climate Change

NBSS&LUP	National Bureau of Soil Survey and Land Use Planning
NBSSLUP	National Bureau of Soil Sciences and Land Use Planning
NCL	Northern Coalfields Limited
NDC	National Development Council
NELP	New Exploration Licensing Policy
NEP	National Environment Policy
NHT	Natural Heritage Trust
NOX	Nitrogen Oxides
NPG	National Public Goods
NPV	Net Present Value
NRAA	National Rainfed Area Authority
NRCP	National River Conservation Plan
NRM	Natural Resources Management
NRSA	National Remote Sensing Agency
NSDP	Net State Domestic Product
NTFP	Non Timber Forest Product
NTPC	National Thermal Power Corporation
NWQMP	The National Water Quality Monitoring Programme
O&M	Operations and Maintenance
OIDB	Oil Industry Development Board
ONGC	Oil and Natural Gas Corporation Ltd.
ORAQI	Oak Ridge Air Quality Index
OVL	ONGC Videsh Limited
PESA	Panchayat Extension to Scheduled Areas
PSC	Production Sharing Contract
RH	Relative Humidity
RPO	Renewable Purchase Obligation
RSPM	Respirable Suspended Particulate Matter
SAIL	Steel Authority of India Limited
SECL	South Eastern Coalfields Limited
SERC	State Electricity Regulatory Commission
SLR	Sea Level Rise
SO_2	Sulphur Dioxide
SPCB	State Pollution Control Board
SPM	Suspended Particulate Matter
SST	Sea Surface Temperature
SWM	Solid Waste Management
T&D	Transmission and Distribution
TDS	Total Dissolved Solids
UNFCCC	United Nations Framework Convention on Climate Change
VBD	Vector borne diseases
WTGROWS	Wheat Grown Simulator

Overview

The terms of reference (TOR) of the 13th Finance Commission requires that it considers in its recommendations the need to "manage ecology, environment and climate change consistent with sustainable development." This report aims at contributing to this part of the TOR by examining how the Centre- State fiscal architecture needs to be reinforced to promote more environmentally sustainable development in India.

The importance of the concept of sustainable development is that it underscores the significance of the environment, along with progress on economic and social indicators, for sustained well-being improvements. In India, the National Environmental Policy (NEP) 2006 points to the consensus around the concept through its three foundational aspirations: first, that human beings should be able to enjoy a decent quality of life: second, that humanity should become capable of respecting the finiteness of the biosphere; and third, that neither the aspiration for the good life, nor the recognition of biophysical limits should preclude the search for greater justice in the world. (p. 2)

Two divergent principles are associated with the concept of sustainable development, with different connotations to the basis of policy-making: strong sustainability and weak sustainability. Strong sustainability, with roots in the biocentric system of values, denies to a greater extent the substitutability between natural assets and other assets, a possibility recognized by the theory of weak sustainability. The principles of weak sustainability would allow, for example, the investment of resource rents into the build up of human and physical capital so that the overall capital base and thus future productivity levels, can be maintained. Policy implications for sustainable development arise from the above-mentioned challenges and the two basic requirements associated with the concept: an integrated development process that simultaneously takes the environment, economy and society into account, and a process of development that does not compromise either intra- or inter-generational well-being.

Climate change poses a key challenge to sustainable development. It is a challenge as it has implications to sectors central to improving the well-being of the poor: food, energy and water; and has the potential to create multiple stresses over the stresses that already exist. The debate around climate change does sometimes tend to become too much of an environmental discourse, and yet quite clearly it is the one issue that, because of the nature of economic and social risks that stressed ecosystems will pose, needs an integrated sustainable development perspective.

Achieving sustainable development also requires good health. Human health cannot be maintained without environmental quality and life support systems. Assessments done by the WHO indicate that environmental factors are responsible for over 25% of the global burden of disease. The large scale utilization of traditional fuels not only has environmental implications but also poses a significant burden on the economy in terms of ill health associated with it and higher opportunity costs. Environmental protection services, viz. services that have a direct bearing on the environmental conditions and therefore health and well-being of citizens living in an area can range from water supply, sanitation provision, solid waste management, maintenance of green spaces in cities, and access to clean energy for cooking and lighting in homes.

Achieving and managing sustainable development and federalism: the ongoing debate

The federalism debate as it relates to environmental policy and management is no longer about centralization versus decentralization. All tiers of government have important and often very clear roles to play in the provisioning of public goods and services. The role of central government with regard to the environmental regulation requires assuming responsibility for those activities that have important environmental "spill over effects" across jurisdictional boundaries and that of a basic research function. State and local governments, would set standards for environmental quality and services, subject to minimum levels set by the central Government, and would design and implement programs to attain these standards for matters that are exclusively (or at least predominately) have "local concern".[1] The general principle of prescribing the provision of public goods and services to the smallest political/administrative jurisdiction where the cause lie and the impacts are manifest, and which has the necessary capacity to address the causes and impacts, has been accepted widely. In Europe, it is known as the "principle of subsidiarity", and, as such it is enshrined in the Maastrict Treaty for European Union. It likewise permeates a wide range of constitutional provisions, judicial decisions and legislative measures in United States.[2] Applying this to the case of environmental management, this principle of fiscal federalism points to a regulatory structure in

[1] Oates, 1998
[2] Ibid

which decentralized levels of government take responsibility for those dimensions of environmental quality that are contained within their jurisdictional boundaries. India's NEP 2007 sets forth the Principle of Decentralization, i.e. *"…ceding or transfer of power from a Central Authority to State or Local Authorities, in order to empower public authorities having jurisdiction at the spatial level at which particular environmental issues are salient, to address these issues"*.

The key arguments for greater decentralization are that it would:[3]

- Address issues relating to sustainable development which involve an understanding of the "span" of public goods and services that are provided or need to be provided.
- Allow for the involvement of local jurisdictions in addressing environmental issues, many of which are confined to these jurisdictions
- Allow for more voice and participation in the design of programmes and enable feedback for fine tuning of policies.
- Make clear jurisdictional responsibilities for enforcement and service. But this requires that the lower tiers have the capacity to carry out the responsibilities.
- Result in better informed policy because of greater proximity and knowledge of local needs by State and local governments as compared to central governments. This will also reduce the asymmetry of information and result in flexible policies that can respond to changing environments.

Despite these arguments, the literature tends to be ambiguous on the ability of decentralized institutions to deliver. The issues of concern relate to (i) the "race to the bottom" thesis, (ii) the capacity of state and local government to enforce rules and manage as required, and (iii) the proximity of those governing and the governed that can result in negative outcomes which are self-serving. [4] The "race to the bottom" thesis argues that state and local governments may reduce environmental standards in order to attract more investment to the region. Fredriksson, et al. (2006) present developing country evidence on the environmental policy effects of federalism. Their research suggests that decentralized institutions in an environmental context lead to weaker environmental policy because of greater competition by capital owners and workers. Their work does

[3] Rao 2000, Oates 2001, Bagchi 2003, Boadway and Shah 2007, Kaul et al. 2003

[4] See Oates,2001, Frederiksson, et al. 2006, S Gupta,2001, Mandal and Rao, 2007

suggest, however, that with increased openness to trade, the race to the bottom thesis is weakened.

Gupta (2001) finds that there is not enough evidence to support or reject the "race to the bottom" thesis in the case of India. He argues that the competition between states for investment is based on fiscal incentives and infrastructure advantages. Moreover, India's Environment Protection Act, 1986, requires the Central Government to set minimum national environmental standards ("MINMAS"), and State Authorities are empowered to only prescribe more stringent standards than MINMAS.

Devolution of powers needs to be nuanced depending on the goals of government. The case for a more centralized or decentralized approach to achieving environmentally sustainable development (ESD) will really depend on the answers to questions around the following goals of governments[5] : Economic efficiency, political participation and protection of rights.

Management of SD requires rules, mechanisms, processes, and institutions, through which groups articulate their interests, exercise their legal rights, meet their obligations, and mediate their differences on issues that create for sustainable development. Failure of governance to enforce environmental standards, monitor environmental health and development, makes such development unsustainable. While the state is the prime player in the management of SD, since it establishes the policy and legal regime, it cannot be the sole province of the state, as other organizations, both in the private sector and in civil society, also have an important part to play. However, the responsibility of developing a legislative framework to address the challenges of sustainable development is with the respective Governments.

Part I: The Environmental and Federal Context in India

Environmental Quality and Management

Chapter one makes a statement on the environmental quality in India and assesses the relative environmental quality and management in Indian states with respect to four key domains—air, water, land, and forests. Given the concerns with climate change and energy needs, it examines how seriously States are beginning to engage with options that have co-benefits such as use of renewable energy and energy conservation measures.

[5] Inman and Rubinfeld, 1997

According to various studies the annual economic costs of degradation in India range between 3.5%-7.5% of the GDP. Key drivers of environmental degradation are population pressure, urbanization, industrial expansion, consumption behaviour, choice of crops, fuels, and technology. It is evident that the EQ across India varies considerably and on various environmental quality parameters states can and should be doing much more. There is no doubt that a number of the existing environmental rules and policies, if better enforced, would considerably reduce environmental degradation in the country. For States and local governments to be more effective, they have to receive greater administrative and financial support and authority. There is also need for developing capability and providing resources to local governments to meet the responsibilities that accompany oversight of resource development. Lack of institutional convergence results in poor coordination; and wrong price signals lead to over- and inefficient consumption as is evident in the use of water, energy, and fertilizers .

Climate concerns

The need to act on environmental issues becomes all the more urgent given concerns of climate change which is expected to affect both human and ecological systems. Given the multiplication of threats that these concerns pose to sustainable development, Chapter 2 reviews current knowledge on potential climate change impacts on India. This review suggests the need for more detailed studies at the State level, but already the need, from what is known, for building adaptation capacity in human and ecosystems. The key challenges of climate change in a federal context will be the need to think beyond spatial borders and yet be local. For effective responses, there is a need to understand the landscape of environmental jurisdictions in the country and the fiscal relations between them.

Environmental Federal Context

The federal features of the Indian constitution provide for multiple tiers of government to be involved in matters of relevance to sustainable development. The analysis in Chapter 3, however, suggests that the distribution of legislative, administrative and fiscal powers between centre and states with respect to environmental matters is often skewed towards the Centre. This bias operates at three levels – firstly, even where certain subjects are under the state list, the states powers are conditional to the power of centre to legislate on the same or another subject, e.g. water. Secondly, in the past items have been removed from the state's domain and been opened to Central intervention by including them in the concurrent list. e.g., forests. Thirdly, residuary power to legislate on any matter not listed under any of the three lists vests with the centre.

A disconnect exists between potential and actual decentralization, not only with respect to Centre and States but states and sub state levels as well. The 73rd and 74th amendments to the Constitution paved the way for greater decentralization by listing down areas in which states could devolve powers to Panchayats and municipalities. However, the states are under no strict obligation to completely devolve functions relating to environmental and natural resource management (ENRM). There are environmental services such as public health and sanitation, sewage and waste disposal, which are managed by local governments. In reality, there is devolution of responsibilities, without the required powers and fiscal autonomy required to fulfil the responsibilities. This is in part because Panchayats do not (yet) have the necessary administrative capacity to take up these responsibilities, but creating such capacity should accompany devolution and lack of it should not be the excuse for delayed devolution.

There are three routes through which funds flow from the centre to the states. The first consists of devolutions made under the recommendations of the Finance Commission. The second category consists of plan grants covering central assistance for state plans as decided by the Planning Commission, as well as the plan grants given by the central ministries for implementation of plan schemes. The third type of grants, which is much smaller in magnitude, essentially consists of discretionary grants given by the central ministries to states on the non-plan side. The XII Finance Commission recommended a grant of Rs.1000 crore for maintenance of forests over the period 2005-10, distributed to states based on their forest area. In addition, the FC has released grants for tackling certain state-specific issues based on representations made by the states. Altogether the XII Finance Commission provided Rs 3910.50 crore for environment- related issues which constituted about 2.74% of total grants-in-aid to states.

Our analysis of X and XI Plan transfers related to the environment suggests that the approach to funding of ENRM is too much of a top down approach and should be used only for those programmes that have clear spillover benefits such the NRCP, the NAP , and for Biosphere reserves. The system of allocations reveals an increase in the discretionary component in Plan grants and using this tool implies that the visibility of the Centre at the State level is increased, and that relatively better off states benefit more from such schemes as they can better match resources.

Lessons for India from the international review

Chapter 4 highlights the different ways in which fiscal transfers have been adopted by different federations incorporating the management and provision of environmental and ecological goods and services in the fiscal federal structure of governance. These clearly vary with the specific type and nature of each country suited to meet the specific characteristics. These country experiences point to some common lessons. It is evident that given the nature of environmental issues the principle of subsidarity is most applicable while considering fiscal transfers for environmental management. One of the major problems associated with centralized provision of ecosystem services is that knowledge about the opportunity costs of protected areas is greater at the local level. Further it is also clear from country cases above that transferring of funds or revenue sharing could generally be based on certain environmental indicators, which vary among countries depending on specific needs and characteristics. These indicators can either be subsumed in the tax devolution formula or form a basis of conditional/ unconditional grants.

Intergovernmental fiscal transfers can be used to address the asymmetrical distribution of benefits and costs across regions and sub-regions, associated with conservation of natural resources. These revenue sharing and transfers are used to serve various purposes. They contribute to the *general financial requirements* of all constituent unit (and local) governments, and can be used to *reduce disparities* in the fiscal means of these governments. Federal governments also use conditional transfers to promote their *policy objectives* with the other tiers of government. Further details on the requisites and the critique of different transfers used internationally to promote ESD are provided in Chapter 4.

Part II: Strengthening centre-state fiscal architecture to promote more environmentally sustainable development(ESD)

Achieving an ESD requires that we aspire to some key outcomes. This study suggests the following: Enhanced air, water, and land quality; increased water availability ; increased eco-system services; reduced carbon emissions from energy use; protection of critical socio-ecological resources; enhanced resilience of population vulnerable to climate change and universal access to minimum environmental protection services for health and well-being.

The centre-state architecture needs to be reoriented to help achieve these outcomes. The key aspects of this reorientation are:

- A differentiated devolution, based on goals of governance, with the involvement of multiple tiers of governments with clearly delineated responsibility
- Institutional strengthening at state and local levels to (i) Enable SPCBs to efficiently discharge the mandated functions specified under the Water, Air and E(P) Act and Rules there under(ii), and have own revenue sources for local governments
- The strategic use of intergovernmental transfers to produce desired outcomes: where public goods or bads spill across jurisdictions; where states and local bodies do not have adequate resources or capacities for improved environmental management; to incentivize more innovative approaches to environmental management; to reward good environmental performance ,and to help equalize the delivery of minimum environmental protection services across States
- Adhering to the "precautionary principle" and the "polluter pays principle" and addressing failures: market, policy, and governance

Environment linked transfers

Given the environmental and federal context of India discussed in Part I, the study recommends that centre-state fiscal architecture should be designed so that it: **"rewards environmental performance", "creates incentives for improvements in key areas", "builds resilience to climate change impacts" and "assists local bodies to improve the delivery of minimum environmental protection services."**

In order to ensure environmental sustainability, and to help further the objectives of the NEP 2007, the IEP, and the NAPCC, it becomes important to assist States to use environmental and energy resources in a more sustainable manner. In the Indian context this means that a proportion of total grants-in-aid could be kept aside *for environmental and ecological management* to be disbursed to the state and local governments. This would internalize the externalities of environmental degradation in various cost computations and provide incentives to improve the natural resource base in the states. Therefore, the aspects of equity and efficiency that have shaped the approach followed by the Twelfth Finance Commission would be equally applicable in case of environment-linked transfers from the centre to the lower tiers of the government. These transfers would need to be cognizant of the fact that states have different environmental (along with fiscal) capacities and needs, as well as inherent differences in the cost of providing environmental services. However, while deficiency in environmental (and fiscal) capacity needs to be redressed, deficiency in environmental (and revenue) effort should be effectively discouraged.

Study proposals

More specifically, the study suggests the following:

(i) **Grants for rewarding environmental performance of states**. Untied, block grants – to states as a reward for management of environmental quality as well as for increased penetration of renewable sources of energy and reduced aggregate technical and commercial (ATC) losses

The grant can be allocated based on Environmental Performance Indices (EPIs). The study proposes two EPIs:

- EPI1 captures effort over time to manage the quality of resources, viz. air, water, and forests based on national standards
- EPI2 captures effort to respond to energy concerns based on State's own existing commitments and obligations.

Chapter 5 describes how the EPI1 and EPI 2 can be constructed with examples for the period 2001/02 - 2005/06. To arrive at the grant allocations for rewarding performance, standardized shares of states can be computed using the index values for a particular state and the sum of index for all other states. An indicative amount of Rs.2000 crores can be allocated for the purpose of rewarding States: Rs.1500 crores for environmental quality management; and Rs.500 crores for addressing energy concerns. Performance awards can be given twice during the Finance Commission's award period. The year for the first assessment can be 2012 with 2010 as base year, and the second assessment year can be 2014, using 2012 as the reference year.

(ii) **Grants for building capacity to address climate change in States**. The Eleventh Five-year Plan and the National Action Plan on Climate Change announced in 2008 state that development is the key adaptation measure for India. Hence, incorporating adaptation strategies in development policies, in other words climate-proofing development, is imperative to reduce the vulnerability of India to climate related risks and impacts. Chapter 6 proposes block grant of Rs. 2500 Crores to set up a State Climate Adaptation Fund to build capacity to address climate change in states. Such a Fund should have a preventive rather than a post facto approach and initial disbursement across states could be based on relative vulnerabilities and coping capacities of the states. An amount of Rs. 100 crore could be disbursed to all states as seed money to develop their own State Action Plans for Climate Change in line with the NAPCC. These Plans should be prepared in a period of 2 years, specifying the key areas of concern, and adaptation measures to be adopted by the state. The State Climate Adaptation Fund could be accessed by States to finance the priority areas identified in the Plans of each state. It should support the creation of adaptation facilities and not just rehabilitation of affected population. The amount suggested here will not be enough to address the problems that are anticipated, and this can be revisited by future Finance Commissions based on new knowledge at the time. The Fund should be a non lapsable Fund, as is the Calamity Relief Fund (CRF) and ring fenced.

At the State level, the work can be coordinated by state level committees, headed by the Chief Secretary of the state and other officials (normally connected with relief work and experts in various fields). Such a committee could also take up monitoring of adaptation related expenditures in the state, studying the progress in the previous year, and ensuring the expenditure is on items for specifically enhancing adaptation capabilities of the states or any other guidelines in this regard which may be issued.

(iii) **Specific Purpose Grants for the provision of minimum environmental protection services.**
Chapter 7 discusses the need for some support through fiscal transfers for the services that local bodies are required to perform that have a relationship with the environment and have implications for health and human well-being such as (i) water supply, sanitation, solid waste management and storm water drainage and (ii) the provision of cleaner energy for cooking for households dependent on traditional biomass. (iii) provision of cleaner energy for lighting for those dependent on kerosene.

Despite the fact that there have been numerous schemes since independence to ensure universal coverage of basic services, this has still been elusive. Most local bodies have very poor revenue generating capabilities to meet O&M costs. This could also be the reason why universal coverage is still elusive in India. Specific purpose grants can be used for bridging the gap in service provision by augmenting budgets of local bodies for such services. It is assumed that the various central programs such as Bharat Nirman and Plan programs in rural areas and JNNURM in urban will create some of the capital assets that are needed to extend coverage in rural and urban areas respectively. It is important that these assets created belong to the Gram Panchayats. Over time, the O & M should be borne through local bodies raising own resources. However, a one-time grant can help local bodies tide over their limited resources, augment their revenue raising capabilities and strengthen their financial capacity. The grant amounts suggested here are towards stimulating local bodies in urban and rural areas to ensure that they are able to do their part in providing minimum environmental protection services to all and stimulating the use of clean energy for cooking and lighting. However, these grants should only bolster the service provision and not undermine or substitute a state's/local body's resource generating potential. Conditionality is important to judge future allocation of grants to states. Money in the ensuing periods should only be released to those states that achieve a certain minimum requirement as laid down by the FC and monitored, and where it can be certified that requisite infrastructure has been provided.

We estimate the following grant requirements:

- Water supply and sanitation: Using the coverage estimates from Census 2001 and the norm as 100% coverage for water supply and sanitation, we find there is a resource gap of Rs.27,642-29,392 crores per annum that needs to be met towards O & M costs of water supply and sanitation services. The Finance Commission can consider meeting part of this need, say 25%, or Rs.6,910.5 – 7,348 crores per annum
- Clean energy for cooking: The Finance Commission could consider assisting households below the poverty line (about 44 mn households) who are dependent on traditional biomass to make the transition to clean energy.[6] A grant of Rs. 8800 crores to States would be needed to facilitate the transition.[7] Despite their importance on environmental health and improved fuel efficiency grounds, and in spite of government support, the improved cookstove initiatives and the biogas programmes have not been as effective in addressing the problem of providing more efficient and clean cooking options as anticipated. Urgent interventions and investments are needed to address issues around technical, social and environmental parameters of these stoves. This can be addressed through the innovation fund, discussed in chapter 8, and also through a concerted action with Gram Panchayats to help increase adoption rates.
- Incentivising the transition from kerosene to solar lanterns: We estimate that Rs. 500 crores will be needed

[6] The Integrated Energy Policy suggests that clean cooking energy such as LPG, NG, biogas or kerosene should be available to all within 10 years.
[7] TERI estimates indicate that the annualized cost (device / connection cost plus fuel cost) of clean cooking energy options (improved biomass stoves, biomass gasifier stoves and subsidized LPG) range from around Rs 1500 to Rs 2500 per household.

to work with Gram Panchayats to set up solar lantern charging stations.

(iv) **Grants to incentivise actions to improve environmental and ecological management.** Chapter 8 highlights the need of States to prepare an environmental strategy supported by time bound action plans. In addition we identified a number of issues and areas that states and local bodies need to address in order to improve the state of their environment and should be addressed in their environmental strategies. These include:

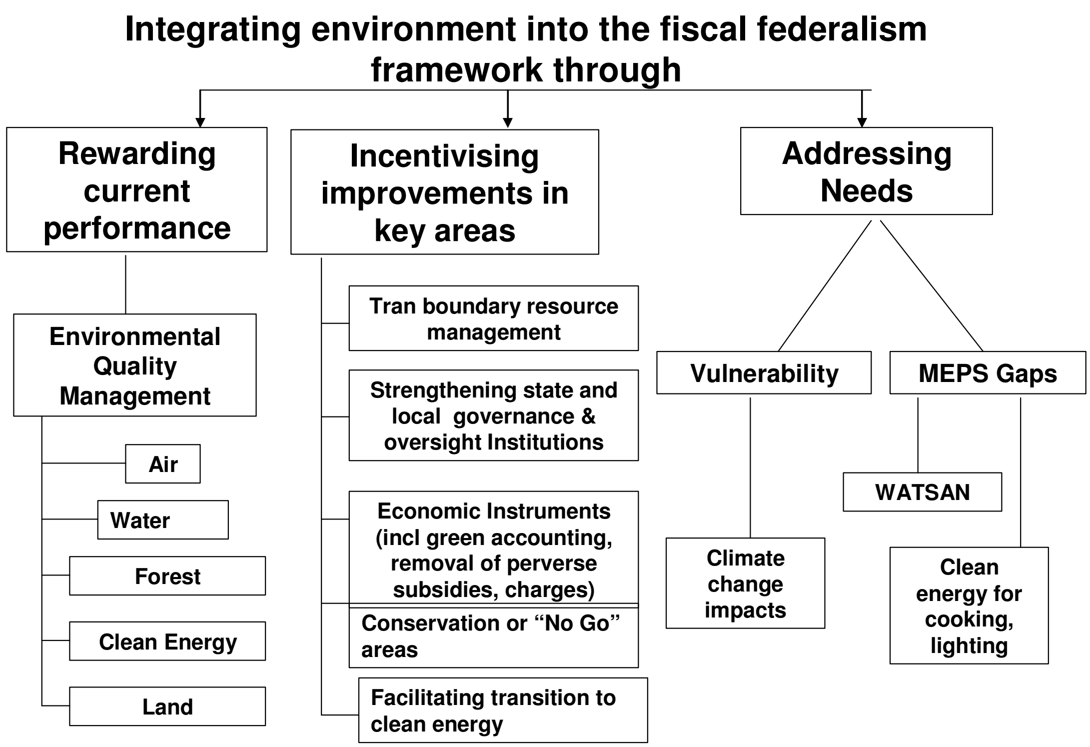
i. Strengthening environmental governance institutions at State and Local levels
ii. Use of economic principles in environmental decision making (such as rationalization of prices of natural resources and use of economic instruments for pollution abatement)
iii. Identifying "No Go" areas in states
iv. Inter-State cooperation to address trans-boundary and shared resources & eco-system management. This is especially important for addressing water quality and flow problems.
v. Incentivising energy efficiency improvements through improved regulation and price signals as suggested by the IEP, 2006 and the BEE.
vi. Facilitating the creation of a market and a platform for trade in renewable energy credits to increase the share of renewable energy based grid interactive power.
vii. Providing a seed grant to set up an innovation fund the focuses on technology development of off grid resources - biogasifiers, micro hydro, hybrids, wind, to assist and facilitate technology extension from the lab to markets. This Fund can also support R & D in improved cook stoves. This fund could then leverage venture capital, social investment funds etc.

The Finance Commission could incentivize this process through a grant of Rs. 5,000 crores towards the setting up of a non lapsable National Environmental Fund. The Fund can be overseen by an independent body such as the Inter-state Council. It is important that this fund be non-lapsable and the initiative be sustained by future Finance Commissions for this system of incentives and rewards to succeed in bringing all States on par. As these incentives strengthen environmental governance in states and bring them at par, the need for such incentives should reduce over time, so that eventually grants could be linked entirely to a more comprehensive index of environmental performance. Our recommendations and suggested grants are summarized in Box 1 and Figure. These grants amount to Rs. 11,160 crores per year.

Box 1: Summary of grant proposals (Rs. Crores, 2010-2015)

Rewarding environmental performance	4000
Building resilience to climate change	2500
Water, sanitation, etc	35000
Clean energy for cooking	8800
facilitate solar lantern use	500
Incentivising Environmental actions	5000
Total	55800

Figure 1



Structure of the report

This report is in 2 parts. Part I examines the context- environmental quality and management in Indian States (Chapter 1), climate change concerns in India (Chapter 2), the federal system in India as it applies to environmental issues (Chapter 3) and how other federal systems treat environmental issues (Chapter 4). Based on the analysis in Part I, Part II focuses on ways in which the Finance Commission could use intergovernmental transfers to manage ecology, environment and climate change consistent with sustainable development. It does this through examining the basis of grants to reward environmental performance of States (Chapter 5), address climate vulnerabilities (chapter 6), provide minimum environmental protection services (chapter 7) and ways in which States and local bodies can be incentivised towards improved environmental and ecological management (chapter 8).

PART I: THE ENVIRONMENTAL AND FEDERAL CONTEXT IN INDIA

Part I

The terms of reference (TOR) of the 13th Finance Commission requires that it considers in its recommendations the need to "manage ecology, environment and climate change consistent with sustainable development." This report aims at contributing to this part of the TOR by examining how the Centre- State fiscal architecture needs to be reinforced to promote a more environmentally sustainable development in India. The objective of the study is "to assess ways in which intergovernmental transfers can be used to manage environment, ecology and climate change concerns consistent with sustainable development. To address the objective, the study involved the following:

(i) Understanding the political economy of center-state resource transfers around environmental and natural resource issues;
(ii) Reviewing the experience of other federal governments that use fiscal transfers as an instrument for internalizing environmental and social externalities from natural resource use and building resilience to climate change, if any;
(iii) Developing an index of environmental performance that gauges the efforts of states towards achieving environmental objectives and based on the above, develop an appropriate methodology for the allocation of grants to states and
(iv) Examining the merits of a climate change response fund and recommend principles for disbursing grants from such a fund

The methodology involved an analysis of relevant national Acts and laws, cases, and Constitutional provisions, fiscal and other policy documents, earlier studies and reports on federalism and fiscal federalism in India; review of material and records of previous studies on the issue in other countries especially in federal democracies and reports of the Finance Commissions; consultations with experts and key decision-makers; analysis of data on various environmental and energy sector parameters at the level of states; construction of Environmental Performance Indexes (EPI1 and EPI2) and an indicative Climate Change Vulnerability and Coping Capacity index for Indian states; an assessment of funds required to provide minimum environmental protection services, and finally, an identification of key areas for incentivising improved environmental performance by States

In this Part of the report, we examine the context- environmental quality and management in Indian States

(Chapter 1), climate change concerns in India (Chapter 2), the federal system in India as it applies to environmental issues (Chapter 3) and how other federal systems treat environmental issues (Chapter 4). Based on the analysis in Part I, Part II focuses on ways in which the Finance Commission could use intergovernmental transfers to manage ecology, environment and climate change consistent with sustainable development.

CHAPTER 1 Environmental quality and management in India

Economic growth is most often accompanied by environmental degradation, as the processes of industrialization, urbanisation and consumption lead to depletion of natural resources, pollution, generation of wastes, and loss of ecosystem health.[8] As India globalizes, new aspirations are created, with new demands and changing preferences putting more, not less, pressure on resources and on the environment.[9] The reconciliation of economic growth with environmental sustainability lies at the core of the environment - development debate and it is important to understand the orientation of industrial and urban policies and their implications to sustainable development. There have been several studies that have sought to provide more 'correct' estimates of GDP in India by taking into account the impacts on the environment and the loss of the natural resource base in the process of creating value. These studies peg the annual damage costs in the range of 3.5-5.5% of India's GDP.[10] Needless to say that these studies provide only a conservative estimate of the costs of degradation in the country not being exhaustive of all natural resources in their scope.

The key environmental concerns in India relate to air, water, land and forests and result from the drivers mentioned above, growing population pressures, poor land use practices and overexploitation of groundwater.[11] There are also a number of more local environmental problems such as indoor air pollution emanating from smoky kitchens that use traditional biomass, and from inadequate clean drinking water and sanitation facilities. This chapter discusses environmental quality and management in the Indian states focussing on key domains—air quality, water (quality & availability), forest cover, land quality and energy usage. The resource quality indicators ascertain the state of the resource and thereby the state of environment; while energy usage is included given that fossil fuel use contributes to the key environmental concern of climate change. The chapter also makes a short comment on local

8 ecosystems are considered to be healthy and functioning if they actively maintain their organization, connectivity and autonomy over time and are resilient to stress, Constanza, 1995. see also Millennium Ecosystem Assessment accessible at (http://www.millenniumassessment.org/en/Framework.asp)
9 See The Global Environmental Outlook 2007, p 45 for a summary of the risks and opportunities that globalization creates for the environment
10 The TERI study came up with slightly higher estimates since it also included the costs of indoor air pollution, which is a significant cause of mortality and morbidity in the economically weaker sections of rural and urban India.
11 See: various SOE reports of the CSE (http://www.cseindia.org), Pachauri and Sridharan 1998, Guha, 2006, chapter 2; Rangarajan, 2007

environmental concerns such as access to clean water, sanitation and clean energy for cooking and lighting, and concludes with some key observations.

The objective of this analysis is to assess how states are doing with respect to the various national standards on environmental quality and highlight both drivers of environmental change as also the reasons for non-compliance by the states. Table 1.1 provides a summary of the indicators considered and rationale for their selection.

Table 1.1 Environmental Quality Management Indicators

	Indicators	Rationale / comments
Air	SPM, SO_2, NO_x concentration Exceedence indicator for RSPM	RSPM-caused by anthropogenic factors, higher health implications Exceedence – captures compliance vis-à-vis CPCB standards
Water	Exceedence indicators for BOD, total coliform (surface) Exceedence indicators for nitrates, total dissolved solids (groundwater)	Caused by anthropogenic factors Exceedence - captures compliance vis-à-vis CPCB norms (surface), BIS (groundwater)
Forest	Forest cover as a proportion of total geographical area Dense forest as a proportion of total forest area	Provides an extent of forest in the state Quality of forests, ecosystem services
Land	Area (%) of degraded land	Status of degraded land which will respond to management
Energy use (proxy for carbon concerns)	Energy efficiency: ATC losses incurred in Discoms of the State Renewable energy: Percentage of achievement of Renewable Purchase Obligations (RPOs) set out by the SERC	Reduction in ATC losses is an important measure of state level energy conservation effort Indicates efforts towards the use of more sustainable energy systems

Air

Urban air quality has been a concern, given the developmental path India has been following over the years. Increased vehicular fleet, industrial expansion and lack of effective enforcement mechanisms have all contributed towards rising pollution levels in almost all Indian cities. The National Air Quality Monitoring Programme (NAMP) periodically monitors four major criteria pollutants—nitrogen dioxide (NO2), sulphur dioxide (SO2), total suspended particulate matter (SPM) and respirable suspended particulate matter (RSPM[12]). Under the ambit of the above programme, monitoring of pollutants is carried out for 24 hours (4-hourly sampling for gaseous pollutants and 8-hourly sampling for particulate matter) with a frequency of twice a week, to obtain 104 observations in a year. The collected data are then collated for all the operating stations spread across India and compared to the desired ambient air quality standards to gauge the status of air quality levels prevalent in different cities.

[12] Particulate matter of size less than 10 microns

Air quality trends

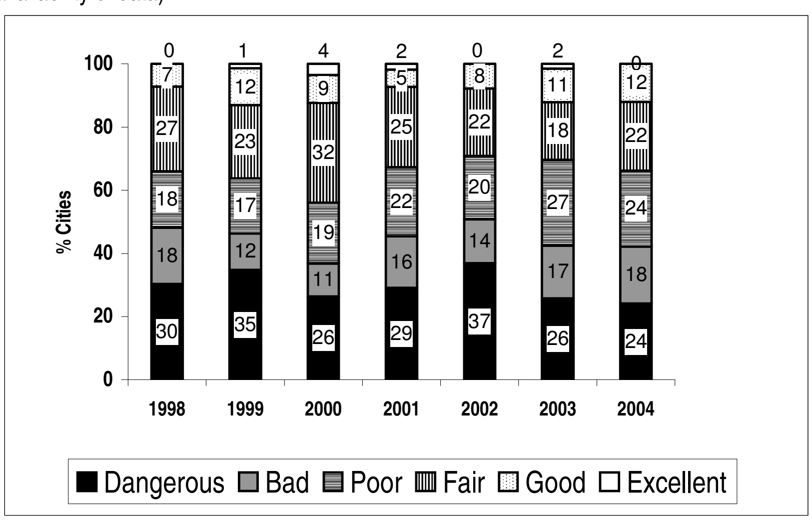
Of the criteria pollutants measured, the past decade (1997-2006) witnessed SO2 levels below the average residential standards set by CPCB in most cities; NOx concentration levels however were found to approach the standards in many cities. The situation in case of particulate matter however was grim. The SPM and RSPM levels in most cities remained above the prescribed limits. Highest average SPM concentrations during the past decade were observed in northern cities-Agra, Kanpur, Delhi. RSPM levels were highest for Gobindnagar, Ludhiana, Ghaziabad, Jalandar and Agra.

The higher SPM levels often are due to geographical location (in North India for instance higher SPM levels are due to natural dust), which are difficult to manage. In case of RSPM however, the higher levels are largely anthropogenic[13] with higher health implications. Therefore to gauge the state of the environment, RSPM concentration in various cities can be taken as an indicator for measuring air quality. Its deviation from the prescribed standards can reveal the extent of the problem and the potential that can be addressed. To collate the available information on various air quality parameters an Air Quality Index can also be evolved. The advantage of using this index is that it reduces large quantities of data to its simplest form while retaining all the essential information (Refer to Box 1.1).

Box 1.1 Air Quality Index (AQI)

On the basis of available air quality data an air quality index for different pollutants can also be ascertained which can give an overall indication of the state of the resource. TERI has used the ORAQI (Oak Ridge Air Quality Index) developed by Oak Ridge National Laboratory (refer to Annexure 1.1) for the three pollutants SO_X, NO_X and SPM to gauge air quality.

It can be seen that the percentage of cities under the 'dangerous' category varied between 16-37% (Figure below) amongst all the cities analysed (which varied annually due to the non-availability of data).



Air quality in Indian cities during 1998-2004
Source TERI (2006)

Comparing air quality across locations: rationale for use of exceedence indicator (RSPM)

Air quality levels are location specific and therefore gauging it at a city or state level has several limitations. Taking a simple average of the pollutant concentrations at various stations to arrive at the state of the resource would hide the magnitude of the problem. To overcome this, an exceedence indicator seems more appropriate. (See Annexure 1.2 for details). States such as Goa, Tamil Nadu have most of their stations complying with prescribed RSPM standards, while others such as Bihar, Punjab, Nagaland have no station complying with the standards (Figure 1, Annexure 1.2).

The following issues however must be noted while interpreting the exceedence indicator:

- **Infrastructure**: in several states the compliance is dependent on the number of stations. For instance if a state has say 3 monitoring stations , if 2 falter on meeting desired standards the performance is much lower compared to the state with several stations. Some states such as Meghalaya/ Nagaland therefore which have very few stations may show high/low performance based on air quality levels from limited locations.
- **Site selection**: The CPCB prescribes guidelines for the site selection. There always remains a probability that the chosen site may not depict the correct representation of the air quality levels given that it is a location-specific issue.
- **Geographical and climatic factors** may also impact air quality levels of a particular region. For instance, Rajasthan may have higher particulate matter primarily on account of it being a desert while coastal cities/states may have better air quality due to seas-wind breeze effects.

Water

Water availability

Water, one of the most crucial ingredients of sustainable human development has increasingly becoming a scarce commodity due to over exploitation of the resource (Figure 1.1). The increasing demand for water for multiple uses primarily in agriculture for irrigation, industry and for domestic consumption has been in excess of the limited supply implying less is available for sustenance of individual needs. Indicators of water stress and scarcity are used to reflect the overall water availability in the country. When the availability falls below 1000 m^3 it is know to be a situation of water scarcity. In case of

India the annual per capita water availability stands at 1050 m^3 making India a water stressed country.

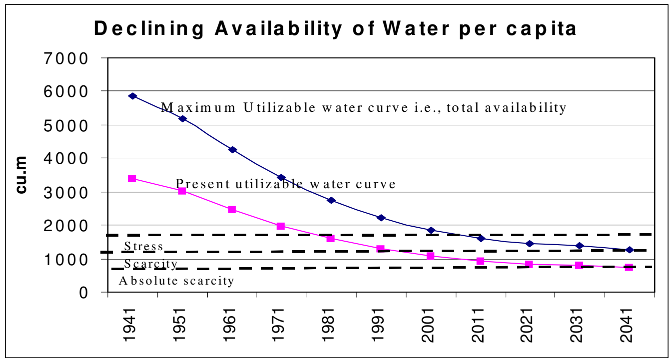


Figure 1.1 Annual per capita water availability in India

SOURCE: TERI 2006

Pricing of water is one of the most important reasons for its overuse. Surface irrigation water is provided on the basis of water charges per hectare by crop grown and water is not charged volumetrically (Pangare et.al[2]), hence the farmer has no incentive to conserve water use as the marginal cost of applying additional quantities of water per hectare is zero. In the domestic sector, a very small part of the O & M costs are recovered; while in rural areas with poor access to water, the problems are very different. There is evidence of high costs, in terms of effort, time and money to ensure access to water. TERI 2002[14] and Parikh et. al. 2003[15] indicated that women and girls spend up to 3-4 hours a day in collecting water from distances of up to 6 kms. This has implications for their ability to obtain productive work and get educated.

Groundwater tables have also been over exploited as seen from the declining water table levels. In Punjab alone groundwater in about 60% of the blocks was being or very near to being overdrawn (World Bank 2005). For Haryana and Tamil Nadu the figure stood at 40%. The over exploitation of groundwater aquifers has been attributed by many studies to resource mismanagement due to several factors. First, lack of coordination amongst institutions at different tiers of the government. The roles and functions are often overlapping resulting in ambiguity in delivering the services. Second concern relates to organisational vacuum in planning at the state level. While water is a state subject, there exist only a few

14 TERI 2002: Impact of population on water and the quality of life (Project Report 1999RD42) submitted to United Nations Population Fund
15 Toll on human resources due to lack of lack of energy, water, sanitation and their health impacts in rural North India by J K Parikh, V Lakshmi, S Karmakar and B Dabrase in Boiling Point No 49, 2003

states that have enacted laws/framed policies on water resources. Third, irrational pricing that has aggravated the problem of ground water depletion. In agricultural sector for instance, subsidised inputs and products have promoted crop choices independent of the resource endowments (for instance cultivation of water intensive crops in drought prone areas) (Figure 1.2).

Distorted water pricing for industry perhaps remains most startling. The Water (prevention and control of pollution) cess Act (amended in 2003) provides water at 30 paise per kilolitre to some industries that then sell this water after processing (as bottled water and beverages) at over 300 times that rate (at over Rs. 10 per litre). Abysmally low water tariffs have not only contributed to inefficient water use but also in misuse as in the case of water being used to dilute effluent discharge (which is monitored only on the basis of concentration). Estimates by CSE[16] indicate that water consumption in industries in India is several times the global best practice. Apart from the skewed policies, the role of local bodies has also been limited due to lack of adequate financial, managerial and technical capacities.

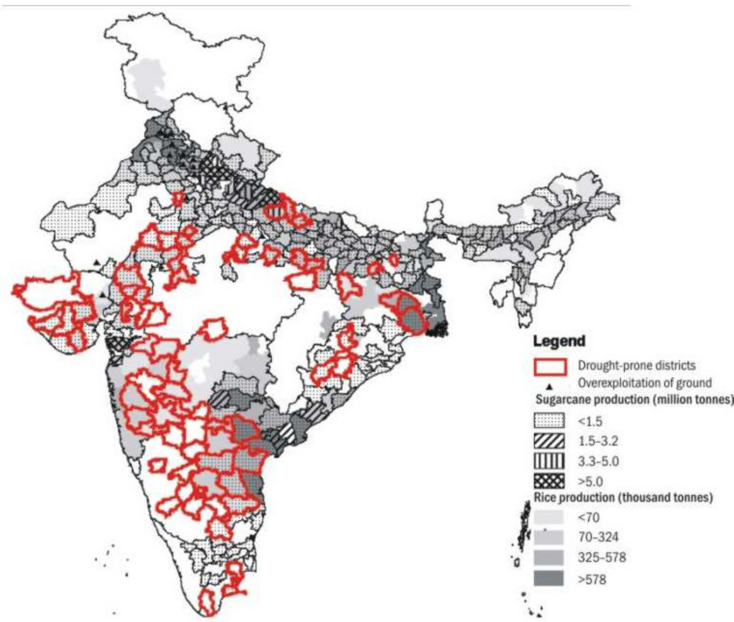


Figure 1.2 Cultivation of water intensive crops in drought prone districts in India

SOURCE: TERI 2006

16 http://www.cseindia.org/dte-supplement/industry20040215/misuse.htm accessed on April 7 2009

Measuring water quality: indicators

Surface water quality

Water quality can be defined from the user's point of view as "those physical, chemical or biological characteristics of water by which the user evaluates the acceptability of water". The rational for this definition is that for water to satisfy any of the uses, it should have some predefined degree of purity. To monitor the level of pollution prevailing in different water sources in India, the Central Pollution Control Board (CPCB) has established a network of monitoring stations (1245) across the country under the National Water Quality Monitoring Programme (NWQMP). Water quality assessment is benchmarked against CPCB's designated best use classification[17]. Annexure 1.3 outlines the different designated best uses and the criteria for the evaluation of samples.

One of the key causes of water pollution in the country remains overexploitation of the resource which reduces the river flows. In many river stretches there are almost no-flow conditions prevailing for 8-9 months in a year. In this situation, discharging wastewater even after treatment may cause serious water quality problems. The other important issue relates to pathogenic pollution caused due to discharge of untreated wastewater generated from human settlements which has direct implications for human health. One major reason for this situation is that municipal authorities charged with collection and treatment of wastewater have insufficient resources for the same.[18] Besides the above, increased salinity due to irrigation activities or seawater intrusion in coastal areas also impairs water quality (CPCB 2008).

The trends in some of the water quality parameters are used to assess the state of the resource. The past decade has witnessed an increasing trend for BOD levels[19], an indicator of deteriorating water quality (Figure 1.3). Another indicator for ascertaining water quality is coliform level that indicates probable presence of disease-causing organisms (pathogens) in the water system. The presence of pathogens in drinking water causes water-borne diseases such as typhoid, cholera,

17 Defined as "use that demands the highest quality of water amongst its several other uses". The evaluation of water samples is done according to four parameters- Biological Oxygen Demand (BOD), Dissolved Oxygen (DO), pH and Total Coliform. The samples are then classified according to different designated best uses based on their conformity with the norms outlined for each designated best use.
18 B Sengupta, CPCB, Note to Task force 6 of the Committee on Centre-State Relations, 2009
19 Biological Oxygen Demand (BOD) is a chemical procedure for determining how fast biological organisms use up oxygen in a body of water. Since wastewater typically contains high amount of organic matter, a high BOD level would typically indicate contamination of water due to the mixing of domestic untreated wastewater.

dysentery, polio and hepatitis (CPCB 2002).[20] Statistics reveal that about 15% of the total riverine length had high pollution (BOD > 6 mg/l) levels in 2004 (TERI 2006).

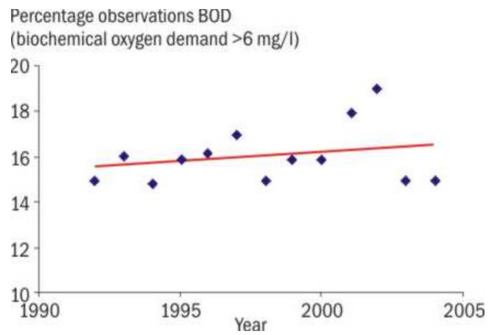


Figure 1.3 Biological oxygen demand levels in surface water

SOURCE: TERI 2006

Comparing water quality across locations: compliance indicator

The overall surface water quality can be adjudged in a river by evaluating levels of water quality parameters BOD and Total Coliforms, (which indicate pollution largely due to anthropogenic sources)[21], against the CBCB's Class "C" norm of designated best use classification. The Class C norm is considered as a benchmark as it provides an indication of the minimum requisite water quality standards for drinking water. It can be seen from Figure 2 in Annexure 1.2) that states such as Rajasthan and Tripura have higher compliance levels compared to Maraharshtra and Haryana that do not have any station complying with the standard. The interpretation should however be considered in the light of the fact that the issue of water quality is location specific, depending on the site selected. Further, in states with few monitoring stations, full compliance may imply good water quality only at a few specific locations and may not be representative of the water quality of the entire state.

Groundwater quality

The groundwater quality is assessed based on the presence of various pollutants. These include inorganic constituents which may be caused due to natural and/or anthropogenic factors. The results of a survey on water quality affected habitations undertaken for the Bharat Nirman Programme reveals that presence of iron in groundwater remained in high proportions in several states (Assam, Bihar, Orissa, West Bengal, Karnataka, Chhattisgarh), followed by fluoride, multiple causes, salinity, nitrate and arsenic levels. Almost 53% of the habitations

20 Water Quality in India- Status and Trends (1990-2001), Monitoring of Indian National Aquatic Resources, CPCB, 2002.
21 In the rural areas however the presence of BOD and Total Coliforms could be due to non-anthropogenic sources.

surveyed were found to be affected by high iron levels in ground water (Figure 1.4). Contamination by fluoride was in about 15% of the habitations.

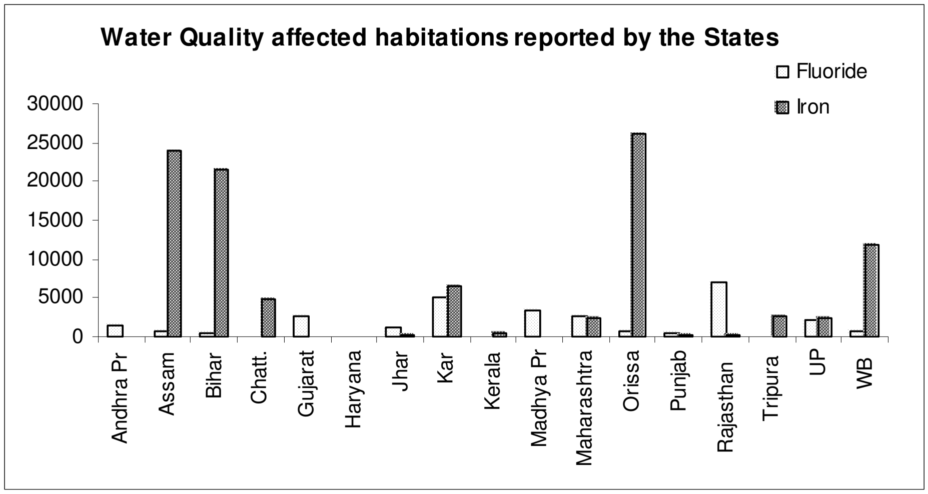


Figure 1.4 Number of habitations affected by fluoride and iron

SOURCE: Based on survey ordered in March 2000 and updated by states in Bharat Nirman Action Plan as on 31/03/2006.

To assess the ground water quality for different states two indicators, presence of nitrates and total dissolved solids (TDS)[22], which reflect the extent of anthropogenic activity are considered. The amount of dissolved solids in a water source reflects contamination due to industrial and domestic wastes, agricultural pesticides and other contaminants. The presence of nitrates is indicative of the impact of anthropogenic activity on water resources. It includes the impact of leaching of fertilizers and nitrification (Water Aid and British Geological Survey)[23].

As in the case of surface water, drinking water quality norms mandated by the BIS in IS:10500 are used as a threshold of quality. Figure 3 in Annexure 1.2 depicts the number of monitoring stations that satisfy the threshold levels with respect to groundwater quality in the year 2005. It can be seen that Meghalaya and Tripura have good groundwater quality in 2005. However, none of the stations located in Madhya Pradesh, Rajasthan and Tamil Nadu conformed to the norms.

22 TDS indicates the presence of bicarbonates, carbonates, sulphates, chlorides, nitrates and phosphates of calcium, magnesium, sodium, potassium, etc in water
23 http://www.indiawaterportal.org/data/res/Groundwater%20Quality-South%20India.pdf, accessed on 6th June, 2008

Caveats

The caveats for the above analysis are similar to those for air quality.

- Site selection: Given that water is a location specific issue there remains a probability that the chosen site may not depict the correct representation of the state for water quality.
- Data availability: For many north-eastern states data is not available.

Forests

The competing demand for land resources under the growing population pressure, urbanisation trends have resulted in changes in land use with area under forests declining. While in the past decade the forest cover has stabilised the degradation of the resource continues. The 1988 Forest Policy mandates increasing of the country's forest cover to 33% overall and 67% in hilly areas.

Currently, India's forest cover is around 21%, and clearly large areas of additional land needs to be brought under forest cover to achieve the national target. However, the policy target does not have a well-established scientific basis; neither can it be translated to the level of state-specific targets. States like Rajasthan, Punjab and Haryana would probably never be able to reach anywhere near the national target due to their agro-ecological condition. Large parts of Himachal Pradesh and Jammu and Kashmir are under permanent snow cover and cannot support vegetation. In this respect, to ascertain the state of the resource, while maintenance or enhancement of forest cover is relevant its linkage with the policy target would not be appropriate.

State of forests

Estimates of forest cover changes are strictly meaningful only for data of the 2001, 2003 and the most recent 2005 assessments of the Forest Survey of India, which use the same scale of interpretation. Comparison with earlier data could lead to erroneous estimates of forest cover changes, since previously existing smaller forest patches would now (post-2001) get recorded as forest due to improvements in the scale of interpretation, while smaller blank areas within forests that were earlier included in forest cover would now get left out. Mizoram, Nagaland, Arunachal Pradesh fare better on the indicator on forest cover as percentage of total geographic area. Particularly it needs to be noted that the north eastern states are relatively better placed compared to other states in 2005. (Figure 4, Annexure 1.2).

Measuring ecological services: issue of forest quality

While establishing a clear functional relationship between type of forest cover and their ecological services is difficult, forest cover of higher density, in general, is expected to provide relatively larger amounts of key ecological services such as watershed and biodiversity. As per the Report submitted by Chopra Committee[24], on an average, 45% of the Net Present Value (NPV) is due to watershed services, 26% due to carbon services and 12% due to ecotourism. In other words, 83% of the NPV is attributed to these three forest services. (The Report does not provide numerical estimates for other forest services such as biodiversity and cultural/spiritual values). Forest goods (timber, fuelwood, fodder and NTFPs) together account for the remaining 17% of the NPV.

It can be argued that a unit increase in dense forest cover, providing relatively higher amounts of ecological services, would be of larger significance as compared to a similar increase in open forest cover, since ecological services contribute much more to the value of forests as compared to goods. Madhya Pradesh has the highest total forest cover in the country whereas Arunachal Pradesh has the highest dense forest cover. Also, Arunachal Pradesh, Sikkim and Uttarakhand, have over 75% of forest cover as dense (Figure 5, Annexure 1.2).

Land

Quality of land is complex, varying in spatial and temporal dimensions. Its deterioration involves a diversity of biophysical as well as socio-economic factors[25]. Defined as a long-term decline in ecosystem function and productivity (Bai et al 2008), decline in land productivity could be reversible or irreversible depending upon the causative factors and the magnitude of degradation. The most obvious manifestations of land degradation are declining soil quality, changes in the water terrain, and other biotic resources, which ultimately result in the loss of biological and/or economic productivity of the land resource (MSSRF &WFP 2004). Apart from reduced productivity, the consequences of land degradation also include migration, food insecurity, damage to basic resources and ecosystems, and loss of biodiversity through changes to habitats at both species and genetic levels. Abrol and Sehgal (1994) also

24 The Report of the Expert Committee on Net Present Value (Kanchan Chopra Committee) submitted to the Supreme Court in 2006 works out per hectare NPV of forest goods/services for five Circles of Himachal Pradesh.
25 ftp://ftp.fao.org/agl/agll/ladadocs/theme1.doc, accessed on 18 July 2008

opine that soil degradation affects global climate through alterations in water and energy balances and disruptions in cycles of carbon, nitrogen, sulphur and other elements.

Degraded lands that can be brought under vegetative cover with reasonable effort, and which are currently under-utilized have been referred to as wastelands in India (e.g. Government of India, 2005). Wastelands are categorised as lands that are deteriorating for lack of appropriate water and soil management or on account of natural causes, and can result from inherent or imposed disabilities such as location, environment, chemical and physical properties of the soil or financial and management constraints. However, the term wastelands is a "misnomer" since it is a "term loosely used to define degraded lands including those under permanent snow cover, water bodies etc." (Sehgal and Abrol, 1994). There is nothing like a "wasteland" since each unit of land has its own potential use and many of such lands have customary users with own ancestral rights.

Measuring land degradation

Degradation of land resources is generally triggered by excessive pressure on land to meet the competing demands of the rapidly growing population for food, fodder and timber. There exist a range of estimates on extent of degraded land area varying between 63 million hectares and 187 million hectares arrived at through different definitions and methodologies rendering them incomparable in both stock and flow parameters. The two data sets that are most commonly used for studying the land quality issues in India are the Wasteland Atlas –Government of India (1986-00 and 2005) and NBSSLUP (2005)[26]. Given the need for harmonized estimate of wastelands and degraded lands, which respond to management interventions necessary for macro and micro level planning. National Academy of Agricultural Science (NAAS) of India initiated a rationalizing and harmonizing activity to arrive at a common estimate based on various datasets. The initiative combines important criteria from both the Wastelands Atlas of India and NBSS&LUP data in addition to others to arrive at a harmonized dataset for the country (Annexure 1.4 for details). Accordingly, land degradation is about 120 million hectares (NRAA, ICAR, NRSA and NAAS 2008)[27] with water erosion being a significant contributor (Figure 1.5)[28].

26 http://www.indiastat.com/india/ShowData.asp?secid=422354&ptid=51&level=3
27 For details refer to Annexure on Land
28 For details refer to Annexure 1.4

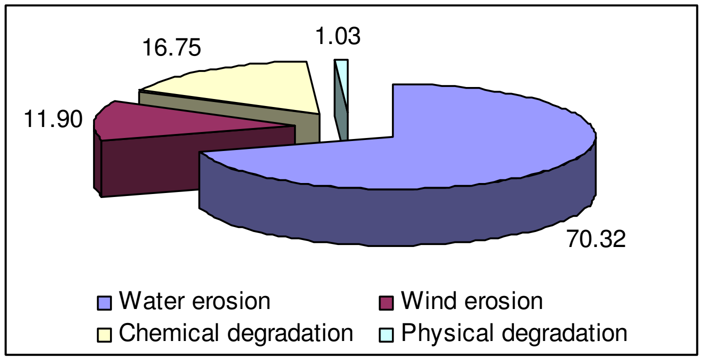


Figure 1.5 Percentage of arable land degraded under different degradation categories

SOURCE NRAA, ICAR, NRSA and NAAS 2008

An indicator that can be used to gauge land degradation at the state level is the extent of land area affected (by water and wind erosion, chemical degradation and physical degradation) as a percentage of total geographical area of the state. To make this indicator a positive one, i.e. to show the land area not affected by degradation due to the above reasons in each state, one minus the percentages thus derived can be calculated.

The 10 states with the least amount of degraded land (as a percentage of total geographical area of the state) include Sikkim, J&K, Punjab, Haryana, Gujarat, Himachal Pradesh, Delhi, West Bengal, Orissa and Arunachal Pradesh. (Figure 6 in Annexure 1.2).

Issues

Using state level indicators for land quality is fraught with several considerations. These include:

- Definitional issues: in terms of classification of land as degraded
- Area under a state: changes in land area under states on account of new states being formed
- A combination of factors affects the increase or decease of degraded area of a state. However, factors such as that of degraded forestland and water erosion emerge as the key factors.

However, given the importance of land and soil management, this is a key attribute of environmental quality of states that needs to be measured, monitored in order to improve management.

Waste management

Increased rates of urbanization as well as the changing lifestyles have resulted in increasing municipal waste generation in India that has more than doubled in the past decade (1997-2007). With low collection efficiency, further aggravated by low transport efficiency managing waste remains an issue of concern. High levels of hazardous waste in the country also pose a serious concern. India generates about 4.4 million tonnes per annum of hazardous waste a number much higher than generation figures of some of the industrialized countries such as Singapore (0.07 million tonnes per annum) and Taiwan (1.5 million tonnes per annum) (MoEF 2000; IGPA 2003)

The informal sector has been involved in undertaking recycling activities, which remarkably influence the waste stream. The average recycling rate for plastics and metals wastes in India is as high as 70%, compared to relatively lower rates in developed countries such as Germany (47.3%), Japan (53%), and the USA (30%). The local recycling market in India has been growing at a rate of 12%–15% annually (IGES 2004).

Municipal waste: data issues

Since municipal waste is largely an urban issue, the available data on Municipal Solid Waste (MSW) generation is for a few major cities in India. Using this data as representing a particular state would be misleading. In this case therefore to gauge the performance of states, it is crucial to compare the waste generation with waste management indicators. As a state even with high generation of waste, might be able to dispose and manage the waste in an efficient manner thus performing better than a state with lesser generation but poor management practices. In wake of the lack of data available for depicting the management aspects of waste, such an analysis could not be carried out. In addition, there is a need for performance monitoring and benchmarking for MSW to facilitate comparison between states, none are available at present though some baseline norms exist for design of collection and disposal systems.

Local environmental services

There are grave inter-state and rural-urban inequalities in access to basic amenities needed for good environmental health. The Census 2001 provides data at the state-level for rural and urban households on parameters such as access to water, drainage and sanitation (Figures 1.6 and 1.7). Service provision in rural areas is abysmally low compared to urban areas. Proportion of households fetching water from far away[29] ranges from about 5% in Punjab to 38% in Mizoram in rural areas as per 2001 census data. Majority of rural households do not have access to toilets – 95% in Chhattisgarh, 93% in Jharkhand, 92% in Orissa and 91% in Madhya Pradesh. The North-eastern states fare better than most other states in this regard with approximately at least 50% of the households having access to toilets. In most states more than half the households in rural areas have no access to drainage. Chhattisgarh has nearly 89% households without access to drainage. In urban areas, access to basic services is much better than in rural areas with at least 80% of household in all states having access to water supply and less than 50% of the households with no access to drainage or toilets.

In rural India about 126 million households rely on biomass as the primary energy source for cooking compared to 13 million biomass dependent households in the urban agglomerations (NSSO 61st round 2004-05)[30] Using the data from the National Sample Survey Organization, India (NSSO 63rd round, 2007), it was found that 65 million households in India still use kerosene for lighting.

It may be noted that while in many states infrastructure for basic environmental services exists (Tables 1.2 and 1.3), the problem of lack of service delivery persists.

29 Over 100 m in case of urban areas and over 500m in case of rural area (Twelfth Finance Commission Report pp.155)
30 Data accessed from NSSO 61st round available at http://www.mospi.gov.in/mospi_nsso_rept_pubn.htm.

Table 1.2 Proportion (%) of households (rural area)

	Dependent on traditional biomass for cooking *	with toilet facility	With drainage	with access to drinking water	using electricity for lighting*
Andhra Pradesh	80.4	18.1	41.4	76.9	84
Arunachal Pradesh	82.7	47.3	26.1	73.7	59.1
Assam	92.4	59.6	15	56.8	30.3
Bihar	83.2	13.9	34.9	86.1	10.1
Chhatisgarh	94.7	5.2	11.3		61.9
Goa	24	48.2	33.2	58.3	99.9
Gujarat	74.2	21.6	13.6	76.9	80.2
Haryana	75.6	28.7	71.7	81.1	89.7
Himachal Pradesh	76.2	27.7	30.8	87.5	97.6
Jammu & Kashmir	83.5	41.8	26.8	54.9	97.3
Jharkhand	83.8	6.6	17.7	35.5	26
Karnataka	89.7	17.4	35.4	80.5	86.2
Kerala	79.1	81.3	16	16.9	79.4
Madhya Pradesh	94.5	8.9	19.8	61.5	69.2
Maharashtra	75.2	18.2	41.1	68.4	76.2
Manipur	79.7	77.5	32.8	29.3	87.3
Meghalaya	96.2	40.1	26.3	29.5	51.3
Mizoram	69.6	79.7	24.8	23.8	85.4
Nagaland	65.3	64.6	38.6	47.5	97.4
Orissa	85.5	7.7	14.8	62.9	31.5
Punjab	64.7	40.9	78.1	96.9	95.5
Rajasthan	94.4	14.6	23.2	60.4	47.2
Sikkim	57.1	59.3	31.6	67	94.1
Tamil Nadu	80.9	14.4	27.4	85.3	84.6
Tripura	91.6	77.9	23.7	45	69.1
Uttaranchal	79.1	19.2	34.9	83	67.3
Uttar Pradesh	93.2	31.6	65	85.5	24
West Bengal	76.9	26.9	15.9	87	34.2

"Source: Census 2001 accessed from indiastat.com; *NSSO 61st round (data for 2004-05)
Descriptor category (excluding biomass dependency): Red colour indicates >50% households without access to that amenity; Yellow indicates 25-50% without the amenity and green indicates <25%. In case of biomass dependency red depicts more than 50% depend on biomass for cooking."

Table 1.3 Proportion (%) of households (urban area)

	Dependent on traditional biomass for cooking *	with toilet facility	With drainage	with access to drinking water	using electricity for lighting *
Andhra Pradesh	30	78.1	82.3	90.2	94.9
Arunachal Pradesh	24.8	86.9	63.3	90.7	95.7
Assam	27.3	94.6	52.6	70.4	86.2
Bihar	29.9	69.7	68.6	91.2	73.8
Chhatisgarh	38.4	52.6	63		93.2
Goa	9.4	69.2	69	82.1	97.9
Gujarat	14.8	80.5	78.3	95.4	95.8
Haryana	18.2	80.7	88.4	97.3	95.5
Himachal Pr	7.3	77.2	86.1	97	87.7
Jammu & Kashmir	17.5	86.9	81.8	95.7	97.1
Jharkhand	13.1	66.7	72.4	68.2	87.1
Karnataka	23.7	75.2	81	92.1	95.9
Kerala	48.4	92	30.9	42.8	93
Madhya Pr	39.4	67.7	75.9	88.6	96.4
Maharashtra	13.8	58.1	87.6	95.4	95.7
Manipur	30.8	95.3	57.1	59.4	95.1
Meghalaya	15.2	91.6	76.7	73.5	98.5
Mizoram	11.1	98	63	47.8	99.7
Nagaland	11.9	94.1	72.2	42.3	99.4
Orissa	38.4	59.7	57.5	72.3	81.3
Punjab	12	86.5	89.8	98.9	97.8
Rajasthan	40.6	76.1	80.2	93.5	89.5
Sikkim	0.4	91.8	94.2	97.1	99
Tamil Nadu	21.9	64.3	70	85.9	94.6
Tripura	40	97	53.1	85.8	91.7
Uttaranchal	21.9	86.9	88.2	97.8	94.3
Uttar Pradesh	34.5	80	92.4	97.2	84.4
West Bengal	13.1	84.8	67.1	92.3	87.3

Source: Census 2001 accessed from indiastat.com; *NSSO 61st round (data for 2004-05)

Descriptor category (excluding biomass dependency): Red colour indicates >50% households without access to that amenity; Yellow indicates 25-50% without the amenity and green indicates <25%. In case of biomass dependency red depicts more than 50% depend on biomass for cooking.

Energy and sustainable development

In order to attain its developmental goals, India needs to grow at a fast pace for which energy remains an integral input. Figure 1.8 compares countries on energy consumption levels vis-à-vis HDI (human development index) values. It can well be seen that energy remains a crucial linkage for development.[31] India's Integrated Energy Policy lays down a vision for providing an energy secure future to all citizens, which would require not only reducing vulnerabilities to supply disruption but also ensuring that minimum, lifeline energy needs of vulnerable households are met and energy used and supplied is in an environmentally sustainable manner.

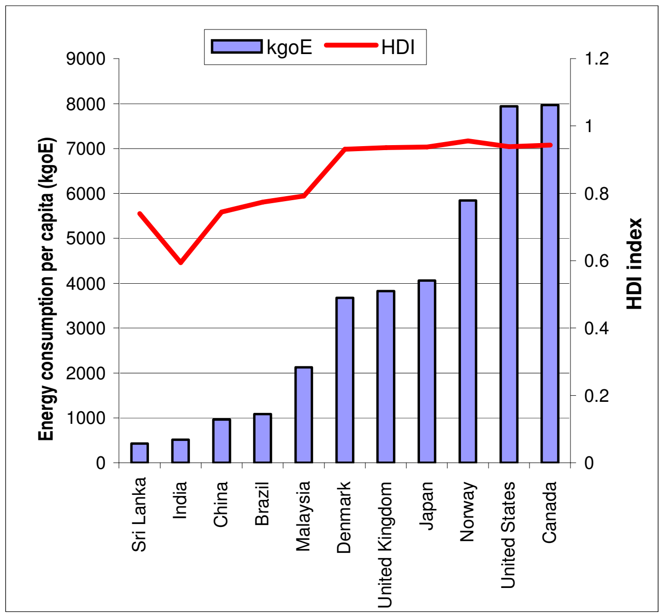


Figure 1.6 Energy use and HDI link

SOURCE: WORLD BANK 2005; UNDP 2005

Given the country's developmental goals, it is estimated that in order to maintain 8% GDP growth scenario, India's total energy requirement would be in the range of 1536-1887 mtoe (million tonnes of oil equivalent) by 2031 (Planning Commission 2006). It can be seen that a considerable proportion of the energy requirements would be met through the usage of coal and oil, which has implications for the environment. While India does not have a carbon reduction target under the UNFCCC, it has, through its National Action Plan on Climate Change, put

31 The inclusion of this graph is not to make a case for a similar consumption as the developed countries for India and other LDCs, as that level is probably an over consumption, but just to highlight that energy is crucial for human development.

forward measures by way it seeks to control its future carbon emissions in order to contribute to addressing climate change concerns.

A set of energy indicators that address social, economic and environmental dimensions can be used to track status.[32] On the social dimension indicators on equity (accessibility e.g. share of households without energy access) can be considered. These are discussed above and in Chapter 7 on access to minimum environmental services where access to clean energy remains crucial. On the economic dimension, energy usage and energy productivity (intensity of energy) can be computed to assess sustainability. The energy intensity of a state is energy consumption per unit of state domestic product i.e. mtoe (million tonnes oil equivalent) per billion Rupees. Interpretation of this indicator, however, should be done carefully as structure of the state's economy can be a significant factor (e.g. large scale processing activities in a state would lead to high energy intensity while service sector activities would be relatively less energy intensive). Further, within the above dimension an issue that needs discussion is that of energy pricing, which remains a barrier to implementation energy efficiency measures. The electricity in India is priced much lower than the full cost of production, imposing environmental externalities. The existing pricing policy has given way to perverse incentives. Subsidised electricity results in wasteful use of energy and related resources such as groundwater.

The energy intensity in Indian states is depicted in Figure 7 in Annexure 1.2. Meghalaya is seen to be the most energy intensive among states. This result is quite contrary to the results for other north-eastern states such as Arunachal Pradesh, Assam, Mizoram, Manipur and Nagaland, all of which consume significantly less energy per unit of SDP. A closer look at the data shows that in 2005/06 Meghalaya consumed 5.6 million tonnes of raw coal classified under the head 'others'. This is the primary reason for the state's high energy intensity. The other energy intensive states were Chhattisgarh, Orissa, Jharkhand and Madhya Pradesh. All of these states have high coal consumption due to the pithead power plants and/or steel plants located there. These states have a comparatively lower SDP as well, which contributes to their appearing at the top of the list in terms of energy consumed per unit SDP.

To address energy and future carbon concerns, the supply side options in this regard include movement away from fossil fuels, towards 'green energy', while the demand side options include enhancing energy efficiency which can reduce the demand for

32 IAEA, UNDESA, IEA, Eurostat and EEA have evolved a comprehensive set of energy indicators for sustainable development.

energy thereby, resulting in less carbon emissions. To measure sustainable energy use by the states, indicators on the extent to which states are adopting renewable energy options and energy efficiency measures are considered.

Renewable energy options

Keeping in view the energy needs in India, renewable electricity is emerging as a win-win option since it is both non-exhaustible as well as carbon free. In India, renewable electricity is generated from sources as diverse as biomass, wind, hydro, photovoltaics, and municipal solid waste. Out of these, wind, hydro and biomass are the main sources of grid interactive renewable power.

As on 31st March 2008, the cumulative grid interactive power generating capacity using renewable energy sources was about 12400.37 MW. Out this total 8757 MW, 2180 MW and 1406 MW generating capacity was accounted by wind, small hydro power; and bio power and bagasse cogeneration respectively. A small part of the generating capacity was accounted by waste (55 MW) and solar photovoltaics (2 MW) also. During the 11th five-year plan period (2007-2012), it is expected that at least 10% of the installed capacity in the country (with 4-5 % share in electricity mix) will come from renewable energy (Approach Paper to the 11th Plan, 2006)[33].

A state wise comparison of renewable energy potential shows that Gujarat has the highest renewable electricity potential amongst all states. This is mainly due to its high wind power potential. Other states with high renewable potential are Andhra Pradesh and Karnataka (Also refer to Annexure 1.5). The installed electricity generation capacity data based on renewable sources, however, reveals a different picture (Figure 1.9; Annexure 1.6). It can be seen that Tamil Nadu had the highest level of renewable based electricity installed capacity as on March 2006 (5.0 GW). Other states with large renewable based electricity installed capacity were Karnataka (4.4 GW) and Andhra Pradesh (4.1 GW).

33 Accessible at http://planningcommission.nic.in/plans/planrel/apppap_11.pdf

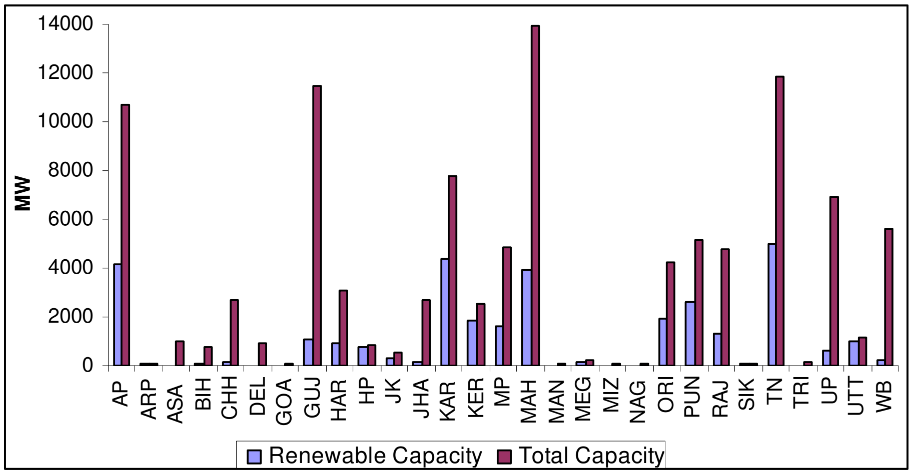


Figure 1.7 State-wise Renewable and Total Installed Electricity Generation Capacity as on 31st March 2006

In order to encourage greater renewable electricity generation in the country and to reach the 10% installed capacity target, the Electricity Act 2003 stipulates that co-generation and generation of electricity from non-conventional sources would be promoted by the State Electricity Regulatory Commissions (SERCs). The Article 86 (1) of the Act mentions that the above function would be discharged by SERCs by ' suitable measures for connectivity with grid and sale of electricity to any person, and also specify, for purchase of electricity to such sources, a percentage of the total consumption of electricity in the area of the distribution licensee'. In addition, the Tariff Policy 2006 mandates that the SERCs should fix a minimum percentage for purchase of energy from such sources taking into account availability of such resources in the region and its impact on retail tariffs.

Subsequent to this mandate, certain SERCs have outlined the proportion of Renewable Purchase Obligations (RPO) that they would be willing to commit to. RPO is a compulsion for the distribution licensees (DISCOMs) within a state to procure a certain percentage of their total power purchase during a financial year from renewable energy sources. The level of RPO is prescribed by the SERC in states is primarily guided by the potential for development of renewable energy sources and their existing utilization within the state and also the proposed/expected investment in building renewable capacities. This issue would be discussed in more detail in Chapter 5.

Aggregate Technical and Commercial (ATC) losses

Aggregate technical and commercial losses (ATC) are defined as the difference between energy input and units of energy from which payment is actually realized. Technical losses occur due to energy dissipation in the conductor and equipments used for the transmission and distribution of power. The losses can be further sub-grouped depending upon the stage of power transformation and transmission system as transmission losses (400kV/220kV/132kV/66kV), sub-transmission losses (33kV/11kV) and distribution losses (11kV/0.4 kV). Specific causes for technical losses include long distribution lines, low power factor loads, inadequate size of conductors, improper locations of distribution transformers, overloading and underloading of transformers. The commercial losses are attributed to theft of energy and defective energy meters.

Estimates reveal that for most states there has been a decrease in the aggregate transmission and commercial losses overtime. Data indicates that the ATC losses in Discoms have fallen from approximately 38% in 2004/05 to 35% in 2006/07 (PFC, 2008). There is however, significant scope for further improvement in this regard.

Technical losses

The technical losses are inherent in a distribution system and can be reduced to an optimum level, reduction in commercial losses however is more a governance issue. A study carried out by the Electric Power Research Institute (EPRI) shows that the losses in the various elements of the transmission and distribution system usually range between 7-15% (Table 1.4).

Table 1.4 Estimates of technical losses

System element	*Power losses (%)*	
	Minimum	*Maximum*
Step-up transformers and EHV transmission system	0.5	1.0
Transformation to intermediate voltage level, transmission system and step down to sub-transmission voltage level	1.5	3.0
Sub-transmission system and step-down to distribution voltage level	2.0	4.5
Distribution lines and service connections	3.0	7.0
Total losses	**7.0**	**15.5**

Source: Bhalla 2000

The Accelerated Power Development and Reforms Programme (APDRP) had been launched by the Ministry of Power in 2002/03 with the objective of improving the financial viability of state power utilities, reduction of ATC losses, improving customer satisfaction and increasing reliability and quality of power supply.[34] The programme aimed at reducing the ATC

34 The Schemes under APRDP were for renovation and modernisation of sub-stations, transmission lines & distribution transformers, augmentation of feeders & transformers, feeder and consumer meters, high voltage distribution system (HVDS), consumer indexing, levels to below 15% in urban and high-density areas. A comparison of the target (15%) with the actual ATC losses incurred shows that the target level is almost half of the ATC losses being incurred currently.

Despite the high amount of funds disbursed, the progress under the scheme is rather slow. The report of the task force on restructuring of the APRDP (Abraham Committee) concluded that poor financial management and unreliable expenditure statements by the states were key factors responsible for the low progress.

Commercial losses

The unmetered supply to the agricultural sector and single point connections by small domestic consumers remain some of the key reasons for commercial losses in the country. In most states, the agricultural tariff is based on horsepower of the motors. Such power loads get sanctioned at the low load declarations but once the connections are released, the consumers increase their connected loads, without obtaining necessary sanction from the utility (Bhalla, 2000).

Annexure 1.7 provides data on the prevailing levels of ATC losses within states. It can be seen that Bihar had the highest level of ATC losses in 2005/06. The subsequent year (2006/07) however the state was able to reduce the loss to a considerable extent. Some of the other states with very high levels of ATC losses were Manipur, Jammu and Kashmir, and Jharkhand.

Main observations

The analysis above suggests that the picture across India varies considerably and that on various environmental quality and service access parameters, states can and should be doing much more. Some of the key issues that need to be addressed include:

Effective enforcement of environmental regulations and policies

Effective rule enforcement remains key to reducing/arresting environmental degradation. There is a very well developed set of environmental laws, rules and policies in the country[35], but there exists evidence that laws and policies are often not enforced or poorly enforced[36]. Weak oversight institutions,

computerised billing etc. Approximately Rs. 2900 crores had been released by the Ministry of Finance under this programme to different states (Refer to Annexure 1.7).

35 For details refer to Chapter 3

36 See for example, Supreme court judgments in Andhra Pradesh Pollution Control Board v. M.V. Nayudu, AIR 1999 SC812, MC Mehta v Union of India AIR 1988 SC1037, Taj Trapezium case, Indian Council for Environmental-Legal Action Vs Union of India: 1996(3)SCC 212, M. C. Mehta v Union of India and Others Writ Petition (Civil) No. 4677 of 1985, dated 11th October, 1996, Almitra.H.Patel and another vs. Union of India AIR 2000 SCW 924. Also see generally, Santhakumar V. (2001), (2003),

inadequate capability and resource availability of the pollution monitoring bodies, and even insufficient monitoring stations remain factors for states not doing well on the environmental dimension. A central issue both from the point of the working of federalism and in terms of the impacts that development can have on the environment and local people is the monitoring, regulation, and enforcement of laws and rules in place.

Lack of institutional convergence and need for institutional strengthening

Lack of institutional convergence further results in high inefficiencies and duplication of efforts. To illustrate, water supply and sanitation are subjects under the purview of various ministries or departments dealing with water, rural development, urban development, local government, health, and even agriculture, because in some rural areas, irrigation schemes and check dams serve, secondarily, as collection points for water used in domestic activities in village households. The result is that there is frequently an overlap of projects and funds that repeatedly attempt to address the same developmental problems.

Many state pollution control boards lack adequate and trained manpower and financial resources for air and water quality monitoring. There is urgent need to develop capability and provide resources to local governments to meet the responsibilities that accompany management of local environmental quality. Lack of financial resources amongst local bodies affects their effective monitoring of water supply resources and sanitation. Improved tracking tools, information base, and incentives for enforcement, compliance and monitoring are key to take this forward.

Wrong Pricing Signals

Environmentally perverse subsidies have proliferated in India, be it in the water or the energy sector. Water subsidies across users is noted as a major factor responsible for diverting resources from new investments in infrastructure and social services, and for contributing to the profligate and inefficient use of the resource. In agriculture, the largest user of water by far, water rates have not been revised to keep pace even with the O&M cost of supply, let alone capital. This, and the continuing laxity in ensuring proper assessment and collection of dues, has led to rapid deterioration in the financial status of public irrigation systems. The magnitude of losses – in relation to full cost of the service provided – is now considerably larger than fresh investments in the sector and an important factor

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Priyadarshini Keren and Gupta Omprakash K. (2003), Sabharwal, YK (2006) contributing to the worsening fiscal health of states (Vaidyanathan, 2005).

The Water (Prevention and Control of Pollution) Cess Act, 1977 amended in 1992 and 2003 provided the central and state pollution control boards with the authority to levy and collect a tax on industries and municipalities using water. It also laid down the minimum level of cess that the states have to charge. The cess is calculated on the basis of the quantity of water consumed. The rates vary between 5 and 30 paise per kiloliter of water consumed (depending on purpose for which the water is consumed) and the central government may exempt industries as it chooses. These rates are abysmally low and provide little incentive for its conservation.

The energy sector is also replete with subsidies. Subsidized electricity is known to encourage profligate use of scarce energy and related resources such as water in agriculture. Taking the case of electricity, the average cost of supply is substantially higher than average realization from sales in all states. There is a significant cross-subsidization in the tariff structure with domestic and agricultural consumers paying less than the average costs while commercial and industrial consumers paying more. This system has continued despite the urgency of reforms expressed in several policy documents. Back in 1996, the conference of Chief Ministers of the States adopted the Common Minimum National Action Plan for Power (CMNPP), which inter-alia reiterated that no sector shall pay less than 50% of the average cost of supply. It was agreed that tariff for agriculture sector will not be less than 50 paise per unit to be brought to 50% of the average cost in not more than three years. Over a decade later, some states continue to provide free power to agriculture. Despite the large subsidies from the state governments, the electricity boards are incurring sizeable commercial losses, to the tune of Rs.26462 crore in 2008-09 up from 25702 in 2007-08 (Economic Survey 2007-08).

Lack of internalisation of environmental externalities

The internalisation of environmental externalities in pricing also remains a key concern. For instance on the aspect of wastewater discharge, industry is required to adhere to certain concentration based wastewater standards with no incentives to reduce the volume of wastewater discharged. On the contrary, this system provides industry an incentive to use more water for dilution before discharge to meet the norms. Rapid urbanization creates the need for increased efforts for augmenting sewage collection and treatment facilities steeply. This may need the application of the "polluter pays" principle in order to generate funds for the task.[37] .

37 B Sengupta, CPCB, 2008

It is evident that much more needs to be done.The need to act on environmental issues becomes all the more urgent given concerns of climate change which is expected to affect both human and ecological systems. In the next chapter, we examine what can be said on this score about climate change in India.

CHAPTER 2 Climate change concerns

This Chapter reviews the literature to highlight some of the key climate change concerns in India. As mentioned in the National Action Plan on Climate Change (NAPCC), there has been an observed increase of ~ 0.4°C in surface air temperatures over the past century, at national level in India. There has also been an observed increasing trend of monsoon seasonal rainfall found along the west coast, northern Andhra Pradesh, and north-western India, while a decreasing trend in monsoon seasonal rainfall has been observed over eastern Madhya Pradesh, north-eastern India, and some parts of Gujarat and Kerala (NAPCC). A number of studies have investigated the impacts of climate change in India. Some of the assessments are summarized in figure 2.1.

The damaging influence of climate change could further be accentuated by the fact that India is a developing country with a medium level of human development and nearly 80% of its population living below $2 per day (UNDP 2007). Climate variability poses as an unprecedented threat to the human security of the poor and marginalized. This chapter discusses impacts of climate change in five sectors in India viz. agriculture, water resources, forests and ecosystems, coastal areas and human health.

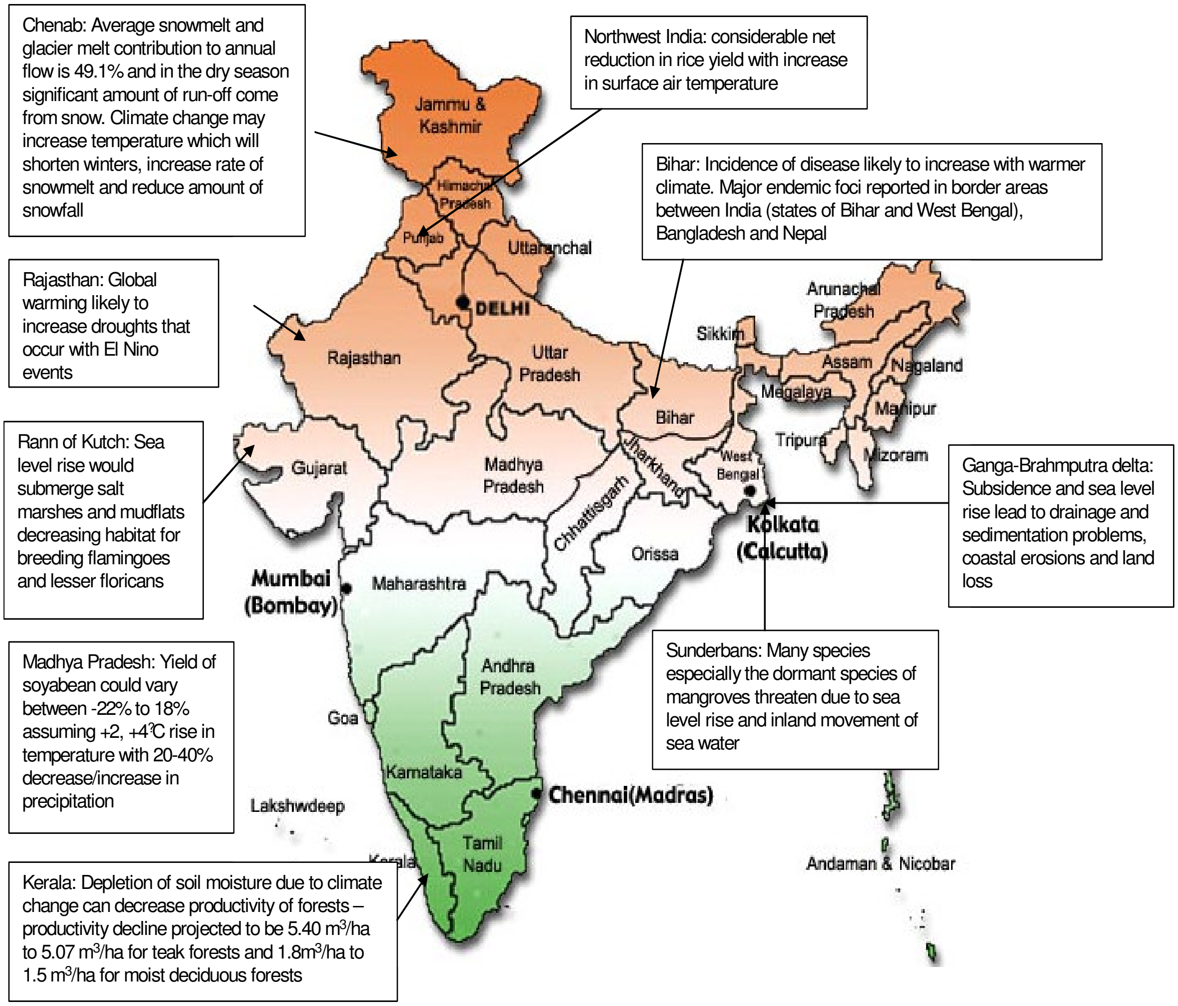


Figure 2.1 Assessment of Climate change impacts on States

SOURCE: HTTP://ENVFOR.NIC.IN/CC/ADAPTATION/IMPMAP.HTM

Potential impacts of climate change in India

Agriculture

In terms of employment and livelihood creation, agriculture is the mainstay of the Indian economy. Though, the share of agriculture in GDP declined from 36.4% in 1982-83 to 18.5% in 2006-07 (Economic Survey 2007-08), the sector employs 52% of the workforce and still contributes significantly to export earnings and provides raw materials for industries. In 2004 India was the second largest producer of wheat (MoEF 2004). Though the net food production rose in the years following the Green Revolution, the food security of India maybe jeopardized in years to come due to the rise in population, which is expected to be 1.6 billion by 2050 (MoEF 2004). Additional concerns like declining growth rate of the sector and irrigation also pose a threat to the food security of India. Though the sector grew at an average of more than 3.5% in the early 1990s, the current average growth of 2.5% post 1997 has raised concerns over the sustainability of the sector to meet future demand. Despite the importance of the sector, the actual net irrigated area in the country is only 43% of the net sown area (Planning Commission 2008) and hence the sector is heavily dependent on rainfall. Threats to food security are further exacerbated by rising environmental degradation, declining soil fertility, changes in water table and degradation of water quality.

In the light of the above, climatic variability can lead to a compounding of the problems plaguing the agricultural sector. The vulnerability of the agricultural sector to climate change has been studied in two ways: (1) the physical impact of climate change and (2) the economic impact. To understand the physical perspectives crop simulation methods have been used to assess the interactive impact of changing temperature, rainfall and CO_2 emissions on agricultural productivity. Assessment of economic model is attempted by a Ricardian approach (see below).

Physical impacts

Climate change impacts agriculture either directly through changes in crop productivity or indirectly by changing factors that play a key role in agricultural production like pest behaviour, irrigation water availability, socio-economic changes etc. Models used for assessing the impacts of climate change on crop growth, productivity and yield are based on the understanding of crop physiology and soil processes. The models commonly employed to study the impact of climate change on agriculture range from Decision Support System for

Agro-technology Transfer (DSSAT) shell to ORYZA for rice and Wheat Grown Simulator (WTGROWS) for wheat (MoEF 2004).

India's Initial Communication to the United Nations Framework Convention on Climate Change (NATCOM) analyses two IPCC climate change scenarios for different years from 2010 – optimistic and pessimistic (Table 2.1) (Government of India 2004a). The pessimistic scenario entails the highest increase in temperature and lowest increase in CO_2 while the optimistic scenario reflects large increase in CO_2 and a small change in temperature, which promote growth. Pessimistic scenario is so called since it is overall detrimental to crop growth. Apart from the direct impact of climate change, climate variability can indirectly also affect agricultural productivity through altering crop-pest interactions, impacting rainfall and changing soil processes. For example, small changes in temperatures can alter the virulence of pests and lead to the appearance of new species of pests in a region (Government of India 2004a). The quality of cotton, fruits, vegetables, tea, coffee, aromatic and medicinal plants could be significantly impacted by climate change. On the other hand the nutritional quality of cereals and pulses could also be moderately altered (Government of India 2004a).

Table 2.1 Impact of climate change on rice and wheat yields

Crop and region	Impact of climate change on yield, %	
	Pessimistic scenario	Optimistic scenario
Rice		
East	2.3	5.4
South	1.3	3.8
North	3	7
Wheat		
North	1.5	6.5
East	-0.3	7.7
Central	-2	6.5

SOURCE: GOVERNMENT OF INDIA 2004a

A study by Indian Agricultural Research Institute (IARI) concludes that a 2°C increase in temperature would reduce wheat yields. Reduction in yields would be greater for rain fed areas than for irrigated areas, and also in warmer areas too. Climate change could result in a shift of regions growing wheat. Rice yields can also be expected to decrease with a 2-4°C rise in temperature with eastern regions being the most impacted.

There have been a host of studies that analyze the impact of climate change on the Indian agricultural sector. Some of the main findings of these studies are presented in Table 2.2. The studies do not provide any unequivocal evidence on the projected impacts of climate change on crop yields. However, most studies conclude that impacts of climate change on kharif crops would very likely be small whereas risks to rabi crops are higher resulting in reduced production (Mall et al 2006a). Mall et al 2006a state that climate change may have a positive impact on food production in India till 2050. However, by 2080, when temperature increases are large, agricultural sector will suffer and food security of India will be greatly undermined.

Table 2.2 Impacts of projected climate change on yield of different crops in India

Crop	Region	Yield impact	Reference
Rice	All India	Increase (regionwise and scenarios based)	Aggarwal and Mail 2000
	North-West, Central	Increase (decrease in North-West)	Rathore et al. 2001
	South	Decrease/increase (scenarios based)	Sasendran et al. 1999
	North-West	Decrease/increase (scenarios based)	Lal et al. 1998
	Punjab	Decrease/increase (scenarios based)	Hundal and Kaur 1996
	All India	Increase	Mohandass et al. 1995
	North	Increase	Achanta 1993
	All India	Decrease	Sinha and Swaminathan 1991
	Northern India	Decrease	Sinha and Nanda 1986
Wheat	North	No impact/decrease (scenarios based)	Aggarwal 2003
	North-West	+ 16 to + 37%	Attri and Rathore 2003
	North-West, Central	No effect in NW, 10-15% decrease in Central	Aggarwal 2000
	North-West	Decrease/increase (scenarios based)	Lal et al. 1998
	Punjab	Decrease/increase (scenarios based)	Hundal and Kaur 1996
	All India	Decrease	Gangadhar Rao and Sinha 1994
	All India	Decrease/increase (region wise and scenarios based)	Aggarwal and Kalra 1994
	All India	Decrease/increase (region wise and scenarios based)	Aggarwal and Sinha 1993
	All India	Decrease	Sinha and Swaminathan 1991
Soybean	All India	Decrease/increase (region wise and scenarios based)	Mall et al. 2004
	Central	Decrease/increase (scenarios based)	Lal et al. 1999
Maize	North	Decrease/increase (region wise and scenarios based)	Sahoo 1999
	Punjab	Decrease	Hundal and Kaur 1996
Chickpea	All India	Decrease	Mandal 1998
Pigeonpea	All India	Decrease	Mandal 1998
Groundnut	Punjab	Decrease	Hundal and Kaur 1996
Sorghum	All India	Decrease	Chatterjee 1998
	All India	Decrease/increase (region wise and scenarios based)	Gangadhar Rao et al. 1995
Brassica(Mustard)	North	Increase	Upreaty et al. 1996

SOURCE: MALL ET AL 2007

Economic impacts

The Ricardian approach of assessing economic impacts of climate change is based on examining that if 'two agricultural areas are similar in all respects except that one has a climate on average (say) 3°C warmer than the other, one would be able to infer the willingness to pay in agriculture to avoid a 3 temperature rise' (Kumar 2007). Kumar and Parikh 2001 and Kumar 2003 use this approach to estimate the impact of climate change on net revenues in the agricultural sector. The former study concludes that a 2°C temperature rise and 7% increase in rainfall would lead to an approximately 8% loss in the farm level net revenues. They further conclude that states that grow wheat in winters like Haryana, Punjab and western Uttar Pradesh would be most affected while eastern districts of West Bengal and certain parts of Bihar could benefit from such changes. The latter study estimates that a 5% increase in climate variation could lead to a 10% drop in the revenues. Regional impacts are not uniform with northern, central and coastal districts facing the brunt. On the other hand MoEF concludes that a temperature rise of 2-3 °C may result in loss in revenues ranging between 9-25%. A study by Sanghi, Mendelsohn and Dinar 1998 suggests that revenues could decrease by 12.3% with a 2 °C rise in temperature and 7% increase in precipitation. Agriculture in the coastal regions of Gujarat, Maharashtra and Karnataka will be worst affected while small losses could also accrue to states like Punjab, Haryana and western Uttar Pradesh. On the other hand, West Bengal, Orissa and Andhra Pradesh could benefit from climate change.

TERI 2003 looked at the synergy between the long-term processes of climate change and globalization and the combined impact that the two could have on Indian agriculture. The study concluded that districts in western Rajasthan, southern Gujarat, Madhya Pradesh, Maharashtra, northern Karnataka, northern Andhra Pradesh and southern Bihar could be 'doubly exposed' i.e. suffer from the negative impacts of both climate change and globalization. Most studies infer that climate change in India could negatively impact both yields and farm revenues in the long run.

Water

Many parts of India are already water stressed and India will most likely be water scarce by 2050 (Government of India 2008). Even under a low water consumption scenario and without taking into account climate change, total water demand will surpass water availability by 2050 (Thate 2000). Gross per capita availability in India is predicted to decrease from 1,820 m^3/year in 2001 to 1,140 m^3/year in 2050 (Gupta and Deshpande 2004). The problem of water availability is further compounded by the fact that more than 45% of annual rainfall in India is lost as natural runoff to the sea (Mall et al 2006 b). This imminent water security threat that India is likely to face, could be further exacerbated by climate change impacts. Climate variability may alter precipitation patterns combined with possible net loss of glacier ice and snow covers enhance water scarcity. Hence it is important to look at the impacts that climate variability will have on water resources and adopt practices that ensure sustainability of water consumption in India.

Climate change impacts on water resources

Many studies for India conclude that the surface mean temperature in India exhibits a rising trend and that for the country on the whole there is no significant rainfall trend, though precipitation at regional levels could be altered (Mall et al 2006b). The rising temperature will impact the hydrological cycle, changing rainfall, magnitude and timing of run-off. Warm air increases the evaporation of surface moisture and holds more moisture. This causes rainfall and snowfall events to be more intense and hence the probability of floods is increased. However, if there is little moisture in the soil, incident solar radiation further raises the temperature and consequently droughts. Climate change, thus, affects soil moisture, groundwater recharge, flood and drought incidences and surface water availability.

NATCOM (Government of India. 2004a) analyses two climate change scenarios - HadRM2 control scenario (1981-2000) and GHG climate scenarios (2041-2060) (Table 2.3). Climate change in India will increase rainfall but this will not necessarily translate into an increase in the surface run-off. Luni River flowing through Kutchh and Saurastra that constitutes 25% of Gujarat, and 60% of Rajasthan are likely to face acute physical water scarce conditions. Water shortage will also be experienced perenially by river basins of Tapi, Pennar, Mahi and Sabarmati. River basins of Ganga, Cauvery, Krishna and Narmada could face seasonal or perennially water stressed conditions. On other hand, river basins of Godavari, Brahamani and Mahanadi are projected to face water shortages only in some locations. The severity of droughts and intensity of floods in India is likely to increase along with a reduction in the available run-off under this scenario (Table 2.3). Ground water recharge will be affected by changes in evapotranspiration and precipitation. More intense rainfall will cause greater run-off and hence less recharge. Flood events could impact the groundwater quality, which may further deteriorate due to sea level rise resulting in increased saline intrusion of coastal and island aquifers. Due to variations in precipitation and possiblereductions in snow and glacial ice there could be change in the course of rivers. Though, the change in the course of the river Kosi is not due to climate change, the repercussions in Bihar, point to the damaging effects of a change in the course of rivers (Box 2.1).

Table 2.3 Climate change impacts on rainfall and run-off of major Indian river basins

Basin	Scenario	Rainfall (mm)	Run-off (mm)	As a proportion of rainfall (%)
Cauvery	Control	1309.0	661.2	50.5
	GHG	1344.0	650.4	48.4
Brahmani	Control	1384.8	711.5	51.4
	GHG	1633.7	886.1	54.2
Godavari	Control	1292.8	622.8	48.2
	GHG	1368.6	691.5	50.5
Krishna	Control	1013.0	393.6	38.9
	GHG	954.4	346.9	36.4
Luni	Control	317.3	15.5	4.9
	GHG	195.3	6.6	3.4
Mahanadi	Control	1269.5	612.3	48.2
	GHG	1505.3	784.0	52.1
Mahi	Control	655.1	133.9	20.4
	GHG	539.3	100.0	18.5
Narmada	Control	973.5	353.4	36.3
	GHG	949.8	359.4	37.8
Pennar	Control	723.2	148.6	20.6
	GHG	676.2	110.2	16.3
Tapi	Control	928.6	311.2	33.5
	GHG	884.2	324.9	36.7
Ganga	Control	1126.9	495.4	44.0
	GHG	1249.6	554.6	44.4
Sabarmati	Control	499.4	57	11.4
	GHG	303.0	16.6	5.5

SOURCE: GOVERNMENT OF INDIA 2004a

Box 2.1 North Bihar flooding due to change in the course of river Kosi

Kosi, also known as the 'sorrow of Bihar' due to the devastation its near annual flooding causes, changed its course in late August affecting nearly 3 million people in the impoverished state of Bihar. The river shifted nearly 120 kilometers eastwards to a course it had abandoned around 250 years ago. Kosi burst a dam in Nepal and safety embankments, thus changing course and destroying 100,000 ha (250,000 acres) of farmlands in the process. This new course has no protective embankments and levees.
The river has breached its embankments in the past because of the high pressure that its silt loads puts on its artificial banks. However, the extent of this year's breach is unprecedented. Population of 16 districts of north Bihar has been impacted by the flooding with Araria, Katihar, Khagaria, Madhepura, Purnia, Saharsha and Supaul districts being the worst hit. Many people wereforced to live on rooftops and thrive on plants and leaves due to destruction of food stocks.

SOURCE:
HTTP://WWW.FRONTLINEONNET.COM/STORIES/20080926251911300.HTM
HTTP://WWW.IHT.COM/ARTICLES/REUTERS/2008/09/01/ASIA/OUKWD-UK-SOUTHASIA-FLOODS.PHP
HTTP://WWW.IHT.COM/ARTICLES/AP/2008/08/26/ASIA/AS-INDIA-MONSOON-FLOODING.PHP

IITM studied the impact of climate-change on the river basins of Ganga, Krishna and Godavari. The hydrological cycle in all the river basins is likely to be more intense, with increased average annual rainfall and droughts, as well. Extreme rainfall,

rainfall intensity and intensity of daily rainfall are predicted to increase. Number of rainy days could decrease in the western parts of the Ganga basin and increase over most parts of Krishna and Godavrai basin. The surface water availability is likely to increase in all three basins.

The findings of some of the studies on impacts on water resources are summarized in Table 2.4. Intense rain over short duration cannot be as effectively utilized as precipitation occurring over a longer time span. Decrease in winter precipitation could lead to reduced precipitation during December-February increasing the water stress during the lean period. Intense rain apart from increasing the frequency of floods will lead to much of the rainfall being lost due to run-off. Water resources could also be affected by the possible impact of climate change on snow and ice cover. The possible reduction in net snow and glacial ice will increase the summer flow in some rivers for a few decades followed by a reduction in flow as melting continues. Some evidence suggests that the Gangaotri glacier, which is the source of Ganga, India's largest river, is retreating at about 28 m per year (Mall et al 2006b).

Table 2.4 Impact on water resources during the next century over India

Region/location	Impact	Reference
Indian subcontinent	Increase in monsoonal and annual run-off in the central plains	Lal and Chander 1993
	No substantial change in winter run-off	
	Increase in evaporation and soil wetness during monsoon and on an annual basis	
Indian coastline	One metre sea-level rise on the Indian coastline is likely to affect a total area of 5763 km^2 and put 7.1 million people at risk	JNU 1993
All-India	Increases in potential evaporation across India	Chattopadhyary and Hulme 1997
Central India	Basin located in a comparatively drier region is more sensitive to climatic changes	Mehrotra 1999
Kosi Basin	Decrease in discharge on the Kosi River	Sharma et al 2003
	Decrease in run-off by 2-8%	Sharma et al 2003
Southern and Central India	Soil moisture increases marginally by 15-20% during monsoon months	Lal and Singh 2001
Chenab River	Increase in discharge in the Chenab River	Arora et al 2003
River basins of India	General reduction in the quantity of the available run-off, increase in Mahanadi and Brahmini basins	Gosain and Rao 2003
Damodar Basin	Decreased river flow	Roy et al 2003
Rajasthan	Increase in evapotranspiration	Goyal 2004

SOURCE: MALL ET AL 2006B

Ecosystems and forests

India is one of the few countries that has varied topography and climatic regimes, a long coastline and is in the possession of oceanic islands, however, amongst this, human interventions in these natural ecosystems, for many years now have led to their exploitation and alteration. A result of these human induced interventions is that at present only a small portion of these can be said to be secure in their original state. Nonetheless, insipte of some glaring trends, around one-fifth to one-fourth of the country's geographical area still accounts for relatively 'natural' ecosystems; of which forest occupy the major area. The non-forest ecosystem includes mainly the wetlands (including mangrove forests and coral reefs) and the grassland (Government of India, 2004).

Climate is increasingly being seen as the most important determinant of vegetation patterns globally and has significant influence on the distribution, structure and ecology of forests. Several climate-vegetation studies have shown that certain climatic regimes are associated with particular plant communities or functional types. It is, therefore, logical to assume that changes in climate would alter the configuration of forest ecosystems (Ravindranath et al, 2006). The climate induced altering is likely to impact not only the forest ecosystems but also the non-forest ecosystems.

Climate change impacts on forests in India

NATCOM [Government of India. 2004a] documented the vulnerability of forest ecosystems to projected climate change based on the application of BIOME-3 model to about 1500 grids across the Indian region. The climate related parameters for these grids are from the HadRM2. The outputs of the BIOME-3 (biome type, net primary productivity etc.) using climate from control run of RCM indicated the current situation, while that from the GHG run described the vegetation that was likely to prevail around 2050 under the GHG scenario.

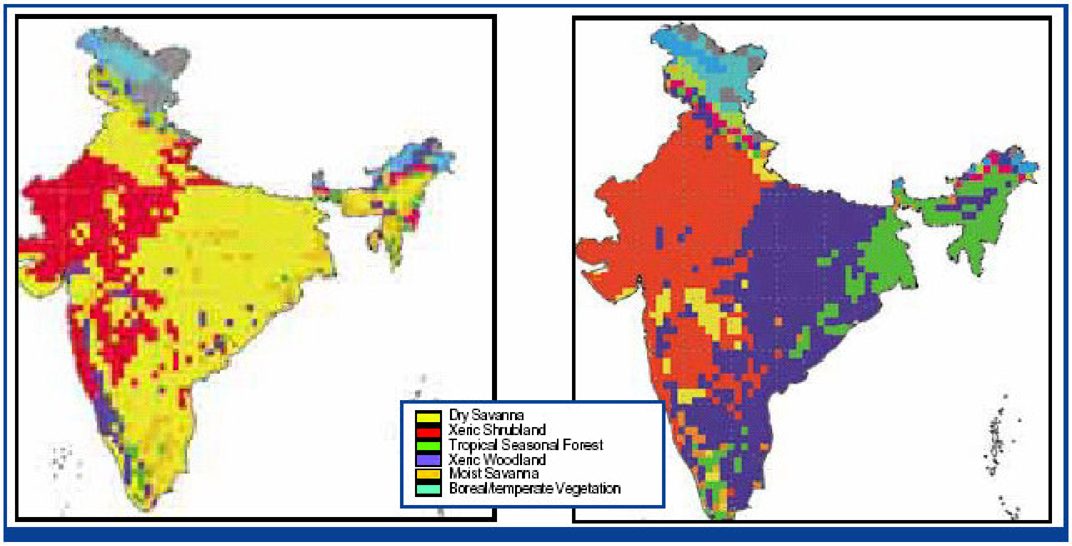


Figure 2.2 Vegetation map for the year 2050, [considering all grids of India and potential vegetation (including grids without forests)]

SOURCE: GOVERNMENT OF INDIA 2004a

The figure 2.2 depicts the expected distribution of biome type in India for the climate projected to prevail over India during 2041-2061 under the GHG scenario. The figure clearly reveals large scale changes in the vegetation types.

On the other hand figure 2.3 below, depicts the spatial distribution of projected changes in forest biome types.

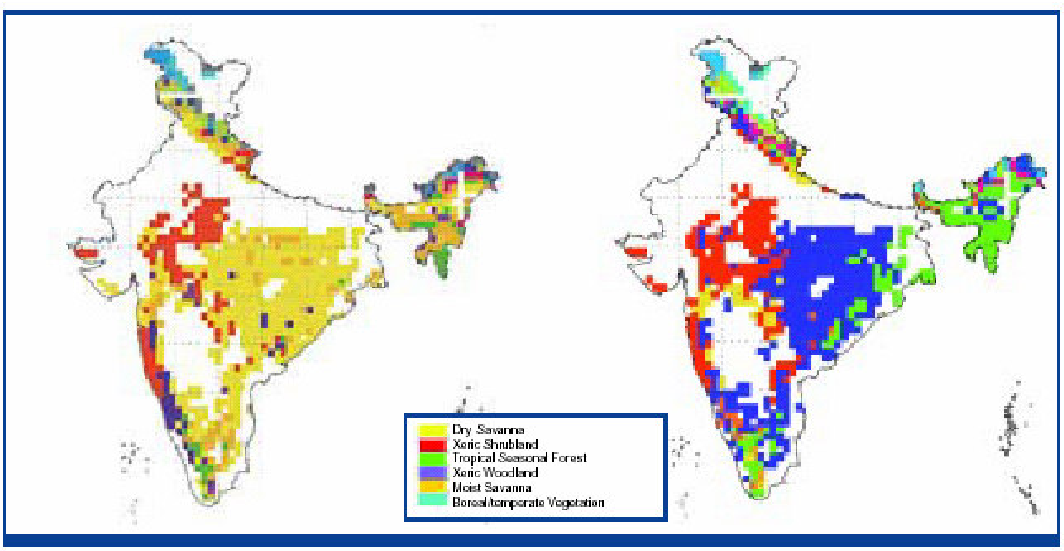


Figure 2.3 Vegetation map of India for 2050 including only the grids that have forests at present

SOURCE: GOVERNMENT OF INDIA, 2004

It is evident from the figure that approximately 70% of the grids are likely to experience a change. Dry Savanna biome is the one most seriously impacted. 62% of it, mainly lying in the northern/central parts of India, is likely to be converted into Xeric Woodland (Dry thorn forest), while another 24%, mainly in the northwestern parts, is likely to change to Xeric Shrubland. Moist Savanna located in the north-east and some parts of southern India are the other biome type most likely to be affected. These are likely to be converted to Tropical Seasonal Forest (about 56%), mostly in the northeast and Xeric woodland (Dry Thorn Forest) about 32% mostly in southern India depending on the change in the quantum of rainfall. The changes expected in the colder regions are also along similar lines, with the Tundras likely to change to boreal evergreens and boreal evergreens into temperate conifers.

Implication for biodiversity

Even if we were to exclude the climate change impacts, increased land use intensity among other stresses are likely to lead to a decrease in biodiversity. However, climate change with the potential to accentuate the current stresses, could lead to increase in species loses. A general impact is that the habitats of many species will move pole ward or to higher elevations from their current locations.

In the absence of species or region-specific research on impacts only some of the qualitative impacts on wildlife species can be assessed at a result of climate change. For example, an increase in precipitation over northeastern India would lead to increased flooding in the Bramaputra and place the wildlife of the Kaziranga National Park at risk. Further, any large-scale change in vegetation to drier types over central and northwestern India would also have consequences for the fauna of these regions (Government of India 2004a).

Socio-economic impacts

As mentioned before, climate change impacts on forest is likely to directly or indirectly impact the livelihoods of the forest dependent communities through the additional pressure created on forests by affecting the biodiversity and biomass production. Significant changes in the forest boundary of different forests biomes as well as biodiversity are projected and it is expected during the transient phase, large-scale forest die back may occur. Thus affecting the production and supply of non-timber forest products to the forest dependent communities, affecting their livelihoods. However, in the transient phase there could be an increased supply of timber, due to forest die back reducing timber prices (Government of India, 2004a)

Impact of climate change on other natural ecosystems

Climate change is also likely to have impacts on other natural ecosystems. Some of these likely impacts include the following:

a) *Inland Wetlands:* urbanization, agricultural development, pollution and road construction already affect most of India's 23,444 inland wetlands (natural lakes, swamps, marshes, and man-made reservoirs and tanks) covering an area of 35,589 km² in the country. At present, site-specific studies on the possible impacts of future climate change on inland wetlands are not available for the country. Studying the impacts, would be a complex issue dependent on several factors including temperature increase, rate of evaporation, changes in rainfall over the catchments, changes in nutrient cycling and the responses of a variety of aquatic plants and animals (Sukumar et al, 2003).

b) *Mangroves:* The Indian coastline is over 7,500 km long which includes the islands of Lakshadweep and the Andaman and Nicobar that comprise 22% of this length. Mangroves are distributed along the east and west coasts of the mainland as well as the Andaman and Nicobar islands. These mangroves are of different types – tide-dominated (Sundarbans, Mahanadi), river-dominated (Godavari, Krishna, Pichavaram, Muthupet), drowned river valley (in Gujarat) and mangroves on carbonate platforms as in Andaman and Nicobars. The Sundarbans of India and Bangladesh covering an area of 10,000 km² constitute the single largest mangrove wetland in the world (Sukumar et al, 2003).

The mangroves of the country are already degraded (Government of India, 2004). The resulting change in the hydrology of rivers due to climate change would further alter mangrove composition. Sea level rise would submerge the mangroves as well as increase the salinity of the wetland (Government of India, 2004a). This would favour mangrove plants that tolerate higher salinity. Larger quantities of freshwater into the Gangetic delta because of possible increased snowmelt in the western Himalayas would, on the other hand, reduce salinity. Changes in local temperature and precipitation would also influence the salinity of the mangrove wetlands. All these effects would have a bearing on plant compositions.

c) *Coral reefs:* Coral reefs are distributed in six major regions along the Indian coastline. Of these the most diverse reefs occur in the Andaman and Nicobar islands, followed by those in the Gulf of Mannar and Lakshadweep islands.

Several anthropogenic and natural factors already pose a threat to the coral reefs in the Indian sub-continent, including destructive fishing, mining, sedimentation and invasion by alien species (Government of India 2004a). It is widely known that an increase in sea surface temperature (SST) of 1-2°C over seasonal maximums could result in bleaching of coral reefs. Mass bleaching of corals and high mortality occurred during the years 1997-98 associated with an intense El Nino event when SSTs were enhanced by over 3°C (Sukumar et al, 2003).. The corals of the Lakshadweep islands were, however significantly affected by this event with bleaching of over 80% of the coral cover and mortality of over 25% of corals. Shallow water corals of the branching type are the most affected by warming while the massive corals recover quickly (Government of India 2004a).

d) *Himalyan glaciers:* the possible retreat of glaciers and loss of snow cover is one of the potentially major climate change impacts facing India. The glaciers of the Hindu Kush-Himalaya (HKH) range covers an area of 52,350 km^2 contains over 15,000 glaciers, 9,000 glacial lakes and feeds most of major perennial river systems including the Indus, Ganges, Brahmaputra and sustains livelihood of over 600 million people. Recent studies have suggested that response of a glacier to climate change depends on its geometry, climatic setting and mass balance depends mainly on air temperature, solar radiation and precipitation. It is vital to understand glacier dynamics and hydrology with changing climate for future water policy and water management in India

Coastal area impacts

India has a low-lying, densely populated coastline extending over more than 7,500 Kms. India's coasts support and provide a number of services. A number of ports and urban centres are present in the country's nine coastal states. Many coastal districts have large agricultural sectors. An important source of foreign exchange earnings and employment generation is coastal tourism thus forming an important industry. Projected climate change is likely to worsen some of the existing coastal zone problems In the context of Indian subcontinent some of the climate related problems include erosion, flooding, subsidence and deterioration of coastal ecosystems. In many cases is expected that these problems would be caused or exacerbated by sea level rise and tropical cyclone. The key climate related risks associated with coastal zones include tropical cyclones, sea-level rise, and changes in temperature and precipitation in the context of the Indian coastal zones (Government of India 2004a)..

A range of impacts can be expected from rise of sea level having implications on coastal population and agricultural performance: some of these would include (NATCOM, Government of India 2004):

- Land loss and population displacement
- Increased flooding of the low-lying coastal areas
- Agricultural impacts such loss of yield and employment, resulting from inundation, salinization and land loss
- Impacts of coastal aquaculture
- Impacts on coastal tourism

It is being highlighted that projected future sea level rise could inundate low-lying areas, coastal marshes and wetlands, erode beaches and increase flooding and salinity of rivers, bays and aquifers, in India. The population along the East coast of India has been historically vulnerable to storm surges arising from cyclones bred over the Bay of Bengal. A recent study (Dasgupta et al, 2007) has placed the coastal population at risk in South Asia between 6 and 40 million. The study reports that the overall regional GDP compression due to direct sea level rise losses is estimated at 0.6 percent from 1 m, 1.6 percent for 3 m and 2.9 percent for 5 m sea level rise for South Asia. Apart from these direct impacts, the major delta area of the Ganga, Brahmaputra, and Indus rivers, which have large populations reliant on riverine resources, will be affected by changes in water regimes, salt-water intrusion and land loss.

Human health

Climate influences supply of food, water, prevalence of infectious diseases, physical safety, and overall well-being. If climate is disturbed, it alters the whole biosphere, thus affecting human health. Climate stresses such as temperature extremes, storms, and other heavy precipitation events, air pollution, water contamination, and diseases carried by mosquitoes, ticks and rodents etc and the potential consequences of these stresses acting individually or in combination, have given rise to concerns about the risks of climate change to human health. Six major vector borne diseases namely Malaria, Dengue, Chikungunya, Filariasis, Japanese encephalitis and Leishmaniasis of which malaria ranks at number one. These diseases not only cause death but also economic loss by causing morbidity of millions of people and therefore resulting in loss of man-days.

Impacts of climate variability on health

Environment plays an important role in the transmission dynamics of vector borne diseases, as the parasite/viruses have to complete part of their development in particular species of insects transmitting the pathogen. Meteorological parameters like temperature, rainfall and Relative Humidity (RH) affect the duration of life cycle, rate of feeding, blood digestion, survival and development of parasite/viruses in insects. Climatic conditions play important role in the distribution, degree of endemicity and epidemicity of diseases in an area. Some areas, which provide most favourable conditions of temperature and rainfall, experience occurrence of disease throughout the year. Howvere, in other areas, in colder months transmission does not take place due to requirement of specific temperature (Dash et al, 2008).

The Impacts of climate variability and malaria and other vector borne disease are closely associated and are being studied since long in India. For example, Gill (1921) found that increased malaria mortality in the Punjab correlated with high rainfall in the previous month. Similarly, Mathur et al (1992) found that floods have also been responsible for extensive breeding potential leading to malaria outbreaks in Rajasthan. Gupta (1996) and Akhtar and McMichael (1996) correlated rainfall with upsurge of malaria in Rajasthan. Relationship between El Nino Southern Oscillation (ENSO) and malaria has also been studied in India. Studies have revealed that in Punjab, malaria epidemics occur most frequently in the year following El Nino phenomenon. Dhiman et al (2003) studied climate variability and malaria with emphasis on different sites in India and found that rainfall is an important early indicator of malaria in Rajasthan and Gujarat.

NATCOM (Government of India. 2004a) presented in detail the vulnerability assessment and adaptation measures in view of climate change on malaria.

Based on monthly incidence of malaria in different states of India, it was found that Northern states such as Jammu & Kashmir, Himachal Pradesh, Punjab, Haryana, Uttarakhand and northeastern states etc are more vulnerable to climate change. Southern states such as Karnataka, Kerala, Orissa, Tamil Nadu and Andhra Pradesh are less vulnerable to climate change as the climatic conditions are already suitable for malaria transmission throughout the year (Dhiman et al 2003).

Projected shifts in the transmission windows of malaria greatly vary for different states depending on the arrival of monsoons. For example, the transmission window based on minimum required conditions for ensuring malaria transmission is open for 12 months in eight states (Andhra Pradesh, Chattisgarh, Karnataka,Kerala, Maharashtra, Orissa, Tamil Nadu and West Bengal), and 9 to 11 months in the north eastern states (Government of India, 2004). It is further projected that that during 2080s, 10% more states may offer climatic opportunities for malaria vector breeding throughout the year as compared tothe year 2000.

NATCOM (Government of India. 2004a) emphasizes that the approach used to study the malaria scenario under climate change is only a preliminary attempt to project climate change impacts. An integrated approach would be required to evaluate the impacts of climate change on malaria in India, that will include not only the future climate and land-use pattern parameters but also would integrate the projected socio-economics which need to include access to medical intervention in the region/state/district.

Conclusion

It is evident that climate change is a grave concern for sustainable development and that there is need for the country to prepare for potential impacts, and have a serious engagement with the level of preparedness in states and sub states. The key challenges of climate change in a federal context will be the need to think beyond spatial borders and yet be local; revisit the role of state and non state actors and the potential of interstate conflict over resources that may become scarce. Adaptation, which we discuss in chapter 6, will require the provisioning of high spill over goods across jurisdictions and this will need coordination; but also the provision of low spill over goods which requires alertness to social and political constraints at the local level. For effective responses, there is a need to understand the landscape of environmental jurisdictions in the country and the fiscal relations between them. In the next chapter we focus on this.

CHAPTER 3 Environmental federalism in India

This chapter discusses the constitutional set up with reference to centre-state and state-sub state sharing of rights, resources, and responsibilities in the context of environment and natural resource management. In order to understand the political economy of centre-state resource transfers around environmental and natural resource issues, the chapter examines certain key resources like forests, land, water, biodiversity, coastal zones along with the prevention and control of pollution, waste management and general environmental protection.

Centre-state and state-local sharing of powers and resources

The Constitution of India stipulates a 'union of States' where governments at central and state levels share powers and responsibilities. It has assigned functions, legislative competence and fiscal powers to both Centre and State with respect to different subjects. Schedule VII of the Constitution of India, read with Article 246, in its three Lists – Union, State and Concurrent, deals with this assignment. Broadly, List I or the Union List covers subjects that serve at a national level and List II, i.e., the State List comprises those areas which are limited to a State's own jurisdiction, subject to other clauses. Parliament may legislate on a State subject if two or more States resolve and request it to make such a law. With regard to List III, both the Parliament and a State Legislature can make laws but in case of a conflict and no scope for harmonious reading of the provisions, law made by the parliament prevails.

Only the parliament has the residuary power to make laws on matters, which are not included in any of the three lists and environment is one such matter. States' ownership of public land and natural resources coupled with legislative powers conferred by Article 246, read with List I and II of Schedule VII of the Constitution, marks the realm of powers enjoyed by and distributed amongst centre and state vis-à-vis natural resources and other environmental subjects.

The Indian Constitution although recognizing panchayats, integrated Panchayati Raj Institution within its text for effective decentralization only in 1992 by way of 73rd amendment. The 73rd and 74th amendment are the pillar stones of decentralized governance in India where empowerment and devolution was envisaged beyond state level and extended to local and rural level. However, local government and village administration is a state subject thereby implying that states are responsible for setting up of these village institutions and endowing them with the powers requisite for becoming institutions of self governance. This dependence on states gets a further thrust from the constitutional provisions itself where the states *may* devolve the 'necessary' powers to municipalities and 'panchayats at appropriate level'. Thus even though envisaged as institutions of self-government, local and rural units are in fact subject to states control as they derive their 'powers, functions and jurisdiction from their state governments and not from the Constitution itself.'[38] The space for decentralized governance further enlarged when the Panchayat Extension to Scheduled Areas (PESA) Act was enacted in 1996. While in most of the country, local units of government are dependent on states to derive powers recognized by the Constitution, there are regions that enjoy greater autonomy and regions where the jurisdiction of states is not as clearly established, e.g. fifth and sixth schedule areas and special category states.

Table 3.1 illustrates how subjects relating to environment and natural resources management are distributed amongst the different tiers of government.

Table 3.1 Distribution of subjects of relevance to Sustainable Development

Governing Unit		Schedule
Union	• Atomic energy, mineral resources necessary for its production • Regulation & devpmt of oilfields, mineral oil resources; petroleum, petroleum pdts; other inflammable liquids • Regulation of mines and mineral development	VII
State	• Constitution and powers of local government units • Public health and sanitation; hospitals; dispensaries • Communication (roads, bridges etc incl. inland waterways), subject to Lists I and III) • Land • Water • Tax on sale and consumption of electricity	VII
Concurrent	• Vagrancy; nomadic and migratory tribes • Prevention of cruelty to animals • Forests • Electricity	VII
Local	• Urban planning, including town planning • Regulation of land use, construction of buildings • Economic and social development planning	XII
Rural	• Agriculture and agricultural extension • Land improvement, implementation of land reforms, land consolidation, soil conservation • Minor irrigation, water management, watershed development	XI

Note: Schedule VII – Legislative Powers as recognized by the Constitution; Schedules XI & XII – States enabled to devolve their powers and responsibilities to Municipalities and Panchayats.

38 Nilima Chandiramani, Environmental Federalism: An Indian View-Point

Environment and natural resources management: federal issues

Environment does not feature in the Indian Constitution as a separate entry under the schedule demarcating legislative rights. However, environment protection is clearly provided for in the Indian Constitution as a directive principle of state policy and judicial interpretation over the years has further strengthened this mandate. In 1977, the State was enjoined with the duty to protect and improve environment and safeguard the forests and wildlife of the country as a part of the directive principle of the state policy and citizens enjoined with the duty to protect and improve the natural environment. Thus, Constitutional sanction was given to environmental concerns through the 42nd Amendment, which incorporated them into the Directive Principles of State Policy and Fundamental Rights and Duties.

Since environment is not a distinct item for legislative and administrative purposes, legal protection of the environment has taken three main routes – *first*, through judicial decisions adopting a broad approach in interpreting the fundamental right to life as guaranteed in Article 21 by including within its ambit the right to a wholesome environment; *second*, legislation in response to international developments[39], and *third,* laws on subjects that form a component of the environment or are bound to have direct or indirect implications for the natural environment, such as forest, wildlife, water, fisheries and land. In this section we examine specific federal issues for a few natural resources and pollution management issues. It must be noted here that since residuary power vests with the centre, any environmental subject not listed in schedule VII, is centre's prerogative. Therefore, land and water are state subjects, forests and wildlife are concurrent and environment in general is a residuary subject.

Forests

The role of forests in a sustainable development framework is crucial not only for the role it plays in maintaining the ecological balance but also the fact that it is a rich reservoir of resources that can sustain communities and generate revenue for the state. Therefore, forest conservation is 'not an end but a means to increase and sustain the resources of the country'[40]. Forests have always been at the centre of debates but these

39 National legislation in response to international agreements is not always necessary. Once an agreement is ratified by the executive, it comes into force, irrespective of the corresponding domestic legislation.
40 Koontz, Thomas M. (2002) Federalism in the forest: National versus state natural resource policy. Georgetown University Press, pp. 35

debates have often focussed on private vs public control and not so much on inter governmental aspect of natural resource policy.[41] In India forest are governed by laws of both states as well as centre since forest is a concurrent subject. While the 1927 Indian Forest Act and some state government laws were more with respect to commercial exploitation of forests[42], the Forest Conservation Act of 1980 had a clear focus on conservation by putting restrictions on non-forest activities in forest areas.

Management of forest for both forest and non-forest activities is distributed between the centre, state and to some extent local bodies depending upon the nature of forests and subject area. The combined effect of the forest Acts is that state governments are empowered to notify reserve forests and protected areas. However, states have to take prior permission from the centre before diversion. In the scheme of forest legislation, one of the most under-utilized provisions is that of village forests, under which management of a forest area can be assigned to village communities.

From a federal perspective, compensatory afforestation is one of the most important conditions stipulated by the central Government at the behest of the Supreme Court[43] for diversion of forestland for non-forest activities. A 2004 Government of India notification provided for creation of a Compensatory Afforestation Fund and that the monies received in CAMPA (Compensatory Afforestation management and Planning Authority) from a State or the Union Territory shall be used only in that particular State or the Union Territory. The Supreme Court in its judgement dated September 2005, observed that the effect of degradation of environment or depletion of forest can be felt more in the adjoining area/ state, therefore, it directed 'that ordinarily expenditure shall be incurred in the particular State or Union Territory but leaving it to the discretion of the CAMPA to also incur expenditure in other State or Union Territory. The ruling of the SC was based on the principle that the payment of NPV is for protection of environment and not in relation to any propriety rights.

In 2008, the government introduced a bill in the Parliament to establish and administer a CAF (Compensatory Afforestation

41 Koontz 2002

42 However, several state laws emphasize on conservation, for example, Andhra Pradesh alone has acts and rules on Protected Forest, transit of forest produce, trade in forest produce etc., Kerala has a Forest Act, Forest Settlement Rules, Forest Produce Transit Rules. It also has some recent acts like Forests (Vesting and Management of Ecologically Fragile Lands) Act, 2003 and the Restriction on Cutting and Destruction of Valuable Trees Rules. Karnataka has a Forest Act, Tree Preservation Act and Wildlife Protection (Karnataka) Rules

43 SC order dated October 2002 in T. N. Godavarman v. Union of India

Fund) through the ***Compensatory Afforestation Bill, 2008***. The key feature about this bill is its departure from the 2005 SC ruling and mandates that afforestation money collected from a state should be used only in that particular state. In a way, the provision strengthens the states' hold on their forest resources. It operates on the simple principle of distribution on the basis of contribution and not need. Moreover, it offers no incentive for *not* diverting the forestland.

Sustainable Development, as evolved in the Indian legislation and case law, has shades of both strong and weak sustainability. On the one hand, it embodies weak sustainability principles in the form of compensatory afforestation; on the other hand, it provides for protected areas, biosphere reserves, eco-sensitive zones as no-go areas further to the principle of strong sustainability. The National Environment Policy 2006 advocates the notion of 'entities with incomparable value' (EIV), where individuals or societies would not accept compensation in money or conventional goods and services in response to risks to EIVs. Although there is no complete list of EIVs as yet, the Ministry of Environment and Forest is working towards it. Some of the examples EIVs are protected areas, heritage sites, areas having charismatic species such as the tiger, unique landscapes, ancient sacred groves, biodiversity hotspots and biosphere reserves.

Land

Land is a State subject and rights in and over land and land tenures, land improvement are within the State's jurisdiction[44] and for acquisitioning and requisitioning of property, both the parliament and legislature of states have the power to legislate.

Since alienation of agricultural land and land improvement are state subjects, land use and state level laws and rules govern conversion of agricultural land to other uses. The eleventh schedule of the constitution provides for devolution of powers with respect to land improvement, implementation of land reforms and land consolidation and soil conservation to the panchayats at appropriate level.

Water

Water governance is an all inclusive broad subject and therefore any discussion on federalism pertaining to water must take into account the usage in question. Ranging from irrigation to water power to clean drinking water to fisheries to easement rights, different uses raise different concerns amongst different units of governance.

44 Entry 18, List II, Schedule VII, Constitution of India

Water under the Indian Constitution features both in the State as well as Union lists. Entry 17 of List II puts water at the disposal of the states. However, the legislative competence of the states is not general and is specifically with respect to water supplies, irrigation and canals, drainage and embankments, water storage and waterpower. It is also subject to the powers of the Centre where inter state river and river valleys are involved, pursuant to list I. Other than the direct entry on water, there are other key subjects relating to water, such as fisheries, which is a state subject and factories, waterways etc., which are concurrent. Power and responsibility to implement schemes with respect to water supply can be devolved to local bodies, and for fisheries, minor irrigation, water management and devolution can be devolved to the panchayats at appropriate level.

Most of the major and contentious uses of water in terms of centre-state and state- state relations, such as irrigation, water storage and waterpower are all state subjects. However, states must exercise their powers without prejudicing the rights of other states in which the river flows.[45] Considering that most of the major rivers in the country flow through more than one state, the Centre has an equally extensive jurisdiction vis a vis regulation of water.

Prevention and control of pollution

Prevention and control of water pollution and the maintaining or restoring of the wholesomeness of water is provided for in the Water Pollution Act 1974. It vests the authority in Central and State Pollution Control Boards to establish and enforce effluent standards in mines and processing plants. Similar to the Water Act, the Air Pollution Act, 1981 provides for the prevention, control and abatement of air pollution.

The Central Board created under these Acts[46] has been assigned functions that are mostly supervisory as well as for co-ordination of activities of State Boards. The Central Board may also provide technical assistance and guidance to state boards, conduct training for persons engaged in programs for prevention, control and abatement of water pollution.[47] The State boards are assigned functions of conducting comprehensive programs of pollution control in the state. The State boards not only lay down effluent discharge standards but also responsible for complete monitoring of compliance of such standards. The may also evolve economical and reliable

45 According to item 56 of list I the Union is responsible for regulation and development of inter-state rivers and river valleys to the extent that it is declared by Parliament by law to be expedient in the public interest
46 The Water (Prevention and Control of Pollution) Act, 1974 (Water Act) and The Air (Prevention and Control of Pollution) Act, 1981(Air Act).
47 Section. 16 of Water Act.

methods of treatment of sewage and trade effluents.[48] The State boards are subject to directions from the Central or the State government. On the other hand, in conducting programs on prevention and abatement of pollution, the State governments have flexibility in design and implementation of the programs.

The State boards have largely remained agencies for control of industrial pollution. Most of the potential powers of state boards remain un-utilized. The provisions of the pollution control Acts do not envisage participation of local authorities in pollution control activities. Consequently the monitoring activities are mostly centralized. The SPCBs do have a network of regional offices. But besides financial constraints of expanding and strengthening such networks, technical capacity remains one of the central concerns for improved service delivery. It is also pertinent to mention that the functions of the pollution control boards are not limited to water and air pollution control, but includes control of environmental pollution as envisaged under the Environment Protection Act, the umbrella legislation on the environment.

Waste management

Waste as a separate subject is not included in the schedule VII of the constitution, therefore, does not come directly under the legislative jurisdiction of centre or state. However, areas such as urban development, land use, public health, which are all important for waste management, are distributed amongst centre and state.

In the federal structure of the Indian polity, matters pertaining to housing and urban development have been assigned by the Constitution to the State Governments. The 74th Constitutional Amendment of 1993 further delegated many of these functions, including the management of solid waste, to urban local bodies. However, central and state governments continue to play a crucial role in the formulation of policy and regulation as well as providing technical and financial support for the management of waste in the country, including for resource recovery projects. The urban local bodies have not been able to manage municipal wastes effectively largely due to poor implementation of the provisions of 74th constitutional amendment - mainly the failure to provide financial autonomy to municipalities- and their resulting poor financial health[49]. Apart from financial

48 Section. 17 of Water Act.
49 The 74th Amendment Act of the Constitution of India redefined the role, powers, functions and financial authority of urban local bodies (ULBs). A three-tier structure of urban local governance has been put in place in various states with the implementation of the Act. The urban local bodies are classified into Nagar Panchayats, Municipal Councils and Municipal Corporations. Further, the 74th Amendment entrusts these local bodies with the responsibility of provision of basic services such as water supply, sanitation and solid waste management in their cities.

constraints, another reason why the municipalities have been unable to meet the demands placed on them is a lack of technical and managerial capacity to undertake alternative waste management options.

With respect to the hazardous wastes, it is the responsibility of the SPCBs to grant authorization to industries and operators of waste treatment/disposal facility, generating or handling hazardous waste under the Hazardous Wastes (Management and Handling) Rules. The state governments are entrusted with identifying disposal sites along with industry or their representatives and conducting environmental impact assessment of selected sites and notifying sites if found suitable.

Decentralization in environment and natural resource management

Decentralization of natural resource management can be defined as an arrangement whereby the central government cedes rights of decision making over resources to actors at lower levels of a administrative, political or legislative hierarchy. (Agarwal and Ostrom. 2001)

Decentralization of environment and natural resources can operate at two levels, - property rights and right to decision-making. Property rights entail (1) access, (2) withdrawal, (3) management, (4) exclusion, and (5) alienation of resource. (Schlager and Ostrom. 1992) These components of property rights assume greater importance in the context of natural resources held as a common or community owned property. In the present regime not all components are exercisable by the local populace since government recognizes community control on natural resources as concessions and not rights. For centuries, indigenous communities have been inhabiting and drawing their sustenance and livelihood from forests. In recognition of this, and a long sustained debate and several amendments in the draft, Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, was enacted in 2006 and operationalized in 2007. The Act recognizes heritable (non-alienable and non-transferable) rights of forest dwelling STs and other Traditional Forest Dwellers.[50] The rights include habitation, self-cultivation for livelihood, ownership, access to, use or dispose of minor forest produce, other community and customary rights. The Act moves further in the direction of decentralized governance and management of resources, where while it recognizes rights of forest dwellers, it also enjoins upon them the responsibility of protection of forests. The procedure for determining the rights of dwellers is initiated at the level of Gram Sabha.

50 in occupation for at least 3 generations or 75 years

Decision-making is another key element of any decentralized process. Till the power to make decisions is transferred, the devolution is incomplete and a little more than one following the orders of another level of government. Decentralized governance is an intrinsic part of the Indian Constitution. As mentioned earlier, the 73rd and 74th amendment are the pillar stones of decentralized governance in India with empowerment and devolution being extended to local and rural level. Beside these amendments also, local governance is recognized in Article 40, where States are to 'take steps to organise village panchayats and endow them with such powers and authority as may be necessary to enable them to function as units of self-government.' After the 73rd amendment, it was explicitly stated that States could devolve powers and responsibilities with respect to the preparation of plans for economic development and social justice and implementation of schemes for economic development and social justice. Panchayats could also be authorized to levy, collect and appropriate such taxes, duties, tolls and fees as specified, be assigned taxes, duties, tolls and fees levied and collected by the State Government and receiving grants in aid from the Consolidated Fund of the State.[51] However, all these changes were to be incorporated in the state legislation on panchayats by the States, which reserved enough powers with themselves to maintain their control.

ENRM in Special Areas

The decentralized governance framework as envisaged by the constitution is not uniform and varies in states, scheduled areas and special category states/regions. While most states are governed by the provisions of *nagarpalikas* and *panchayats*, certain areas are exempt from it or have a modified version of the same. In this regard, it is important to examine three articles of the Constitution – Article 244(1) r/w Schedule V, Article 244(2) r/w Schedule VI and Article 371.

Administration of scheduled areas and scheduled tribes in the states of Assam, Meghalaya, Tripura, and Mizoram is carried out in conformity with the Fifth Schedule. Vth Schedule deals with administration and control of Scheduled Areas and Scheduled tribes in any state other than Assam, Meghalaya, Tripura and Mizoram. Vth Schedule described, as 'a Constitution within the Constitution' is the most comprehensive provision for the protection of the tribal people living in Scheduled Areas against the State and other exotic forces.[52] As per Para 2 and 3 of the Schedule and Art. 60 and 159, it is the duty of the President and the concerned governors to preserve, protect and defend the Constitution including this special feature concerning the Schedule Areas and the law including customs and usage of tribal people. Subject to only one

51 Article 243G, 243 H
52 Sharma, B.D., 'Tribal Affairs in India'

condition that it does not affect the basic structure of the Constitution, governor is given immense power to apply or not to apply any Act to the Scheduled Area, make regulations for peace and good governance of any area of the state, which for the time being is a Scheduled Area.

During the 73rd amendment, provisions of panchayats were not extended to Scheduled Areas, and it is only in 1996 that the provisions were extended to resource rich V scheduled areas. Panchayat Extension to Scheduled Areas Act (PESA) 1996 leaves it to the respective states to ensure that the PAL have the power to prevent alienation of land in the Scheduled Areas and to take appropriate action to restore any unlawfully alienated land of a Scheduled Tribe and control local plans and resources. It also mandates the States to make provisions for obtaining recommendations of the Gram Sabha or the Panchayats at the appropriate level mandatory prior to grant of prospecting licence or mining lease for minor minerals in the Scheduled Areas. The much ambitious and hopeful piece of legislation paving way for decentralized governance too was diluted in the corresponding state enactments. This is primarily because the powers that panchayats derive come from their home state governments and not from the Constitution, which only offers recognition and direction in this regard. Overall, the states are under no strict obligation to completely devolve functions relating to ENRM.

VI Schedule deals with Administration of tribal areas in the states of Assam, Tripura, Meghalaya and Mizoram. In these areas, there are formal modern central laws, traditional customary laws from within community and laws by autonomous district councils. There are three institutions for justice administration – traditional institutions dealing with customary and folk laws, formal administrative bodies like Deputy Commissioner and Autonomous District Councils.

Non-VI Scheduled Areas are governed by Rules of Administration of Justice (State wise rules). VI Schedule Areas bar application of Acts of Parliament and State Legislature to areas in the subject matter where Autonomous Council is authorized to make and extend laws.[53]This is the major distinction between the Sixth Schedule states and non-sixth Schedule states. This implies that the Indian Forest Act, 1927, the Forest (Conservation) Act of 1980 and the Wild Life Protection Act 1972 would be extended to the Autonomous District Council Areas only to the extent of Reserve Forests therein, whereas these Acts would apply *in toto* to the other North Eastern states of the country.

53 Part 3 of VI Schedule

Other than the Fifth and Sixth schedules, there are special provisions with respect to certain regions under Article 371 of the Constitution. These are Maharashtra, Gujarat, Nagaland, Assam, Manipur, Andhra Pradesh, Sikkim, Mizoram, Arunachal. The special provisions relate to inter alia, setting up of separate development boards, educational and employment opportunities, law and order, greater autonomy in terms of application of parliamentary laws. With respect to ENRM, it is the special provisions for Nagaland and Mizoram that deserve mention.

Until 1957, Nagaland was a Part 'B' tribal area within the State of Assam. Following the demands by Naga People Convention (NPC) for a separate administrative unit, an agreement between the NPC and the Government of India was reached and eventually the state of Nagaland was created in 1963. Initially under the Ministry of external affairs, Nagaland was brought under the Ministry of home affairs in 1972. The 1960 Agreement and the thirteenth Constitutional amendment provided that no Act of Parliament would apply to Nagaland unless so decided
by the Nagaland Legislature with regard to: -

- Religious or social practices of the Nagas;
- Naga Customary Law and procedure;
- Administration of civil and criminal justice involving decisions
  according to Naga Customary Law;
- Ownership and transfer of land and its resources[54]

These provisions of autonomy were made for Mizoram as well when statehood was conferred in 1987 vide the fifty-third amendment to the Constitution of India.

Despite the autonomy, greater rights over resources and legal pluralism of special category states, the actual devolution of powers and responsibilities has been debatable. The ‘institutional arrangements for autonomy were organically related to other institutions of federal structure’ (Kumar, 2005:99) The Councils were created as units of self-government but they had to remain dependent on state governments for management of funds.

Even in non-special category states, there are environmental services like public health and sanitation, sewage and waste disposal, which are managed by the local and rural governments. However, in reality, there is devolution of responsibilities, without powers and fiscal autonomy necessitated to fulfil the responsibilities. In terms of complete decentralization, ‘there is considerable variation across Indian

54 Article 371A (1), Constitution

states in the range and nature of environmental functions discharged by the panchayats and municipalities.' (Chandiramani Nilima. 2004)

It would be unfair to say, however, that policies and measures aimed at decentralization have not been introduced or voices seeking a more decentralized process have been rejected. On the contrary, from time to time, decentralized process is talked about and included in the mainstream policy decisions of the government. However, these efforts have lacked the political will and actions to make the decentralized management of environment and resources effective. Demands for decentralization reforms are normally met with insufficient power transfers and inappropriate local institutional arrangements that compromise the actual decentralization process. (Ribot et al. 2006)

Some issues

It may be said that the distribution of legislative, administrative and fiscal powers between centre and states with respect to environmental matters is often skewed towards the Centre. This bias operates at three levels – firstly, even where certain subjects are under the state list, the states powers are conditional to the power of centre to legislate on the same or another subject. For example, water is a state subject, but is subject to the laws made by the parliament on inter-state rivers and river valleys. Similarly, regulation of mines and mineral development is subject to Central laws on the same subject. The latter example must be distinguished from a concurrent subject, as states' power from the outset is subject to conformity with the central legislation. Secondly, in the past items have been removed from the state's domain and been opened to Central intervention by including them in the concurrent list. In case of concurrent subjects, both the Parliament and a State Legislature can make laws but in the event of conflict and no scope for harmonious reading of the provisions, law made by the parliament prevails. Thirdly, residuary power to legislate on any matter not listed under any of the three lists vests with the centre.

Although higher units devolve different powers to the lower units of government, they make these powers subject to approvals, permissions etc., thereby keeping the effective control concentrated at a higher level. In cases of mineral development, permission for exploitation of schedule I minerals is granted by the states, but they cannot do so without the approval of the central government. A similar case is that of approval for non-forest activities, where states cannot divert forestland without prior approval of the Centre. Even where decentralization is provided for, the corresponding institutional support required to perform the functions and responsibilities are inadequate.

The disconnect between potential and actual decentralization is not only with respect to Centre and States but states and sub state levels as well. 73rd and 74th amendments paved way for greater decentralization by listing down areas in which states could devolve powers to Panchayats and municipalities. The PESA further strengthened this vision through state level Acts. However, when the states legislated in this respect, the gram panchayats and sabhas were empowered only with regard to some of the issues and subject to approvals by state.

Fiscal federalism in the environment and natural resources sector

In this section, we examine the roles of various levels of government within the environmental federal system with a focus on their raising and spending of revenues. The concern here is both explanatory – how and why things happen, and evaluative- what would be a better way.55

Importance of the environment in state budgets

In 2006-07, states spent on an average 1.9% of their total state outlays on forestry, wildlife, ecology and the environment. At the lower end of the spectrum were states like Bihar (0.30%), Maharashtra (0.17%), and West Bengal (0.33%) and at the upper end were newly formed states –Chhattisgarh (4.29%), Jharkhand (3.2%), Uttaranchal (8.33%) as well as states like Haryana (3%), Himachal Pradesh (3.54%) and Madhya Pradesh (3.43%). By and large more than 90% of this money was spent on the 'forestry and wildlife' sub-sector with some exceptions- Goa (78.28%), Manipur (86.48%), Orissa (70.37%), and West Bengal (73.29%), the balance being spent on 'ecology and environment'.

The states that earn a substantial amount of revenue from forestry and wildlife are also the states that spend maximum percentage of their total revenue expenditure on forestry and wildlife. (*See* figure 3.2) Chhatisgarh (4.3%), Uttarakhand (4.2%) and Madhya Pradesh (3.2%). However, three key observations must be made here, firstly, Kerala that earns 1.32% of total revenue (24% of its non tax revenue) from forestry and wildlife, spends only 0.8% on it, which is even lesser than the average of all the states (1%). In fact it is the only state whose share of forestry in total revenue exceeds forestry share in total expenditure; *secondly,* in terms of expenditure most of the north east states seem to be performing better despite earning little revenue from forests, which could be due to the importance of the NAP (National Afforestation Programme) in

55 Anderson, forthcoming, p 2

these states.; *thirdly*, the new states of Chhattisgarh, Jharkhand and Uttarakhand spend a noticeable share of their total outlay on forest and wildlife. Both Jharkhand and Uttarakhand are in sharp contrast with their original states.

Sources of revenue

Receipts of the Government of India comprise tax and non-tax revenue and capital receipts, while those of the states consist of revenue generated from own sources - tax or non-tax instruments on subjects that fall under the domain of state governments- as well as transfers from the Central government. The latter meets a substantial amount of state outlay and takes the form of tax assignment and grants-in-aid.

Grants-in-aid from the central to state governments take different routes and are for different purposes, both plan and non-plan (*See* figure 3.1) These grants are channelled essentially through the Finance Commission, Planning Commission and Central government ministries and departments. Through these channels, central funds are devolved to states in the form of resources for state budget or state plan schemes, central sector schemes, centrally sponsored schemes, special plan schemes, and some non-plan and ad hoc grants.

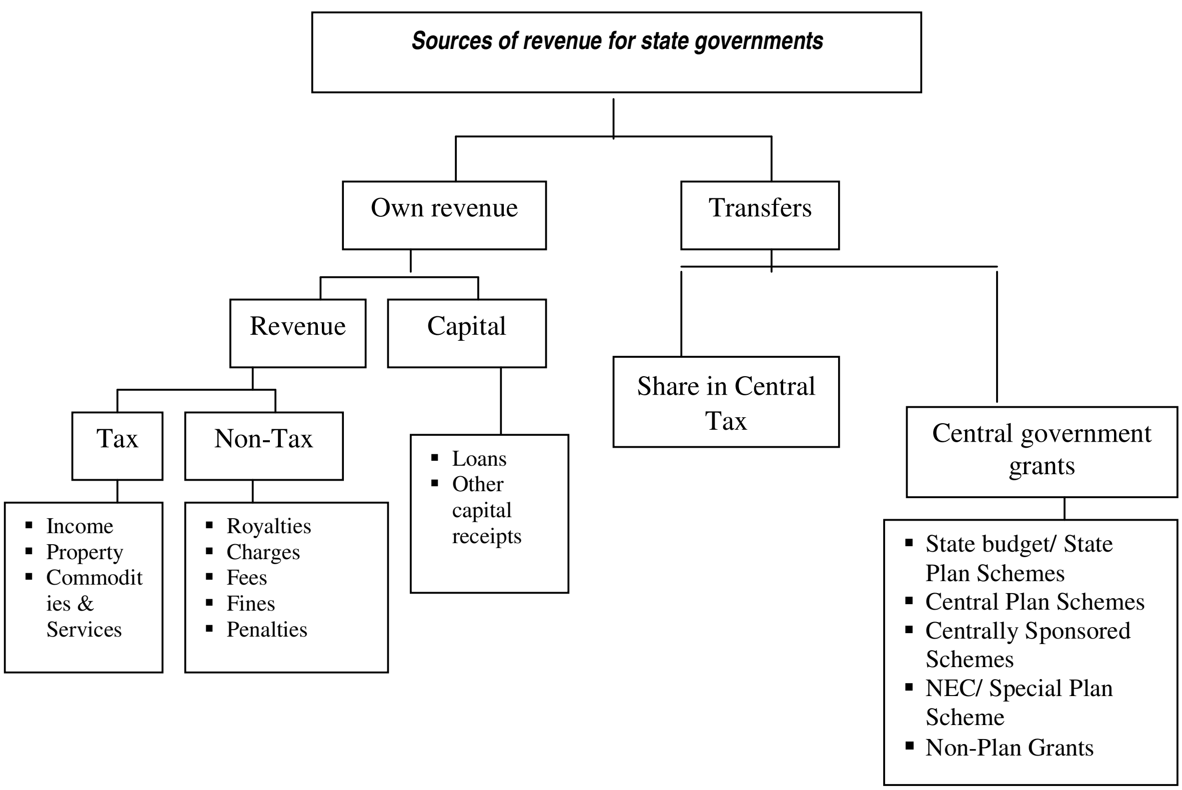


Figure 3.1 Fiscal Federalism: Flow of funds to state governments

Table 3.2 gives an example of the types of revenue instruments – tax and non-tax- available to states in the environment and natural resources sector.

Table 3.2 Examples of revenue from environmental subjects at sub national levels

Subject	Nature		Recipient
Forest	State's own revenue	Sale of timber and non timber forest produce	State
		Revenue from forests not managed by states	State
		Fines and seizures	State
		Penalty on unauthorized entry	State
		Sale of plants	State
		Surrender and others	State
Water	State's own revenue	Tax (irrigation)	State
		Betterment charge (irrigation)	State
		Ground water extraction charge/ fee	GWA (state)
		Water Charges (drinking water)	State board
		Development Charges (drinking water)	State board
Pollution Control (air and water)	State's own revenue (SPCB)	Consent fees	State
		80% of the Water cess [From the consolidated fund of India]	State
		Partial Reimbursement of MINARS and NAAQM expenses by CPCB	State
		Fines and penalties	State
Waste	Municipality's own revenue	Refuse removal charges	Municipal
		Fines (for littering, improper delivery, creating nuisance)	Municipal
	State's own revenue – SPCB	Fine (set up with approval of CPCB)	SPCB
		Authorization fees (biomedical/ hazardous waste)	SPCB
		Treatment and disposal (hazardous waste)	State maritime boards

As suggested by the table above, most of the fiscal instruments pertaining to environment and natural resources are in the nature of non-tax revenue. Therefore, there is merit in examining these non-tax revenue sources in detail.

Non-tax revenues

Non tax revenues can be defined as payments made to government that are: (i) compulsory and requited (e.g., fines and penalties) (ii) voluntary and unrequited (e.g., payments made to the PM's Disaster Relief Fund); and (iii) voluntary and required (e.g., mineral royalties, cess). (A Dasgupta, p 4)

In the Indian federal context, both the Centre and the States, but especially the States, have scope to greatly increase their non tax revenues from environmental and natural resources, which fall under voluntary and requited category. This category of revenues can come from assets, from the sale of goods and services and from the sale of licenses and permits for regulated activities. (Dasgupta, p 4). In the ENRM context, these can take the form of (1) revenues from assets such as: (a) the use of common property resources like forests, marine and riverine resources, grazing lands, Khazan fisheries, etc. (b) Other exhaustible or renewable resources to which private property rights are not assigned, for example mineral and petroleum royalties, royalties on hydropower, and looking further ahead on land used to generate wind and solar power, if this land is government land. (c) Returns from PSUs operating in natural resource development such as ONGC, CIL in the Central Sector and GSPC, OMDC, GMDC, in the State Sector. (2) Revenues from sales of goods and services from forest such as timber, NTP, or from user charges for the services supplied by the government such as municipal waste collection and disposal, etc and (3) Revenues from licenses for regulated activities such as "consent Fees' under the Air and Water Pollution Acts.

With respect to compulsory and requited revenue, since poor law enforcement is one of the key reasons for increased development related environmental degradation[56], it is important that penalties and fines be designed to create the right incentive to change behaviour. There should also be penalties for inaction by bureaucrats and officials to reduce opportunities for non-compliance by polluters.

Examining the revenue generated on account of environment and natural resources and its share in the total non tax revenues and own revenues of the state, it may be said that as of now, states do not sufficiently use their sources of non tax revenues around the ENRM domain, except for mineral royalties. These are important sources of non tax revenues in mineral rich states, but even here their right is constrained in terms of the royalty rates that States can charge as these are decided by the Centre (TERI, 2007) [57]. Over the years, mineral and coal rich states have complained of inadequate revenues due to infrequent revision of specific royalty rates and demanding the move to ad-valorem especially as markets for these commodities have become very buoyant.[58]

Given the inadequate use of own revenues to fund expenditures towards environmental and natural resource management, much of what happens in this domain is due to Central transfers as we discuss below.

56 See for example, Priyadarshini Keren and Gupta Omprakash K. (2003) Compliance to Environmental Regulations: The Indian Context International Journal of Business and Economics, 2003, Vol. 2, No. 1, 9-26; Sabharwal, YK (2006) Environment-Awareness-Enforcement, Asia Pacific Jurist Association, January 2006; TERI, 1997

57 We discuss this in more detail in chapter 6

58 We discuss this in more detail in a supplementary paper provided in this report.

It is difficult to arrive at a cumulative figure of all the sectors relating to environment, as environment itself is a broad and cross cutting sector and the data are limited. Due to want of available data we examine only forestry and wildlife, minerals and water supply and sanitation as sectors in which states are generating revenue.

Prima facie, Uttarakhand (2.55% of state's total revenue), Kerala (1.32% of total revenue), Madhya Pradesh (1.85% of total revenue) and Chhatisgarh (1.77% of total revenue) have a larger share of revenue accruing out of forestry and wildlife as compared to rest of the states. (*See* figure 3.2) Normally revenue under forestry and wildlife include payments for sale of timber and non timber forest produce, revenue from forests not managed by states, fines and seizures, penalty on unauthorized entry, sale of plants, surrender and others, NPV, grants for state and centre sponsored schemes and other grants based on recommendations of Finance Commission. (*See* Table 3.1)

Minerals form another major constituent of non-tax revenue of resource rich states. In Chhatisgarh, Jharkhand, and Orissa, royalty revenue is almost as important in total revenue as the contribution of the mining and quarrying sector to GSDP. In terms of contribution to the total revenue of the state, mineral royalty contributed 14.55% in Jharkhand, 9.50% in Chhatisgarh and 4.33% in Orissa. (TERI, 2007)

Water supply and sanitation constitutes comparatively a much smaller share in the total non-tax revenue with an average of only 0.8% with only few states like Goa, Rajasthan, Mizoram and Jammu & Kashmir earning above 2.5%[59] of the total revenue from water supply and sanitation.

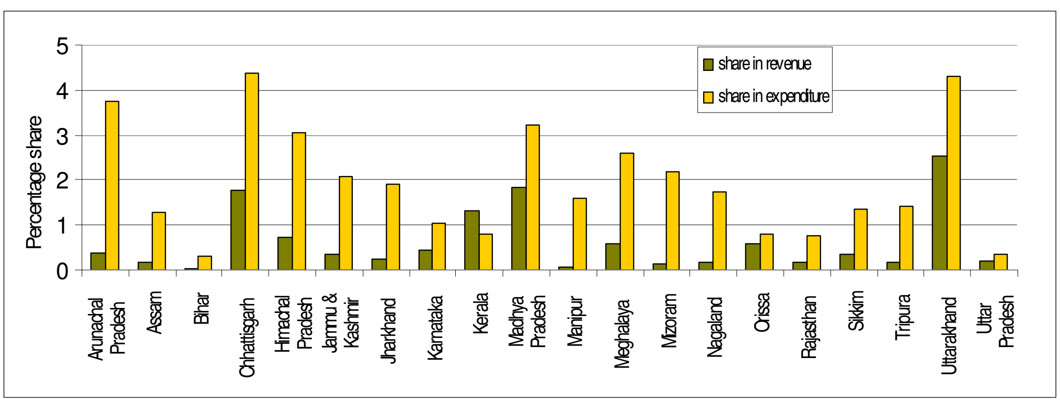


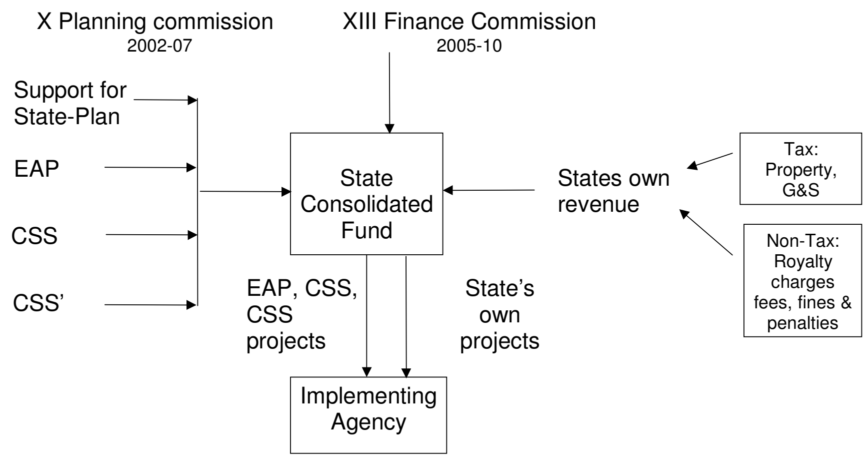
Figure 3.2 Share of forestry and wildlife in total revenue and revenue expenditure

SOURCE: STATE BUDGETS, RESERVE BANK OF INDIA

59 State Finances, Reserve Bank of India

Central transfers

There are three routes through which funds flow from the centre to the states. The first consists of devolutions made under the recommendations of the Finance Commission. The second category consists of plan grants covering central assistance for state plans as decided by the Planning Commission, as well as the plan grants given by the central ministries for implementation of plan schemes[60]. The third type of grants, which is much smaller in magnitude, essentially consists of discretionary grants given by the central ministries to states on the non-plan side. Given the multiplicity of channels it is important to look at the total transfers. Figure 3.3 provides an illustration of the centre state transfers for the environment under the TFC and the X plan.



*EAP: Externally Aided Projects; CSS: Centrally Sponsored Schemes; CSS1 : Central Sector Schemes

Figure 3.3 Centre – State Fiscal Transfers relating to ENRM – X Plan and XIII FC

Twelfth Finance Commission transfer for the environment (2005-2010)

Transfers under the recommendations of the Finance Commission on the whole account for about 65% of the total transfers. An examination of the TFC shows that specific transfers for the environment were made under two heads. First, the Finance Commission recommended a grant of Rs.1000 crore for maintenance of forests over the period 2005-10, distributed to states based on their forest area. This was in response to the submission by states that following Supreme Court restrictions on the exploitation of forests, shortage of funds had become a limiting factor in their forest management efforts. The FC required that there should be increased expenditure by the states on the maintenance of forests to the extent of this amount. In addition, the FC has released grants for tackling certain state-specific issues based on representations made by the states. Examining these grants, it

60 It may be noted that for plan assistance, there is a condition of matching contribution by the state through a 30:70 grant: loan proportion in the case of general category states and 10:90 for special category states.

can be estimated that the FC recommended an amount of about 2900 crore (about 40% of grants-in-aid for state specific needs) for environment-related issues (Table 3.3). Adding the grants made for the forestry sector, the FC allocated Rs 3910.50 crore for environment- related issues. This constitutes about 2.74% of total grants-in-aid to states.

Table 3.3 Environment related state-specific grants recommended by the Twelfth Finance Commission

State	Scheme	Grant Rs. crore
Andhra Pradesh	Drinking water supply to fluoride–affected areas	325.0
Bihar	Improving urban water supply and drainage	180.0
Gujarat	Tackling the salinity ingress problem particularly in the Saurahtra coastal area	200.0
Haryana	Tackling water logging/salinity and declining water table	100.0
Himachal Pradesh	Augmenting water supply in Shimla	38.0
Kerala	Coastal zone management	175.0
Maharashtra	Coastal and eco-tourism	250.0
Manipur	Improving water management at the Loktak lake	11.5
Meghalaya	Zoological park	30.0
	Botanical garden	5.0
Mizoram	Bamboo flowering	40.0
Orissa	Consolidation and strengthening eco-restoration work in the Chilika lake	30.0
	Sewerage system for Bhubaneswar	140.0
Punjab	Addressing stagnant agriculture	96.0
Rajasthan	Indira Gandhi Nahar Pariyojana	300.0
	Meeting drinking water scarcity in border and desert districts	150.0
Tamil Nadu	Tackling sea erosion and coastal area protection works	50.0
West Bengal	Addressing arsenic contamination of ground water	600.0
	Addressing problems relating to erosion by Ganga-Padma river in Malda and Murshidabad districts	190.0
All States		2910.5

X Plan (2002-2007) and XI Plan (2007-2012) environment linked transfers to states

The Plan transfers for MoEF have gone up from Rs. 5119.14 crore (actual expenditure) in the X Plan to Rs.8841.5 crore (2006-07 prices) projected in the XI Plan. The share of Centrally Sponsored Schemes for the environment and forest sector has been going up relative to the Central Sector Schemes. In the X plan, about 70% of the allocation for the Ministry was under CSS, but this has risen to about 77% under the XI plan. An amount of Rs 3562.38 crore was allocated for the period of the Tenth Five Year Plan (2002-07) for all states and union territories for ongoing CSS under the Ministry of Environment and Forests. An analysis of these schemes suggests the following:

- The National River Conservation Plan (NRCP) is the largest CSS in terms of funds released in both plan periods (37%in X and 27% in XI Plan); the second largest scheme was the National Afforestation Programme, accounting for about 32% of total CSS transfers under the MOEF in the X plan and 25.8% under the XI Plan.

- Tamil Nadu was the largest recipient of CSS in the X Plan (16.65%). The state received about 36% of the amount released under the NRCP. The inter-state allocation under the NAP was more uniform, with Karnataka getting the largest share- about 8.8%[61].
- Funding to strengthen pollution control boards suggests that of a total amount of Rs.19.53 crores transferred to states over the period 2002-03 to 2006-07, five of the 30 states received 50% of the funds. These include Kerala (18%), Goa (8%), Assam (6%), Tripura (9%) and Delhi (9%). Over the same 5 year period, a total of Rs. 20 crore was given for the promotion of common effluent treatment plants. Of this 76% was given to Maharashtra, 20% to Gujarat and the rest to Andhra Pradesh (1.5%) and Tamil Nadu (0.5%) [62]
- The highest financial assistance for the creation of management structures for hazardous waste over the five period 2002-02 to 2006-07 has been given to Gujarat (33%) followed by Maharashtra (15%) and Andhra Pradesh (14%), more or less in line with the hazardous waste generated by these states relatively.[63] It is important to identify and evaluate the activity/ industry to which this hazardous waste generation is linked. *For example,* Gujarat has the ship scrapping industry, a potential source of hazardous waste, which is a source of revenue to the state. This may or may not be true for other coastal states that receive metal and other scraps containing toxic waste[64] for scrapping industry, depending on whether they (the receiving states) house the scrap industry or serve as just a transit before the waste reaches other states.
- The eight North east States had a share of about 12% in the total CSS transfers for the X Plan. About 53% of these transfers were for NAP. It is unclear why the North East States are given such a large transfer under the NAP when they are rich in forest cover, unless it is a way of compensating them for the same, in which case, given that the XII FC has also transferred 1000 crores for forest compensatory purposes, no further transfers may need to be given on this score to these States.

Figure 3.4 below provides the share of total funding that has been provided to NGOs to for environmental education, awareness and training over the X Plan. It is evident that 76%

61 Needless to say these numbers provide conservative estimates of central assistance since a number of other central schemes such as the Jawaharlal Nehru Urban Renewal Mission have environmental components
62 Source: Lok Sabha unstarred question 3073 dated 5.09.07 and starred question 616 dated 9.05.05; and Rajya Sabha unstarred question 2631 dated 15.12.2006; http://www.indiastat.com/india/
63 Ibid
64 for example see news item 11 Jun 2008 Times of India "US toxic waste dumped at Indian port"

of the share of total funding over the last 3 years has been given to 4 states – Gujarat (35%,), Rajasthan (15%) Tamil Nadu (14%, and Delhi (12%). While increasing environmental education and awareness is a good policy instrument, perhaps more should also be given to the laggard states which are at the bottom five of the environmental performance index, (see chapter 3) and include Bihar (3%), Assam(1.8%) and UP (3%) along with Delhi and Gujarat in order to increase pressures from civil society for greater accountability and responsiveness by environmental officials and industry.

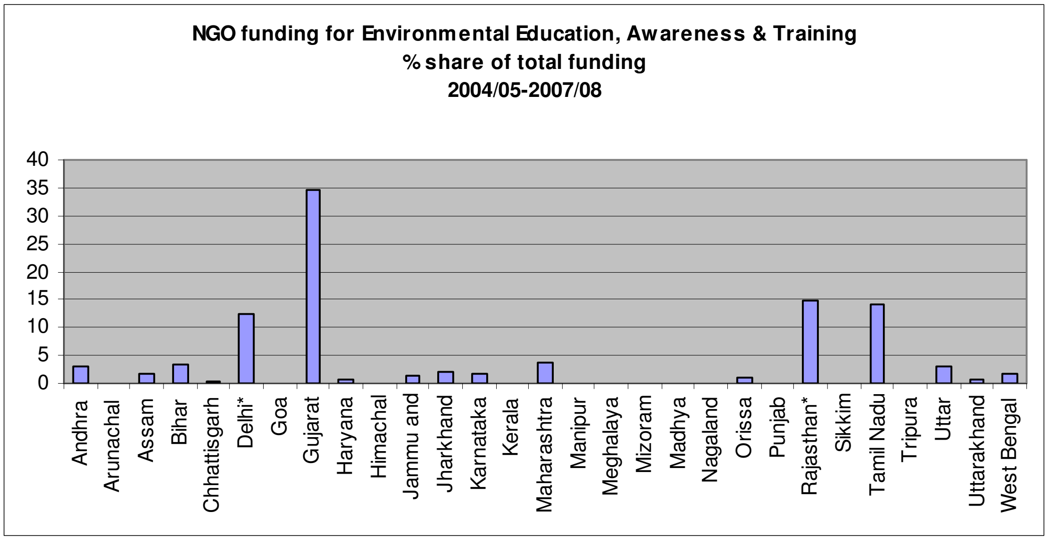


Figure 3.4 NGO funding for Environmental Education, Awareness & Training

Note : * : Including release under National Green Corps Programme.
** : Figures for 2007-08 are approximate and upto 13.03.08.

SOURCE: LOK SABHA UNSTARRED QUESTION NO. 2889, DATED ON 19.03.2008.

SOURCE: INDIA STATS

Some observations

A general criticism of the system of allocations is the increase in the discretionary component in the grants. The Planning Commission provides general grants according to the NDC (national development Council) formula as well as for specific schemes. A general feature of assistance over the past has been increasing proportion of the assistance being provided for specific schemes outside the formula –based assistance-
The criticism that applies to such transfers[65] also apply here: (i) they are discretionary as they are designed by Central Ministries where many non economic reasons may enter in the distribution (ii) relatively better off states benefit more from such schemes as they can better match resources[66] and have greater implementation capability (iii) Using this tool increases

65 See N C Saxena, Central Transfers to States and Centrally Sponsored Schemes ww.nac.in, p 7
66 CSS have a 25% matching component from States

the visibility of the Centre at the State level in the domain of environmental and natural resource management (ENRM) expenditure which is constitutionally more of a State domain as key resources belong to the States (minerals, land, water, with forest as concurrent) (iv) Ministries are more concerned with the expenditures rather than outcomes; accountability is poor as Centre does not interfere too much with States' as this is the domain of the States.

All in all, this approach to funding of ENRM is too much of a top down approach and should be used only for those programmes that have clear spillover benefits such the NRCP and the NAP, for Biosphere reserves.

The support to the NE states may be motivated by the asymmetric federal principles that drive other allocations, (viz. border states, less developed, etc) but this will also increasingly be due to their increased importance to the country in terms of forest cover.

Implementation of NRCP and other Central Sponsored Schemes points out that release of matching grants by states acts as a risk factor. Although grants may be made conditional for ensuring accountability and implementation, central assistance should not be contingent on matching contribution (especially based on loans from the centre) by states in all cases.

Newly formed states seem to be doing better, in terms of their percentage of environmental expenditure in total X Plan outlays. Since these are resource rich regions, their revenue, especially non-tax revenue draws a large share from forest and other natural resources (for example, of Uttarakhand's own non-tax revenue, 27.74 % comes from forestry and wildlife). The difference in distribution across states is also noteworthy, as for example in the case of the very large share of Tamil Nadu of the NRCP (36%), which could be a result of the coalition politics as well as the vexed issue over the sharing of the Cauvery waters and having to deal with pollution that emanates upstream of the river.

Conclusion

All this suggests that a rational environment linked fiscal transfer system should distribute funds based on needs , linked to performance and environmental effort and seek to build the capacity of states and local bodies for improved environmental governance. This domain would also benefit from an increase in States' own revenues that originate from these resources, as it would reduce the need of Central transfers and make local and State governments more accountable and responsive to the people and less dependent on the Centre. Before we examine how an environment linked fiscal transfer system can be designed, we review international experience on this with a view to examine what lessons we can draw for India.

CHAPTER 4 Fiscal Federal Frameworks around Environmental Issues – a Review of International experience

This chapter reviews the literature and studies related to select countries with regard to the use of fiscal transfers as an instrument for enhancing environmental sustainability. The main objective of this review is to assess these systems and practices and see what lessons can be drawn for India from their experiences.

Intergovernmental transfers for enhancing environment sustainability

The extent, number and type of fiscal transfers for diverse issues greatly vary in different federations. These are often used in addition to or as an alternative to tax devolution and revenue sharing with a view of enhancing the fiscal capacity of the lower tiers of the government. The fiscal transfers can generally possess different characteristics; they can be *legal entitlements* or *discretionary, conditional or unconditional* (Anderson, 2008).

Conditional grants are usually special purpose grants that are given to state/local governments for it to spend on a particular activity or a program, though the degree of conditionality varies from being highly detailed to very general. Unconditional grants are given for general spending purposes and they include equalization transfers and "block" transfers that could be linked to a specific program area (such as health), but with few or no conditions in terms of how the money is spent. On the other hand the unconditional grants are generally for broad programming and administrative needs of constituent units, usually used as a tool to correct fiscal imbalances at state/local level.

The Conditional grants can prove to be an effective tool through, which the central government can make the constituent units of government spend on programs, which are priorities for the central government. In some cases, the central government can encourage spending in areas where it considers the constituent units under-spend, such as universities or hospitals and now environment, which have strong spillover benefits across the regions within a country. In other cases, it may want to encourage more coherent program structures or design provisions to strengthen the internal common market by facilitating individual or corporate mobility across constituent units.

However in order to ensure that the grants tied to particular objective is used effectively and for the purpose of its transfer it is critical that the design of the transfers is appropriate such that it ensures local service provision and the fiscal health of constituent units of government. Good grant design provides incentives for constituent units not to drive up program costs (so federal grants are tied not to actual spending but instead to some established norm for costs) and to spend efficiently (so grants are tied not to inputs but to outputs); there may also be caps on the grants. While designing grants it is crucial to maintain clarity in grant objectives, autonomy, revenue adequacy, responsiveness, equity (fairness), predictability, transparency, efficiency, simplicity, incentive, reach, safeguarding the grantor's objectives, affordability, singular focus, and accountability for results.

Box 4.1 Conditional Grants in Various Federations

The United States, driven by its Congressional system, attaches conditions to all transfers to the states; it has 600 categorical grant programs and 17 block grants (which are less constraining but much smaller in total size), as well as an annual several thousand "earmarked" pork-barrel projects (such as a bridge). Its grant conditions can have a very weak connection to the program (e.g. federal highway funding requires prohibition of alcohol sales to those under 21) and earmarked projects can be attached to virtually any legislation. While the Swiss constitution does not permit federal conditional grants, in practice certain grants are made for particular programs, though largely with the consent of the cantons (which could challenge such conditions through a referendum). The largest grants in Canada are block transfers targeted to health care and social assistance, with minimal conditions. While Indian states main support from the federal government comes through unconditional shares of federal taxes, they also receive conditional grants for development plans and various centrally-determined projects. In South Africa, the constitution requires transfers of an equitable share of federal revenue to provinces to which the federal government can and does attach conditions for its expenditure

SOURCE: ANDERSON, 2008

Following the above logic, potential benefits of introducing fiscal equalization principles into regional environmental funding have been recognized in many federations and many have used fiscal tools either in form of introducing environmental indicators in the tax devolution formula or through the provision of conditional grants tied to a particular environmental program, appropriately to internalise the associated externalities with natural resource management. The following section provides a review of international practices in environmental fiscal federalism, followed by commonalities and lessons for India to learn.

Countrywide policies: a case-by-case review

Germany[67]

Since the Treaty of Maastricht on European Union of 1992, environmental federalism has been rediscovered and extensively discussed in Europe, basically strengthening the principle of subsidiarity (Huckestein 1993; Hansjurgens, 1996; Doring, 1997; Oates, 1998). According to this principle, public

67 Ring I. 2002, 'Ecological public functions and fiscal equalization at the local level in Germany', Ecological Economics 42, pages 415-427 policy and its implementation should be allocated to the smallest jurisdiction with competence to achieve the objectives. Hence, as per the tenets of the Maastricht Treaty, distribution of responsibilities pertaining to public goods and services in Germany among various government levels follow the principle of subsidiarity. The federal government bears responsibility for functions that have a general and nationwide character. On the other hand the state and local authorities cater to the regional and local development. Similarly, the intergovernmental transfers for ecological services fall under the ambit of subsidiarity and are based on the principle of fiscal equalisation. The most important source of income for local levels in Germany is grants aimed at fiscal equalisation. Grants disbursed under the guiding principles of subsidiarity and fiscal equalisation, help decentralized jurisdiction to sustain their natural endowment by offering compensation for their ecological services. Fiscal equalisation is important since spill over effects or positive externalities arising from environmental public functions can be addressed within the system of intergovernmental fiscal relations.

All German states have access to earmarked grants very often in the forms of incentive programmes for environmental or conservation-oriented purposes. Some of the programmes are implemented at the state level, while the state and federal governments jointly manage some and still others are in collaboration with the agri-environmental programmes at the European level. Table 4.1 gives a list of some of the ecological aspects covered under fiscal equalisation in Germany. Two approaches are used in Germany for fiscal transfers for ecological services: indirect approach and direct approach. Moreover, most ecological services in fiscal equalisation laws are supported by conditional grants or provision of loans to local government.

Table 4.1 Ecological functions in fiscal equalisation at the local level in Germany

Area	Supported Measures
Soil	Prospecting and remediation of contaminated sites, recultivation
Water	Water protection Water supply Sewage Disposal
Nature conservation	Nature protection and landscape conservation
Recreation	Spas Recreation and tourism
Waste disposal	Waste disposal plants
Energy	Energy saving measures

SOURCE: RING 2002

In the indirect approach, area-related indicators form an important constituent for the basis of intergovernmental transfers. This is because the larger a community, lower the population density and farther away from an urban settlement, the higher the cost of public service provision. The additional costs can be encountered in the provision of both ecological and socio-economic public goods like nature conservation, waste disposal, education and water supply. Remote areas are also typically characterized by valuable habitats for rare species and high proportion of agricultural land and forestry. Hence the importance of area-related indicators increases manifold for remote areas. Majority of fiscal equalisation inter-governmental transfers consider area-related indicators in Germany. Conditional grants that get more expensive with a larger district area are disbursed to most states in Germany. However, though the theoretical underpinnings cover ecological services for area related indicators in intergovernmental transfers, currently area as an indicator is mostly used for socio-economic functions.

Apart from the indirect approach, under the direct approach many fiscal equalisation laws directly consider ecological services. Within this, there are three main approaches adopted for direct consideration of ecological public functions. Firstly, from the amount available for distribution to the local government, before any indicators come into play, a certain proportion is earmarked for ecological services apart from the finances set aside for socio-economic functions. This approach is employed by states like Bavaria, Baden-Wurttemberg, Saxony and Mecklenburg Western Pomerania. Second approach entails the inclusion of ecological services as a basis for calculating the fiscal need in case of lump-sum transfers. Saarland uses such transfers for local jurisdictions suffering from mining damage. Thirdly and by the most commonly employed technique fiscal equalisation at the local level considers ecological functions through conditional grants. 'Most of the fiscal equalisation laws explicitly specify measures related to sewage disposal, water supply and waste disposal. Conditional grants for the prospecting and remediation of contaminated sites are also quite common. Further ecological functions can only be sporadically found in a few fiscal equalisation laws, mainly concerning precautionary-type measures related to nature and resource protection or landscape conservation' (Ring 2002). Hence, by means of conditional grants, supports projects related to biotope protection, biotope networks and water conservation schemes.

However these approaches adopted by Germany have come under criticism by authors like Ring (2002) and Bergman (1999). Fiscal equalisation laws in Germany tend to cover 'end-of-the-pipe infrastructure' and resources protection and nature conservation apart from functions pertaining to drinking water are usually neglected. Intergovernmental transfers for environmental services are not based on indicators apart from area related indicators unlike the transfers related to socio-economic public goods. As a result 'ecological functions provided by rural and remote area are underrepresented in fiscal equalisation laws at the local level and therefore the respective jurisdictions are not compensated for the external benefits of their expenditure' which in turn leads to under provision of such public goods.

The German case, clearly showcases that although ecological functions have been started to be only partly considered within the system of fiscal equalization at the local level, there is still a long way ahead before intergovernmental fiscal relations systematically address ecological functions (Ring, 2002).

Switzerland[68]

In Switzerland, fiscal transfers are vertical from the federal to the 'cantonal' level. These funds are transferred on a project-oriented support basis. For each conservation activity, applications have to be submitted and examined by the federal administration. Financial support depends on the ecological value of the resource, the financial capacity of the canton, and the overall fiscal need for nature conservation (Kollner et al 2002). This is also the chief criticism of such transfers because it violates the subsidiarity principle, involves a lot of red-tapism and can be costly. 'With regard to the assigned activities and the fiscal need of the cantons, the cantons have both to enforce federal law and to set and enforce cantonal law.'

Canada[69]

Canada comprises ten provinces and three territories, governed by three orders of government: the federal, provincial and local governments. In the Canadian federal structure, territorial governments have no constitutional standing. The federal government delegates the expenditure responsibilities and ability to raise revenues to the territorial governments. , The federal government in general plays a more important role in the provision of services in the territories than in the provinces. The local governments do not possess any power under the Canadian consitution, they are under the full responsibility of the provincial governments. Hence, some expenditure responsibilities and taxation powers are delegated to local governments at the discretion of provinces. Therefore, the dependence of the local governments on the provincial governments is very large in Canada, from which they receive their mandate and an important part of their revenues.

68 Kollner T., Schelske O., and Seidi I., 2002, 'Integrating biodiversity into intergovernmental fiscal transfers based on cantonal benchmarking: a Swiss case study', Basic and Applied Ecology. 3, 381-391
69 Tremblay J, 2006, "Fiscal Federalism and Public Service Provision in Canada", Department of Economics, University of Ottawa.

Revenues, expenditures and transfers by levels of government
The Canadian federal structure and assignment of powers under the consitiution clearly shows that in Canada the powers are more centralized with very limited flexibility. However, there has been an important long-run trend towards the decentralization of both revenues-raising and program spending in Canada, especially across the federal and provincial levels. Many fiscal instruments are prevalent in Canada and intergovernmental transfers are for a fairly substantial part in Canada, both between the federal and provincial governments and between the provincial and local governments. There are two main categories of these transfers to provinces: equalization grants and transfers for the financing of provincial expenditures in the areas of health care, post-secondary education and social assistance. The principle of equalization is specified in the Constitution and necessitates that the federal government should transfer funds to provinces in order to ensure that all provincial governments have the capacity for offering comparable levels of services to their citizens at comparable levels of taxation.

Equalization transfers are provided to all provinces with a below-average fiscal capacity, which currently includes all provinces except Ontario and Alberta. The equalization payment to a particular recipient province is determined by a formula, which intends to cover, for each eligible tax base, the difference between the revenues that would be raised by that province if it were to set the average tax rate on that base and the average revenues raised on that tax base across five representative provinces. The second main category of transfers are those that are specifically intended for the financing of health care, post-secondary education, social assistance and social services, and are now provided to provinces on a per capita basis. These transfers are divided in two blocks: the Canada Health Transfer (CHT) and the Canada Social Transfer (CST).

Provincial governments also transfer substantial amounts to local governments. These are infact transfers that are almost as large as federal transfers to provinces. However, only about 20 percent of provincial transfers to local governments are general purpose transfers, in contrast to over 30 percent for federal transfers to provinces (Treff and Perry. 2005). Most provincial transfers are conditional on municipality expenditures on social services, on the construction and maintenance of the road systems, public transportation, water treatment and supply and public housing. Some of the provincial transfers to local governments have an equalization component, although the precise form of these transfers varies across provinces (Boadway and Hobson. 1993; Kitchen. 2002). As federal equalization transfers to provinces, they are intended to compensate, to some extent, municipalities that have below average tax capacity. In some provinces, expenditure needs are also taken into account (Kitchen, 2002; Slack and Bird, 2006), and grants may be differentiated for rural and urban municipalities (Slack and Bird. 2006).

In Canada, specific environmental performance based earmarked fiscal transfers do not exist, however the expenditure on environment are allocated at all levels of government. In the year 2005, for example, the federal government allocated 0.9%, provincial 0.8% and local government allocating 10.6% to environment. Local governments supported around 70% of total environment expenditures in 2004-2005 (Treff and Perry. 2005). Most of local government spending in this area is for water purification and supply, sewage collection and disposal, and garbage and waste collection and disposal. However, these functions are often regulated and subsidized by provincial governments. Federal responsibilities in the environment area include the protection of water and air quality, pollution control, meteorological services and international agreements.

Australia[70]

In Australia, regional governance agencies such as watershed management committees have been playing a significant role in natural resources management. The growth of such agencies can be attributed to publicly funded programs such as Landcare, the Natural Heritage Trust (NHT) and the National Action Plan (NAP) for Salinity and Water Quality. Some of the regional natural resources management (NRM) groups have statutory powers, in accordance with the principle of subsidarity, and at times regulatory powers as well. Under the management framework for NAP and NHT, regional agencies are responsible for delivering the service and they depend on central government for their revenue. For example, the sole source of funding for the Far North Queensland Natural Resources Management for 2003-04 was NHT while Central West Catchment Management Authority of New South Wales received 98% of its revenues from NAP and NHT programs in 2003-04. This dependency on central government for income is typical of most NRM groups and gives rise to the dilemma of allocating limited resources among competing regions. In this regard Queensland disbursed environmental funds amounting to $146.6 million across 14 regions based on the multiple criteria analysis in order to enable fiscal equalisation among the different regions. 'Fiscal equalisation of environmental funds aims to equalise the capability of each region to address

70 Hajkowicz S., 2007, 'Allocating scarce financial resources across regions for environmental management in Oueensland, Australia, Ecological Economics, 61, pages 208-216 environmental degradation' by allocating money according to needs. The MCA method was adopted since it 'provided the most feasible analytical framework to inform decision makers in setting indicative regional budgets for Queensland NRM groups'.

Brazil[71]

Brazil provides a classic case of how the spillovers associated with the provision of public goods and services at the local level can be internalized through intergovernmental fiscal transfers from more centralized levels to the local level. These transfers as is known compensate municipalities for the external benefits of their conservation expenditure, as well as for their opportunity costs related to land use restrictions to be borne. This is especially necessary in relation to social benefits that accrue in the long term, where public actors are bearing the costs arising in the present. In this way, the 'value added' of local ecological goods and services is acknowledged socially, which at the same time can provide an incentive for local actors to engage in more conservation activities. Following this genesis of intergovernmental fiscal transfers, Brazil introduced fiscal transfers for local ecological services.

Brazil has 27 states with an elected government each, with revenue raising powers. ICMS tax (Imposto sobre Circulacdo de Mercadorias e Services) represents largest sources of state revenue in Brazil, constituting approximately 90% of overall state tax revenue. Also, an important sources of revenue for the local government and is similar to value added tax in other countries. It is collected on all commercial transactions and exchanges of goods and services such as energy, transportation and communication (May et al., 2002). Under the Constitution 25% of the revenue raised by this tax is to be allocated by the state to the local level of government. Constitution law further demands that 75% of total amount passed on to the municipalities should be distributed in accordance with the share of the state ICMS that has been collected within that municipality. The allocation of the remaining 25% is done by the state governments based on certain indicators. Typical indicators are based on population, geographical area and primary production. Since the 1990s the states began to introduce ecological indicators. It was first introduced by the state of Parana, which was the first state to introduce the ICMS Ecologico, meaning the ICMS along with an allocation of tax revenues based on environmental indicators.

71 Ring I. 2007, 'Integrating local ecological services into intergovernmental fiscal transfers: The case of the ecological ICMS in Brazil', Land Use Policy

Following the implementation of more strict environmental legislation in the early 1980s, a number of municipalities in Parana´ that had protected areas on their territory exerted pressure on the state legislature and government agencies (Loureiro, 1998). The land-use restrictions associated with large conservation and watershed protection areas were preventing the municipalities from developing productive activities and thereby generating value addition. The municipality of Piraquara is a typical example of this situation: 90% of municipal territory consists of designated protected areas for conserving a major watershed to supply the Curitiba metropolitan region (1.5 million inhabitants) with drinking water, and the remaining 10% occupies protected areas for biodiversity conservation (May et al., 2002). The ICMS Ecologico was introduced in response to these concerns, as an instrument to compensate municipalities with large protected areas for the land-use restrictions they faced, while providing incentives for conservation (Loureiro, 2002). Following the adoption of the Ecological ICMS Law in 1991, 5% of the total amount distributed to the local level has been based on ecological indicators since 1992. Half of this (2.5%) is distributed to municipalities that have watershed protection areas on their territories, which partly or completely provide services for public drinking water systems in neighbouring municipalities. The other half is for those municipalities that have "conservation units" (Loureiro, 2002). Conservation units (CUs) are conservation areas that consist of completely protected and restricted sustainable use areas that can be publicly managed (federal, state or municipal level), privately owned or managed by public–private partnerships. The ICMS-E revenue accrues to the municipality and not to the owner of the land. Therefore, the incentive effect primarily addresses local public authorities.

The states of Paraná, Minas Gerais, Rondônia and São Paulo have now been operating the ICMS-E for several years. Mato Grosso do Sul, Pernambuco and Tocantins introduced the new system only recently. Each state is free to decide upon the indicators for distributing 25% of the ICMS to the local level, and therefore, different operating systems are in place.

Participation in the programme

In the states in which ICMS-E legislation exists, ecological fiscal transfers are automatically distributed to all municipalities that qualify, i.e. that hold officially registered conservation units within their territories. Therefore, an important prerequisite for the success of the programme is a good information policy. Municipalities need to know about the programme and they also need to expect benefits from participation for actually making an effort to create new conservation units or to use the ICMSE revenues for additional conservation benefits.

Young (2005) stresses the effectiveness of the ICMS-E in encouraging the creation of new protected areas. Changing municipal revenues: the total amounts passed through to municipalities are appreciable.

Way forward
Although the basic features of the ICMS-E are rather uniform across the various Brazilian states, however the method of implementation, its operation in practice and the reactions on the part of the municipalities greatly varies. In-depth empirical studies show that ICMS-E allocations appear to have substantial impacts on conservation decisions in some areas, while in others only a limited impact can be observed (May et al., 2002). Municipalities with a high share of protected areas in particular can benefit substantially from the ecological fiscal transfers, and therefore appreciate the ecological services they provide across local boundaries.

Despite the pros and cons of how precisely to design the ICMS-E, this innovative instrument is in the ascendant in Brazil. One of the great advantages of the ICMS-E is that it is not an instrument that requires new institutions or a new bureaucracy. By simply introducing an ecological indicator into the existing fiscal transfer mechanism, it builds on existing institutions and administrative procedures, thereby entailing very low transaction costs.

Lessons for India

The above section clearly brings out the different ways in which the tool of fiscal transfers has been adopted by different federations incorporating the management and provision of environmental and ecological goods and services in the fiscal federal structure of governance. These clearly vary with the specific type and nature of each country suited to meet the specific characteristics. Tables 4.2 and 4.3 below presents the prominent features of each as well as outline the key requisites of a particular country approach and the critique as highlighted in the environmental fiscal federalism literature.
It is evident from the analysis that federations of Germany and Brazil follow the principle of subsidiarity when incorporating the environmental aspects in the fiscal federal transfers. Switzerland on the other hand does not follow the principle of subsidiarity where the transfers are made mainly on a project-oriented basis. The type of environmental issues covered also varies among countries, where in Germany the range of issues covered is

broad and in Brazil on the other hand the transfers are limited covering issues of watershed protection and conservation units.

In addition the transfers take different forms in every country. In Germany, the transfers are mainly in form of equalization conditional grants and loans to the local government, to project based funding in Switzerland. And in case of Brazil ecological indicators introduced in the tax devolution formula guide the transfers. Similarly Queensland in Australia adopted a MCA to disburse funds to various regions.

These country experiences point to some common lessons. It is evident that given the nature of environmental issues the principle of subsidiarity (except in the case of Switzerland) is most applicable while considering fiscal transfers for environmental management. Further it is also clear from country cases above that transferring of funds or revenue sharing could generally be based on certain environmental indicators, which vary among countries depending of specific needs and characteristics. These indicators can either be subsumed in the tax devolution formula or form a basis of conditional/unconditional grants.

Table 4.2 Features of different country initiatives in adopting environmental issues in fiscal federal frameworks

Features	Countries			
	Germany	Brazil	Switzerland	Australia
Environmental issues covered	Soil (prospecting and remediation of contaminated sites and recultivation), Water (water supply and protection, sewage disposal),Nature conservation (nature protection and landscape conservation), Recreation (spas, recreation and tourism), Waste (waste disposal plants), Energy (energy saving measures)	Watershed protection, conservation	Nature and landscape protection, etc.	Salinity, water quality, conservation of natural heritage, land
Basis of transfer	Compensation and Both indirect and direct approach used: Indirect: area indicators Direct: certain portion earmarked for ecological services	Incentives for conservation; compensation for land-use restrictions – based on ecological indicators	Ecological value of the resource, the financial capacity of the canton; the overall fiscal need for nature conservation	Multiple criteria analysis (MCA) adopted by Queensland to disburse funds to 14 regions
Form of transfer	Mostly conditional grants and loans to local governments	Percentage of tax revenue- ICMS Ecologico: 5% of total amount distributed to local governments by states is based on ecological indicators	Project oriented support	Devolution of centre governments funds through the MCA

Features	Countries			
	Germany	Brazil	Switzerland	Australia
Principle of fiscal federalism followed	Subsidarity	Subsidarity	Violates the principle of subsidarity	
Planned reforms		Focus more on the individual land user, PES, agricultural certification schemes, etc	A shift from activity orientation to result-orientation with respect to purpose-linked transfers	
References	Ring (2002)	Ring (2007)	Kollner et al (2002)	Haj kowicz (2007)

Table 4.3 Requisites and critique of country approaches

Country	Requisites	Critique of the approach
Germany	▪ States needing to have access to earmarked grants ▪ Under indirect approach: area related indicators required ▪ Direct approach: - Apportioning amount available for disbursements for ecological functions before any indicators - Including ecological services while calculating fiscal needs for lump sum transfers - Identifying specific ecological function measures to be tied to grants	▪ Inclusion of ecological function for fiscal equalization in a rather nascent stage: only sporadically found among regions ▪ Inclusion of only end of the pipe and infrastructure related ecological functions; neglect of resource protection and nature conservation ▪ Inclusion of only area related indicators; thereby under-representation of ecological issues
Switzerland	▪ Submission of project specific proposals for undertaking conservation activities ▪ Requires setting up an institution at the central level, for examining proposals and earmarking funds	▪ Violates the subsidiarity principle ▪ Involves of red-tapism ▪ Costly ▪ More activity than result orientated
Australia	▪ Establish publicly funded programs ▪ Regional agencies responsible for delivering the ecological service ▪ Dependence of regional agencies on central government revenue ▪ Developing a MCA[72] for disbursement of environmental funds; as undertaken by the region of Queensland	▪ MCA mechanism is only as good as the input data and weights assigned by the decision maker
Canada	No specific environmental performance based earmarked fiscal transfers	-
Brazil	▪ Sub-national governments to have revenue raising powers ▪ Revenue from tax such as the value added tax used for disbursements ▪ Allocation of tax revenues based on environmental indicators: mainly as lump sum transfers ▪ Indicators chosen can vary among states	▪ Type of indicator chosen determines the incentive effect ▪ Not only quantity but quality indicators should be included' majority of states Brazil still lagging in this ▪ Allocation of revenue based on indicators through lump sum transfers could be earmarked to specific environmental purposes

72 The process of MCA to define an environmental needs index for fiscal equalization involves:
- Identify the criteria (attributes) that collectively define environmental need
- Identify the set of objects that will be assigned an index value ('objects' could be states for example)
- Decision mares to assign weights to the criteria to identify their relative importance
- Transform criteria into commensurate units. Combine the weights and transformed measures via one of many MCA algorithms to attain an overall score for each object
- Allocate the fixed resource amongst the regions based on the needs index ensuring the ratio of funding to needs is equalized

(Source: Hajkowicz, 2007)

As depicted in Table 4.3, there are certain pre-requisites in form of complementary actions; institutions etc., associated with every approach to incorporate environmental issues in fiscal equalization mechanism. However, it needs to be mentioned that among the countries considered in the above section, where some form of fiscals transfers have been made on environmental basis, Brazil being similar to India in its federal structure and both based on "holding together"[73] view of federalism offers pertinent lessons to learn from the country. In Brazil the focus is on compensating municipalities, i.e. public institutions, based on environmental indicators. Every state in Brazil has the freedom to decide upon the indicators for distributing 25% of the ICMS to the local level, and therefore, different operating systems are in place. This provides flexibility to the states and thereby suits local needs.

One of the major problems associated with centralized provision of ecosystem services is that knowledge about the opportunity costs of protected areas is greater at the local level. Brazil provides a unique example where, the ICMS Ecologico addresses this problem by combining centralised incentives with decentralised decisions. The incentives are inform of authority for every state to disburse a percentage of tax revenue collected and, the way these are distributed among the local governments by every state, is left at the discretion of the state, as it is free to decide the indicators it wants to incorporate. In addition, the ICMS-E is not an instrument that requires new institutions or a new bureaucracy. It simply introduces an ecological indicator into the existing fiscal transfer mechanism and builds on existing institutions and administrative procedures, thereby entailing very low transaction costs. Similarly in India, such an approach can be adopted wherein the environmental performance indicators can be introduced in the present formula of devolutions of funds between the center and states. The present study focuses on building a case for introducing such indicators for various resources with an aim to build an incentive mechanism for rewarding good environmental performance by states as well as building capacity for better performance.

The use of ecological indicators as a means for disbursing resources to states and local bodies would help incentivise environmental management and the protection and

73 The "holding together" view of federalism, also called "new federalism", is based on decentralization model where an attempt is made to decentralize responsibilities to state-local orders of government with a view to overcoming regional and local discontent with central policies. This view is the driving force behind the current interest in principles of federalism in unitary countries and in relatively newer federations such as Brazil and India and emerging federations such as Iraq, Spain, and South Africa (Shah, 2004).

enhancement of ecosystem services by raising awareness and rewarding performance. Further in India, States that hold forest areas and are also foregoing rights to resource development on account of forest or "no go" areas should be compensated through special Finance Commission provisions. One can also examine ways in which states that are engaging in more energy efficient paths or in the use of renewable energy can be rewarded.

Conclusions

To conclude, some key lessons that emerge from our review:

- Given the nature of environmental issues the principle of subsidarity is most applicable while considering fiscal transfers for environmental management
- Intergovernmental transfers need to be given to incentivize environmental performance in states and local governments
- Ecological indicators are used to assess environmental outcomes; these build on existing institutions and administrative procedures and help streamline the fiscal transfer mechanisms,
- From the amount of funds available for distribution to the local government, a certain proportion is earmarked for ecological services in many sub national governments
- The local benefit of providing certain ecological goods and services should ultimately be reflected in the matching contribution of the local government to receive conditional grant
- There is need to address institutional constraints and build capacity for environmental governance

With the exception of Brazil, where the transfers on ecological grounds have been widely implemented by the states, it evident, that in the present phase, the case of other federations repeats the historical development of environmental policies. Where in early phases of environmental policy, a narrow focus on the point of emissions favoured technological, end-of-the pipe solutions to acute and mostly local environmental problems, in later and more mature phases of environmental policy, the importance of precautionary, long term and co-evolutionary approaches was highlighted, calling for integrative concepts (Ring, 1997).

Therefore, what is crucial is to carefully consider both, phases together, while, exploring the intergovernmental fiscal relations within the ambit of environmental functions.

Part II: Strengthening centre-state fiscal architecture to promote more environmentally sustainable development (ESD)

Part II

Part I analyzed the environmental and federal context in India. The analysis in Chapter I, while recognizing that development in India has a large environmental footprint, focused on what States are doing by way of managing environmental quality through complying with national environmental standards at the minimum. Given the multiplication of threats that climate concerns pose to sustainable development, Chapter 2 reviewed current knowledge on potential impacts on India. This review suggests the need for more detailed studies at the State level, but already the need, from what is known, for building adaptation capacity in human and ecosystems. Chapter 3 argued that while in some cases, there is a clear constitutional division, space for involvement of state and local governments is limited. The analysis of current intergovernmental transfers on ENRM issues highlights an approach to funding of ENRM that is currently too top down, and that should be used only for those programmes that have clear spillover benefits. The review of international experience in federal systems in Chapter 4 highlights the applicability of the principle of subsidiarity while considering fiscal transfers for environmental management. It finds evidence for the use of intergovernmental transfers to incentivize environmental performance in states and local governments and the use of ecological indicators to assess environmental outcomes. The review also documents instances where a certain proportion of funds for local governments is earmarked for ecological services in many sub national governments.

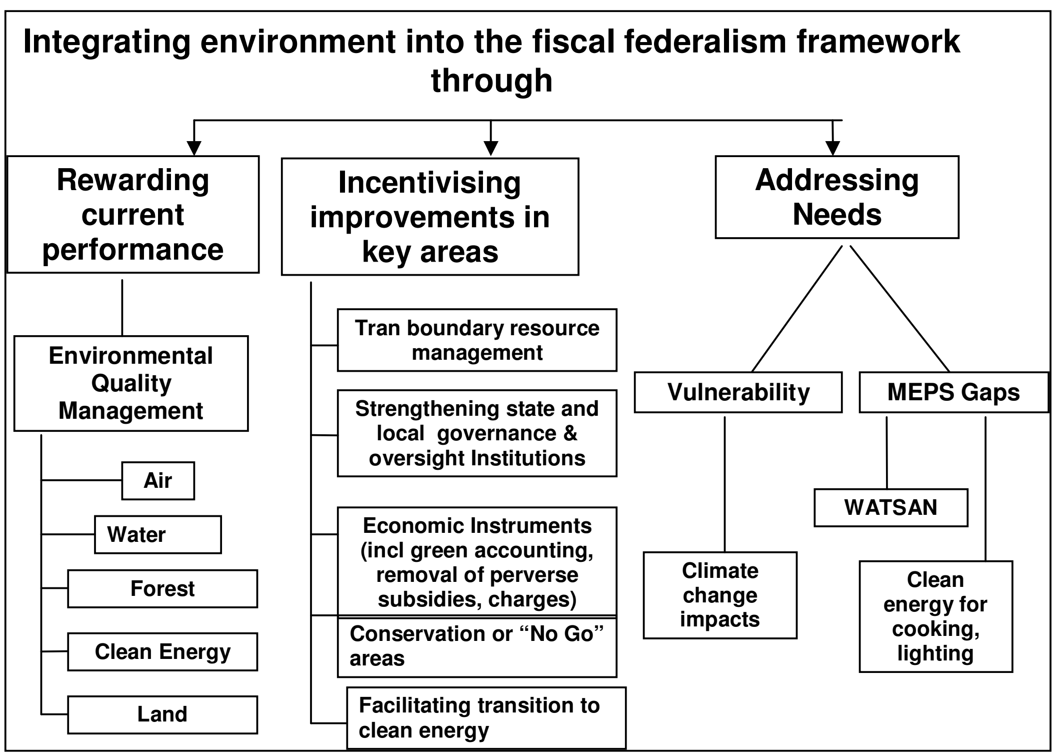
Achieving an ESD requires that we aspire to some key outcomes. This study suggests the following: Enhanced air, water, and land quality; increased water availability ; increased eco-system services; reduced carbon emissions from energy use; protection of critical socio-ecological resources; enhanced resilience of population vulnerable to climate change and universal access to minimum environmental protection services for health and well-being. Moving forward and based on these outcomes and this analysis of the environmental and federal context, we argue that to integrate ecological and climate concerns consistent with sustainable development requires:

- A differentiated devolution, based on goals of governance, with the involvement of multiple tiers of governments with clearly delineated responsibility
- Institutional strengthening at state and local levels
- Addressing capacity constraints at the local government level

- Enable SPCBs to efficiently discharge their mandated functions
- Clearly defining own revenue sources for local governments
- Incentivising the strengthening and performance of local governments
- Delimiting 'No Go' areas
- Full adherence to constitutional (Schedules 5 and 6) and statutory (PESA) provisions for the protection of the rights of tribal communities
- Adhering to the "precautionary principle" and the "polluter pays principle" and
- Addressing failures: market, policy, and governance

The study makes the following grant proposals for the consideration of the Finance Commission which are discussed in Chapters 5-8 and summarised in the figure below:

1. For rewarding environmental performance of states. (Chapter 5)
2. For building capacity to address climate change at the level of the states. (Chapter 6)
3. For the provision of minimum environmental protection services (Chapter 7)
4. For incentivising key actions needed to improve environmental and ecological management (Chapter 8)



CHAPTER 5 Rewarding environmental performance of states

This study recommends that the XIII Finance Commission reward states for improving the quality of environmental resources within their jurisdiction and for responding to energy related environmental concerns. This chapter draws upon the discussions in Chapter 1 and develops a framework for evaluating and rewarding environmental performance of Indian states over the period 2010-2015 . It illustrates, through an example, the construction of these indexes and how the ranking from such assessments can be used to disburse a performance grant.

In Chapter 1, environmental quality of states was commented upon based on the following: air quality, surface and groundwater quality and availability, dense forest cover, extent of land degradation, energy intensity, renewable energy, and aggregate technical and commercial losses in the electricity sector. This commentary was based on data available for 2005/06 and focussed where relevant on established national standards. Box 5.1 summarises the indicators used in chapter 1 to assess the state of various environmental domains and energy use in the country.

Box 5.1 Indicators of environmental performance of states

Air quality: The exceedence factor with regard to RSPM which has been taken as the key criteria pollutant to determine the air quality status.

Surface water quality :The number of monitoring stations of a state satisfying the BOD and Total Coliform norms under criteria "C" of designated best use classification.

Ground water quality: The number of monitoring stations of a state satisfying drinking water quality norms mandated by the BIS in IS: 10500.

Forest quality: The level of dense forest cover as a proportion of the geographical area.

Land quality:The share of degraded land amenable to management as a percent of total state geographical area.

Energy Intensity: Commercial energy consumption within states per unit SDP.

Renewable energy: Renewable electricity potential within states and the prevailing level of installed electricity generation capacity based on renewable sources; RPOs issued by SERCs.

Energy efficiency: Aggregate technical and commercial losses incurred by Discoms located within a state.

Assessing and rewarding the environmental performance of states

For assessing the improvements in performance over time within states, the following framework is suggested. It involves the construction of two dynamic performance indices and their use to reward.

1. Environmental Performance Index I (EPI1) captures the effort made by states overtime to manage the quality of resources, viz. air, water and forests.[74] This index is computed by using 3 indicators[75], one for each domain, which measures how the states fare against benchmarks established by minimum environmental standards set for each domain. In the case of forests, performance is differentiated for hill states and non-hill states to reflect varying initial conditions.
2. Environmental Performance Index II (EPI 2) captures the efforts made by states overtime to respond to the twin concerns of carbon and energy. The indicators used in this case are RPOs issued by states and the ATC losses of distribution licensees within a state.

While EPI1 is based on national minimum standards, EPI2 is based on obligations/targets set by states themselves. It is proposed that 2 awards be given. The assessment years could be 2012 with base year as 2010; and 2014 with 2012 as base year.

Based on the performance of states in the two environmental performance indices, the states should be allocated untied block grants as a reward for management of the environment of the State as well as for improved efficiency of energy use and penetration of renewable sources of energy.

An indicative amount of Rs. 2000 crores can be allocated for purpose of rewarding states. Out of this total, Rs. 1500 crores could be disbursed for environmental quality management based on EPI1; and Rs. 500 crores could be given for addressing carbon concerns based on EPI2.

The following section provides a methodology for the construction of the Index, and its use in the allocation of grants among states.

Methodology for construction of the EPIs and their use for grant disbursal

Step 1: To evaluate the improvements made by states with respect to the aforementioned indicators:

74 Land quality is nor covered as national assessments on this are done more randomly and may be difficult to synchronise with the other three.
75 Performance indicators compare the actual situation with targets, allowing progress towards such targets to be measures (Warhurst 2001)

This would involve the computation and standardization of the change in indicator values to a 0-1 variable. This procedure would make the respective figures unitless so that the indicators became comparable for the construction of index. In the index the best performer with respect to a specific indicator would get the value of 1, while the worst performer would be ascribed the value 0.

The standardization procedure, assuming x to be the variable, is as follows:

$$x\text{-index} = \frac{x - \min(x)}{\max(x) - \min(x)}$$

where min(x) and max(x) were the lowest and highest values the variable x attains, respectively.[76]

<u>Step 2</u>: To compute the two indices of environmental performance:
The scores received by each state with respect to each of the indicators are weighted and then averaged. It is proposed that for the construction of both environmental performance indices, equal weights may be assigned to the constituent indicators. Keeping the weights are equal for all indicators would lend simplicity to the index construction process.

<u>Step 3</u>: To arrive at a procedure for grant disbursal:
The standardized shares for the allocation of grants to states would be computed using the index values for a particular state and the sum of index for all other states. States would then be assigned ranks based on these index values. The standardized share for each state is derived using the following formula:

$$\text{Standardized Share}_i = \frac{Index_i}{\sum_{i=1}^{n} Index_i}$$

It should be reiterated that there is a structural difference between the two performance indices. While in the first index the performance of states would be judged based on national environmental benchmarks, in the second index the performance of state would be assessed based on obligations/targets for performance made by the states themselves.

76 This is the procedure used to arrive at the Human Development Index in the UNDP Human Development Reports

It has to be noted that one of the caveats to the environmental performance index is that there is a possibility that a state that has nil compliance in all years may score higher in the flow indicator than a state that has witnessed deterioration in status overtime.

The rest of this chapter provides only an illustration of how EPI1 and EPI2 can be constructed and used for grant disbursal. It is not meant to arrive at a ranking of States for the actual use by the Finance Commission.

Illustration

Environmental Performance Index I

As mentioned earlier, EPI1 covers the broad domains of air, water and forests. The following sections present the trends for indicators that are representative of the performance of states in these domains. The assessment year for this illustration is taken to be 2005/06, the and the base years are 2001/02 and 2003/04 depending on data availability. Only a subset of environmental indicators outlined earlier in Chapter 1 has been used due to the lack of annual/bi-annual data[77]. Thus, while in an ideal situation an Environmental Performance Index should include all the eight indicators proposed in Chapter 1, data constraints can be a limiting factor. This has limited us to include only a subset of these in this illustration. The broad domains, the indicators for which have been used to construct the indices, are air quality, water quality, dense forest cover, renewable electricity, and reduction in aggregate technical and commercial losses. Indicators for land quality and groundwater quality had to be dropped due to the probable unavailability of data at regular intervals for all states in the future. The indicator for energy intensity was also dropped since it was difficult to set up benchmarks of performance in this dimension.

Air Quality

Chapter 1 has provided a detailed discussion on the usage of exceedence indicator to determine performance by states. It has been proposed that the number of stations within a state complying with the respective RSPM standards should be the indicator of performance. The selection of RSPM rests on the fact that it is mostly generated due to anthropogenic factors and has adverse health impacts. Thus, in the construction of

77 The Environmental Sustainability Index for Indian states (IFMR, 2007), uses missing data analysis to construct the indicator for those states for which data is missing. In this process, the missing data is imputed based on the relationship between the indicators for which data exists with the ones that data is not available. However, for the current analysis the method has not been used since the relationship between existing and non-existing data need not be the same across states.

performance indicator for air quality, the increase/decrease in the proportion of monitoring stations in a state complying with the RSPM standards overtime would be used.

As an illustration, an index constructed for the improvement made by states in the period of 2003 to 2005 is provided below (Figure 5.1). The two points of comparison have been taken to be 2003 and 2005 since maximum number of states can be compared for these two time periods. In 2001 there were very few states that were being monitored for air quality.

For the time period considered it can be seen that Jharkhand has the highest improvement overtime, i.e. from 2003 to 2005. Some of the other states that showed improvements were Rajasthan, Tamil Nadu, Kerala, Gujarat and Maharashtra. The states that showed a decline in number of monitoring stations complying with standards were Nagaland, Meghalaya, Chandigarh, Andhra Pradesh, Orissa, Haryana, West Bengal, Karnataka, Himachal Pradesh and Uttar Pradesh.

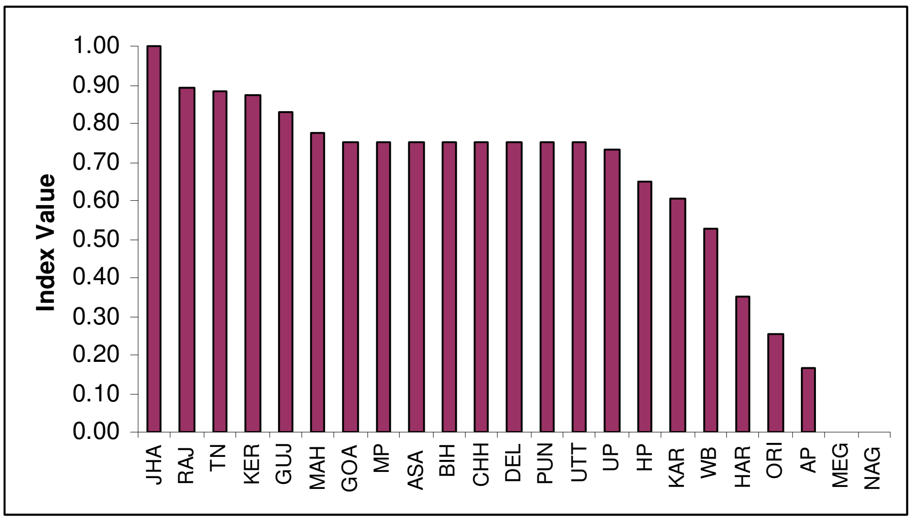


Figure 5.1 Index value for states based on change overtime in air quality levels 2003-2005 (RSPM)

SOURCE CPCB (various years)

Water Quality

Similar to the case of air quality, the improvement in the performance of states with respect to water quality is assessed through the number of monitoring stations within a state that exceed the CPCB Designated Best use Classification class "C" norms over the period 20001/02 and 2005/06. The class "C" norms have been selected for defining the quality benchmarks since they provide the minimum quality consideration requisite for potable water. The quality parameters for Biological Oxygen

Demand and Total Coliform have been chosen to indicate the impact of human activity on surface water quality.

The improvement made by states, as illustrated by the increase in the number of monitoring stations complying with benchmark norms, is shown in figure 5.2. Uttarakhand displayed the maximum improvement in 2005/06 compared to 2001/02 levels. Tamil Nadu also showed good improvement overtime. The poorest performance amongst states was noted in Manipur wherein compliance levels in water quality norms fell drastically over the years.

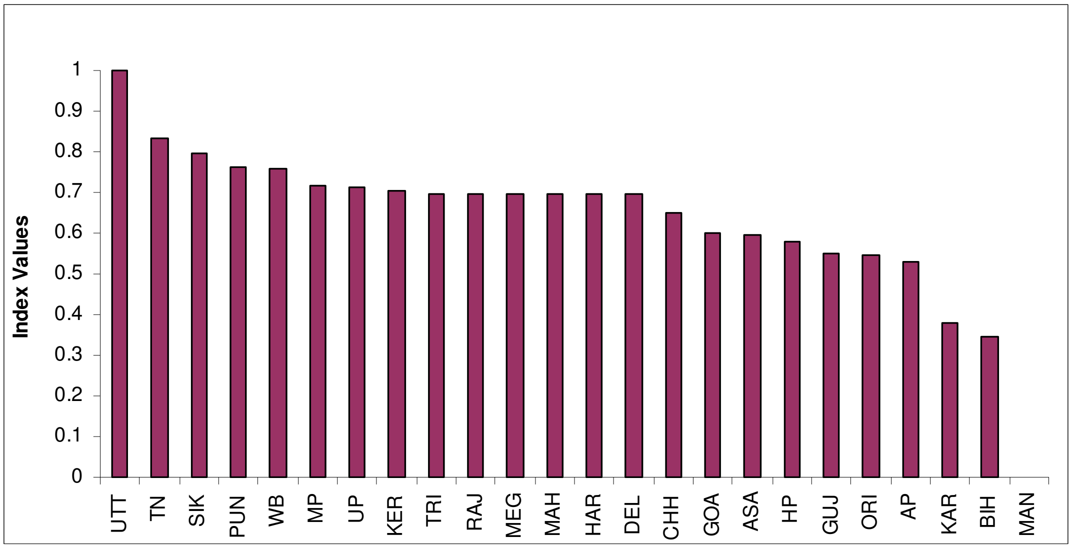


Figure 5.2 Index value for states based on change overtime in water quality levels 2001/02 to 2005/06

SOURCE CPCB (various years)

Dense forest cover

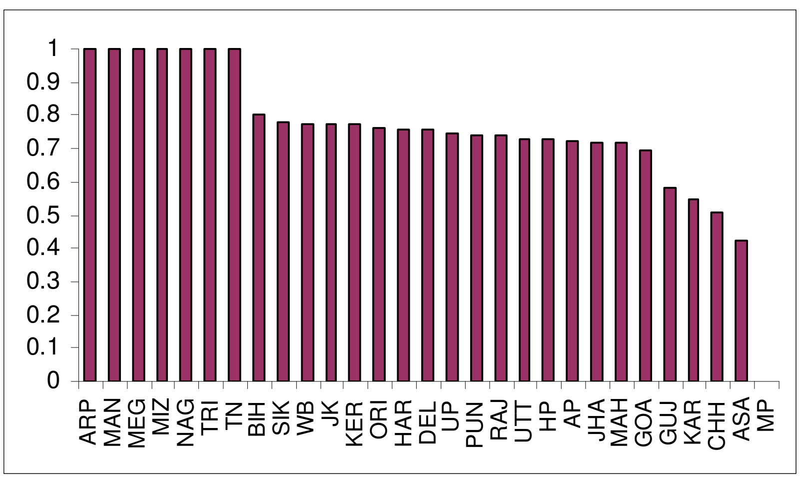
The indicator for adjudging state of forests is the change in the area under dense forest cover.

For the purpose of this exercise, the states that already have a high forest cover (>75% of the geographical area) have been treated separately. Currently, all the north-eastern states, except Assam, fall in this category. These states (Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland and Tripura) are naturally endowed with rich forest resources. In all of these states, shifting cultivation is prevalent, causing a cyclical change in forest cover. A biennial change in forest cover is therefore not an adequate indicator of environmental performance in these states.

We note that these states have forest cover well above the policy target of 67% (for hilly states) and it would be unfair to penalize them for not further increasing the forest cover. Indeed, in states like Arunachal Pradesh (with forest cover 81% respectively), a large part of the remaining area is under permanent snow cover so that bringing additional area under forest is biologically impossible.

For the rest of the states, it is proposed that the biennial changes in dense forest cover need to be rewarded/ penalized. Hilly states like Himachal Pradesh, Uttarakhand and Jammu & Kashmir have forest covers well below the policy target; however, large chunks of area in these states are again under permanent snow cover that makes achieving the policy target very difficult. We therefore suggest that absolute changes in dense forest cover be considered the indicator of performance, without linking these with the policy target. Additionally, it is also suggested that for any assessment year, the average of dense forest cover of that and its preceding assessment year be considered in order to smooth out influences of any special factor that may have caused a major change in any given year.

For illustrating the construction of index, we use figures for the 2005 and 2001, remembering that the reported data for these two assessments is based on satellite images of the immediately preceding years. Data of assessments prior to 2001 are not comparable with the data of 2001 onwards because of differences in the scale of resolution.[78] Data shows that most states record a decline in dense forest cover over this period, Tamil Nadu and Bihar being among the notable exceptions. The North-Eastern states (except Assam) have been ascribed the index value of 1 in view of their high natural endowment of forest resources.



78 For this reason, averages over two assessment years are not being considered in the illustration. Data for 2001 and 1999 are not comparable.

Figure 5.3 Index values for States based on change in dense forest cover overtime

SOURCE: FOREST SURVEY OF INDIA, 2001 AND 2005

Environmental Performance Index II

EPI2 highlights initiatives taken by states to address energy access and climate change concerns. The index incorporates two elements in its ambit, namely-renewable energy and ATC losses. State promotion of renewable energy production and consumption is one of the ways that the society can move towards the sustainable development trajectory. Enhanced effort aimed at conserving existing resources such as reduction in technical and commercial losses would also contribute towards reaching the goal of sustainable development.

Renewable energy

As has been outlined earlier in Chapter 1, SERCs mandate all distribution utilities to source a minimum quantum of electricity annually from renewable sources. This is termed as renewable purchase obligation (RPO) for states. Data shows that till date 15 states have issued RPO regulations. (see Annexure 5.1) The specification of RPOs by respective SERCs are dependent upon a number of factors:

- projections of total quantum of energy required for sale in the state in the future,
- potential for different types of renewable energy in the state,
- quantum of energy currently being generated by renewable energy generator inside the state,
- commercial impact of renewable power on the retail tariff
- technical impact of renewable energy generator on the state grid, and
- overall target as specified by the central government policies. (Goyal and Jha, 2008)

In an ideal situation, the RPO mechanism would ensure that the potential in the states as well as the country are being exploited to the maximum possible extent. However, there have been arguments made by certain states that due to their lower renewable potential their RPO commitment would be smaller.

Two arguments can be made in this respect. While it is true that development of renewable potential for wind and hydro power, which are largely site specific and natural endowment based, would be difficult for a state that is poorly endowed with these resources, there exist other sources such as solar energy, biomass and municipal solid waste that have a much diffused generation source.

The second argument that could be made is that the states deficient in natural resources can purchase renewable energy from a nearby renewable surplus states. However, this alternative would be applicable only if the concerned SERCs have issued open access regulations. Additionally, the purchase of renewable electricity may lead to high transmission costs as well as network congestions due to the transmission of electricity over long distances.

A better option in such a situation would be development of a renewable electricity credit (REC) system within the states. This would both allow the deficit states to purchase credits from other surplus states as well as encourage states with greater renewable potential to tap into their potential to a greater extent. Additionally, the purchase of RECs by NGOs, environmental organizations, etc would ensure that a greater market exists for renewable products. With greater market, there would an assurance of greater investments flowing in the development of renewable technologies. This is an example of a Coasian solution to an environmental problem.

It should however be mentioned that the application of this system would require a monitoring authority that would provide an effective monitoring mechanism for accrual of credits, a national registry for credits and a trading platform. This would thus, require load dispatch centers with state-of-the-art communication and data acquisition capacity on a real time basis. (Electricity Policy, 2006; Singh 2009). The Finance Commission can help by giving incentives and this is further discussed in chapter 8.

In the current framework, the indicator with regard to renewable energy has been taken as the percentage of achievement of the RPO put forth by the SERC. As the states keep progressing towards achieving their targets over the years, their scores with regard to this indicator would increase. As with the other indicators, the comparative performance of states can then be adjudged based on the percentage of targets actually achieved.

Aggregate Technical and Commercial (ATC) Losses

A look at data for AT&C within states reveals that while the levels of AT&C losses have been falling overtime, they still amount to approximately 35%. This implies that of the total number of units generated by the utilities, only 65% of units have their value realized. To rectify the situation the Multi year tariff (MYT) framework was sought to be adopted in 2006.

Introduction of MYT principles is mandated by Section 61 of the Electricity Act 2003 as well as the National Tariff Policy 2006. In fact, the Power Tariff Policy announced by the Union

Government in January 2006 specifies that a Multi Year Tariff framework has to be adopted for any tariff determined from April 1, 2006 onwards.

A Multi Year Tariff (MYT) framework is defined as a framework for regulating the Generating Company or licensees over a period of time wherein the principles of regulating the returns/profits of licensees and the trajectory of individual cost and revenue elements of the Utility are determined in advance. The concept of MYT gives an element of certainty to all stakeholders. [79]

Under the MYT framework, expenditures on administrative and general expenses, repair and maintenance come under controllables while power purchase and rise in costs come under non-controllables. AT&C losses are defined as a controllable item and the financial loss if any on account of failure to achieve the target specified has to be borne by the distribution licensee. The gains, if any, on account of achieving the loss below the target should be shared with the consumers. The Mechanism for this pass-through of approved gains or losses arising due to the difference between the actual performance vis-à-vis the commission approved forecast of performance by the licensee on account of uncontrollable factors may however differ from state to state.

From the performance index perspective, it is proposed that the degree to which states comply with their SERC approved targets should form the basis for assessing their future performance. The distribution licensee may arrange for third party verification of energy audit results so as to validate the prevailing level of AT&C levels within the state for the assessment year.

79 A long-run tariff gives regulatory certainty to the licensee having known the principles for tariff determination for the control period that helps to adopt management policies and undertake investments which are likely to yield sustainable and improved performance in the long run. At the commencement of the control period a forecast of the aggregate revenue requirement and the expected revenue from existing tariffs and charges are submitted by the distribution licensee and approved by the commission. They have to provide a forecast of aggregate revenue requirement and expected revenue and tariffs and charges during the control period, based on reasonable assumptions relating to the expected behaviour of the underlying financial and operational variables. In the tariff orders submitted to the SERCs, the licensees provide the annual review of performance vis-à-vis the approved benchmarks provided by the SERC and categorization of variations in performance into those that were caused by factors within the control of the licensee (controllable factors) and those caused by factors beyond the control of the licensee (uncontrollable factors).

Environmental Performance Index: results

The performance of states with respect to the environmental performance index 1 (EPI1) is provided in the following section. Based on the criteria of data availability, a subset of states has been selected in the analysis for which data for all three indicators was present.

The results for the performance index (Figure 5.4) reveal the following:

- Tamil Nadu emerged as the best performer.
- The other good performers were Uttarakhand and Kerala.

Tamil Nadu performed the best among states with respect to increase in area under dense forest cover. There was an improvement in its air and water quality as well as indicated by the number of monitoring stations complying with quality norms.
Domain wise performance of States is given in annexure 5.2

Uttarakhand was another state that performed well in the environmental performance index. Between the period of 2001/02 and 2005/06, the state showed the highest improvement in water quality indicator. Its good performance with respect to air quality and dense forest cover has to, however, be treated with caution. With regard to air quality, the state had only 1 monitoring station in both time periods. Moreover, in both these time points the station was violating RSPM norms. However, since there was no deterioration or improvement in the state overtime (0% in both time periods) it got a higher score than those states that displayed a much greater degree of deterioration in air quality. As a similar case, the state shows a decrease in area under dense forest cover overtime. However, since the decrease was much lesser in magnitude as compared to the state that showed the greatest fall in area under dense forest cover, i.e. Madhya Pradesh, it scored reasonably high in the dense forest cover indicator index.

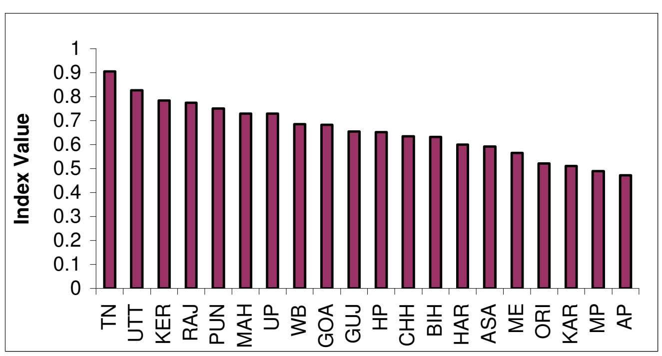


Figure 5.4 Ranking of States based on Environmental Performance

The index values as well as the standardized share for different states are presented in Table 5.1. Following a similar methodology the share of each state can be computed based on a dynamic real time index of performance and it is recommended that the Thirteenth Finance Commission should make transfers based on these in order to reward states for environmental performance, for 2012 and 2014.

Table 5.1 Shares of states based on EPI1

State	Index Value	Standardized Share (%)
Tamil Nadu	0.91	6.9%
Uttarakhand	0.83	6.3%
Kerala	0.78	5.9%
Rajasthan	0.78	5.9%
Punjab	0.75	5.7%
Maharashtra	0.73	5.5%
Uttar Pradesh	0.73	5.5%
West Bengal	0.68	5.2%
Goa	0.68	5.2%
Gujarat	0.65	5.0%
Himachal Pradesh	0.65	4.9%
Chhattisgarh	0.63	4.8%
Bihar	0.63	4.8%
Haryana	0.60	4.6%
Assam	0.59	4.5%
Meghalaya	0.56	4.3%
Orissa	0.52	4.0%
Karnataka	0.51	3.9%
Madhya Pradesh	0.49	3.7%
Andhra Pradesh	0.47	3.6%

Environmental Performance Grant Framework: Caveats

An important point with regard to EPI1 needs to be mentioned. Currently data for all states are not available for two of the constituent indicators- air quality and water quality. For these states the lack of data and environmental monitoring for a state could be due to the lack of appropriate institutions within the state. States should be incentivised to improve their monitoring system and environmental governance. This is discussed in Chapter 8. Once the system is in place, a more comprehensive environmental performance index incorporating all states should be developed to allocate grants to all states for environmental management.

Delhi has been taken as a special case and excluded in the analysis as it faces almost a different set of development issues. Being the national capital it faces a lot of developmental pressures such as greater urbanisation, migration issues, etc.

Therefore, it becomes unrealistic to expect it to compete at the same level as the rest of the states that have alternative land use patterns, etc. However, to the extent that a national capital has enhanced visibility due to its importance domestically and internationally, and needs to serve as a show case for the country, it has to perform better environmentally. It is therefore, argued that it needs to be taken up separately from the rest of the states.

Conclusion

Environmental performance of a state is measured in this study by the improvements made overtime in key environmental domains. These improvements are captured both through indicators that reflect performance relative to national environmental standards as well as performance standards set by the states themselves. It should however be recalled that in the case of the environment, there may often be the case that efforts made by states may not reveal results quickly and this needs to be considered.

While the performance index is a good indicator of efforts made by states, and the disbursal of grants made on this basis would serve to incentivise states to improve their future performance, certain problems in the approach need to be acknowledged. The states that are already at the top rung of the environmental quality ladder may face difficulties in further improvements and would need to put in enhanced efforts towards this end.

Additionally, as acknowledged in the illustrative example for the environmental performance index only a subset of states could be taken because data for certain states was unavailable for both time points. Efforts should be made for improving capacities of states, to comply with standards, improve reporting, and address key state level environmental concerns. Chapter 8 addresses this need.

CHAPTER 6 Addressing vulnerability to climate change impacts

Historically, India has been among the most vulnerable countries to climate variability, which threatens the lives and livelihoods of a large population in India. These will be further accentuated by climate change. Government of India has a number of adaptation related programmes that address measures such as development of arid land crops, pest management, flood control, drought mitigation, etc. as well as capacity building of extension workers and NGOs. These programmes at the moment cover broad areas such as crop improvement, drought proofing, health, risk financing, disaster management, and livelihoods preservation. Currently, (2006-07) the central government expenditure in India addressing adaptation to climate variability as shown in the figure below, exceeds 2.6% of the GDP with agriculture, water resources, health and sanitation, forestry, coastal zone infrastructure, and extreme weather events, being specific areas of concern.

These schemes, as indeed most Plan schemes, serve multiple development and poverty alleviation objectives. It is also the case that development and poverty eradication are in themselves the most effective strategies to reduce vulnerability to climate change. Anthropogenic climate change will involve greater expenditures on these efforts.

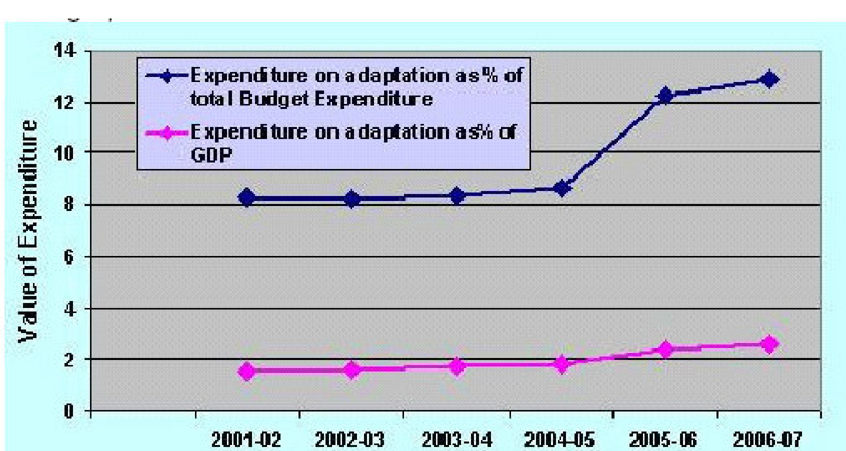


Figure 6.1 Expenditure on Adaptation Programmes related to climate variability in India

SOURCE: GOVERNMENT OF INDIA. 2007

Adaptation strategies in India

Agriculture

Though the results on impacts of climate change on Indian agriculture are mixed, there is consensus that interventions are required to increase the adaptive capacity of the sector and hence make it less vulnerable to the adverse effects of climate change. Physical factors like cropping patterns, crop diversification and shifts to drought/salt resistant varieties and socio-economic factors like ownership of assets and access to services and infrastructural support are important determinants of the adaptive capacity of the agricultural sector to climate change. Crop insurance, seed banks, alternative employment options, trade policy and enhanced access to inputs and markets can go a long way in reducing the vulnerability of the sector.

Private sector and civil society also have a key role to play in enhancing the coping capacity of the sector (TERI 2003). The Government of India plans to address the vulnerability of the agricultural sector to climate variability through the National Mission on Sustainable Agriculture. The National Mission for Sustainable Agriculture is one of the eight missions, which forms the core of the National Action Plan on Climate Change (NAPCC).[80] The aim of the mission is to reduce the vulnerability of Indian agriculture to climate change. This would be fulfilled by progressively adapting agriculture to anticipated climate change and better research systems to understand and evaluate the impacts of climate change. The mission would revolve around improving the productivity of rain-fed agriculture, developing new varieties of crops especially thermal resistant ones, and those that can withstand extreme weather and variable moisture availability, promoting alternative cropping patterns, besides integrating traditional knowledge with scientific research for advocating adaptation and mitigation options.

Water

Given the uncertainties surrounding the effect of climate change on water resources at the regional level and the paucity of such studies future research should focus on regional impact assessment. More concrete results are needed on the interface between the timing, magnitude and nature of climate change; ability of ecosystems to adapt to change; and future demographic and economic patterns. Nonetheless, it is

80 The Government of India has recently (June 2008) adopted the National Action Plan on Climate Change (NAPCC) that spells out various actions towards adaptation and mitigation in the context of sustainable development.

imperative to adopt policies that will ensure that the needs of the country are met sustainably without undermining water security.

Strategies that aim at efficient water use, water conservation, and equitable water distribution can address water shortage issues. Water quality can also be enhanced through revival of traditional knowledge on water conservation and community based irrigation. Changing land use and cropping patterns and development of new varieties of crops that are less water intensive and have high yields will help in water conservation. Vulnerability to water shortages can be reduced through risk mitigation, economic efficiency, watershed management, crop diversification, etc. Flood protection also needs to be strengthened through construction of dams and dykes, and flood plain zoning, forecasting systems and insurance.

National Water Mission seeks to redress the water stress that may ensue due to climate change. The mission is based on improved management and regulation of surface and ground water resources, better storage for fresh water and drainage for wastewater, conservation of wetlands and development of desalination technologies. The thrust of the mission is to optimize water use, conserve water, minimize wastage, promote equitable distribution of water, improve the efficiency of present irrigation systems, and develop new regulatory structures with appropriate entitlement and pricing. The mission will also focus on recycling wastewater in urban areas and using new technologies for desalination to permit use of seawater. Rainfall and river flows variability will be addressed through basin level strategies.

Forests and ecosystem

There is reasonable evidence and confidence on the likely impacts of climate change on forest and ecosystems. There is an urgent need to develop and implement adaptation strategies given the fact that impacts of such loss of biodiversity are long term and irreversible, there is generally inertia and time lag between climate change and impacts. Further, a long gestation period is involved in developing and implementing adaptation strategies in the forest sector to avoid adverse impacts on the livelihoods of forest dependent population. And more importantly, there is immense inadequacy capacity to adapt to climate change impacts at the forest dependent community level.

In additions, limitations exist in current state of science in projecting climate change at the regional level and even greater limitations are making projections at the local level. There is a need for initiating research on developing and evaluating adaptation practices and strategies to enhance the resilience of the forest ecosystems

It is crucial to promote and sustain research on adaptation to climate change for conservation of forests, other ecosystems, and biodiversity. In addition, there is a need to create awareness and enhance technical and institutional capacity in the research intuitions, forest departments and NGOs as well as build the institutional, financial and technical capacity of forest dependent communities.

Coastal areas

Climate change is not a stand alone, one-time event, it is a continuous process. Therefore there does not exist a one-time solution to cope with its impacts. The capacity to cope with the climatic impacts have to interwoven into the planning process and ensure their continued implementation by facilitating research and adequate funding. For example, in case of sea-level rise there is a need to constantly assess, evaluate and monitor the coastal areas, leveraging the existing network of site observations, as well as the growing array of coastal observing systems in order to save the lives and livelihoods of millions of people living in the coastal regions. This needs a scientific approach and the Monitoring &Evaluate system should be built in to the planning and executing processes of coastal management. There is also need to monitor development activities that might accelerate vulnerability to see level rise impacts.

Human health

There are large-scale efforts by the Government of India and State Governments through various programmes to control malaria in India. Such programmes are also essential from the viewpoint of adaptation strategies in the climate change regime. In addition to the existing plans and programmes it is crucial for India to design adaptation strategies in such a way that they take into account the uncertainties associated with the impacts of climate change, the specific anticipated changes in the existing disease conditions, and the expected improvement in the socio-economic conditions of the people in the future. Some of the measures as specified by Government of India, 2004 include:

- Improved surveillance and monitoring systems
- Develop vector specific regional maps
- Technological engineering strategies
- Improved infrastructure to avoid artificial breeding
- Medical interventions
- Develop integrated environmental management plans
- Public education

The relative need and importance of each would vary depending upon public health care needs in the region, the relative coping capacity of the regions to climate-induced stress as well as the institutional and financial capacity of the regions.

In addition to above, the impacts of climate change on human health has huge knowledge gaps and requires region specific localized research to be undertaken. This is because the health outcomes have many confounding factors such as sensitivity of human health to elements of weather and climate, differing vulnerability of various demographic and geographic segments of the population, the movement of disease vectors, and how effectively prospective problems can be dealt with. Given these factors it is crucial that improvements in environmental practices, preparing for disaster management plans and improving the public health infrastructure in India, including disease surveillance and emerging response capabilities are developed and implemented as they could go long way in coping with the impacts of climate change on human health.

Financing adaptation strategies

Adaptation needs to be planned in response to different needs at various levels, and differential vulnerability amongst affected people. Adaptation measures within a country can be considered as national public goods (NPG) and local public goods (LPG). The services that adaptation measures provide need to be segregated based whether they are NPGs or LPGs and financing appropriately met. At the local level financing options need to take into account differential vulnerability and needs of the least advantaged (TERI 2005b). In respect of Adaptation, the Finance Commission may help towards implementation of the NAPCC as follows by providing support for adaptation to climate change through earmarking grants to build capacity within the states.

In respect of climate change mitigation, there is at present little scope for the Finance Commission to provide additional resources to States/Local Governments, beyond grants to incentivize use of cleaner energy. In addition there do exist separate market based mechanisms supporting climate change mitigation, thereby a need for a separate fund to address it, is not really essential.

Grants to states for building adaptive capacity

Enhancing and ensuring efficient implementation of different developmental and poverty eradication measures are in themselves the most effective strategies to reduce vulnerability to climate change. Different regions have differing coping capacities to threats accentuated or initiated by climate change based phenomena. This may be due to biophysical placement of the region or other socio-economic characteristics. Thereby, what is crucial is planning of adaptation needs at various levels, and taking account of different vulnerability among affected people. At present, impact assessment studies specifically related to climate change induced vulnerability/or capacity to develop resilience to climate related impacts are very few and scattered at State or local levels in India and cannot form the basis of decision making.

The present study, proposes block grants (of Rs. 2500 Crores in total) for building capacity to address climate change at the level of states. These grants could then be provided though a State Climate Adaptation Fund, which could have similar norms and conditions as the present facility on calamity relief, the Calamity Relief Fund (CRF), but with a focus on preventive rather than a ex-post curative approach to disbursement of funds. The initial grants from this fund could be provided based on the vulnerabilities to climate change of the states to climate change. The grants provided to states based on different vulnerabilities, apart from supporting the states to build capacity in developing resilience to climate change should also require the states to develop their own State Action Plans for Climate Change in line with the NAPCC. The state action plans should specify the key areas of concern, and specific adaptation and mitigation measures to be adopted by the state as per the characteristics of the area.

Within these plans, any adaptation measures proposed should be able to justify the risks related to changing climate and are over and above that can be otherwise managed. Such plans could also provide a list of projects that a state would undertake to reduce its vulnerability to climate change impacts, along with an implementation strategy.

As the current feature of the CRF, the proposed state climate adaptation fund could also be administered by the respective state level committees, headed by chief secretary of the state and other officials (normally connected with relief work and experts on various fields of the state). Such a committee could also take up monitoring of adaptation related expenditures in the state, studying the progress in the previous year, and ensuring the expenditure is on items for specifically enhancing adaptation capabilities of the states or any other guidelines in this regard which may be issued or identified under the State Action Plan on Climate Change.

Assessment of vulnerability and coping capacities of states to potential climate change impacts

Our review suggests that there are not many assessments, which could be utilized to develop a weighted ranking of states based on their vulnerability and coping capacities. And those, which do exist differ in methodology or indicators adopted, data used, etc. An attempt is made here to provide a broad ranking of states based on certain biophysical and socio economic indicators for gauging the vulnerabilities and coping capacities of the states of India to climate change. The objective is to chart a way forward for the Finance Commission for disbursing grants addressing climate change adaptation. But much more detailed studies are needed on this score.

Capacity to cope with climate related impacts are not only dependent on climatic variability, but also on other non-climate issues. It is hard to determine how to measure vulnerability, resilience, and adaptive capacity while focussing only on climate factors. Vulnerability assessments, which start at the societal end of the linear chain and study environmental aspects of specific geographic locations through the lens of individual human and groups of people, are powerful tools in the examination of societal well being in the face of climate change (Downing and Patwardhan 2005). Vulnerability assessments, by integrating social and environmental factors, account for their interplay, and thereby are useful in looking at issues surrounding the ability to adapt to climate change.

Quantifying and modelling this assessment process is subject to certain issues and as with any other analysis the benefits of such an analysis and difficulties in actually conducting it need to be considered carefully. Such analyses have been conducted to varying degrees as case studies, but not in a systematic, comparative framework so far. One such study, undertaken by Brenkert and Malone in 2005, assessed the current resilience of India and Indian states to climate, using the Vulnerability – Resilience Indicators Model (VRIM), where 17 different proxy values, representing sensitivity or coping capacity, to the overall assessment of resilience were taken.

Developing an indicative climate change vulnerability and coping capacity index

Drawing from Brenkert and Malone, 2005 study and building on the methodology undertaken for the present project, we took a set of 9 broad socio economic and biophysical indicators to develop indices providing insights into the relative vulnerability and coping capacities of the states of India. The methodology used for this purpose is adapted from the methodology[81] that is used to construct a composite environment performance index in chapter 5 of the report. The relative ranking score could be used by the Finance Commission, on the basis of which it could decide to disburse initial block grants amongst states from the State Adaptation Fund. These could further be with respect to any particular impact the Finance Commission may want to focus on to start with. It should be noted that information on the indicator used is based on most recent available data, and taking a common year for all variables was not possible. Table 6.1 lists the details on indicators used.

81 See page 117 of the Report for details on methodology.

Table 6.1 Indicators considered for vulnerability and coping capacities to climate change impacts

State level Indicator	**Year**	**Source**	**Proxy variables**	**Indicative vulnerability and coping capacity**
Percentage of population below poverty line	2004	PlanningCommission and NSSO data, 61st round[82]	No of persons below poverty line Population of the state	Greater the poverty levels in a state greater the vulnerability and lesser the coping capacity
Percentage of rainfed agriculture	2001-02	Agriculture Census 2001[83], Government of India	Gross unirrigated area Gross cropped area	Greater the dominance of unirrigated area or rainfed agriculture in the total gross cropped area of a Sate; there is increased dependence on climate related variable; thereby more susceptibility of the region to climatic variability
Health Infrastructure (No. Of people per health centre)	2004	Central Bureau of Health Intelligence, Ministry of Health and Family Welfare, Government of India[84]	Total number of health care units in a state Total population of the state	Better health infrastructure of the state, better it is placed to cope with climate induced or otherwise to health of the population.
Economic Capacity	2007-08	Central Statistical Organization (CSO), State Series, 1999-2000 prices	Net State Domestic Product per capita (Rs)	A proxy for depicting economic well being of a state in general. With a higher per capita income implying a better coping capacity.
Population Density	2008	Population figure from the Registrar General[85]	Population (persons) Total Geographical Area (sq. kms)	Population density will indicate the level of exposure of the population of a state to climate change impacts. Greater the density greater will be the vulnerability of a state.
Share of agriculture and allied activities in NSDP	2007-08	CSO State Series, 1999-2000 prices	Value of output from agriculture and allied activities Total Net State Domestic Product	The indicator is used to provide the relative importance of agriculture in the states' income. Thereby, gauging the importance of climate dependent sector in the state and thus higher the share; greater the vulnerability.
Sea Level Rise	1993	JNU	Area affected by 1 metre of sea level rise Total geographical area of the state	Applicable to only coastal states, a larger share of area affected by 1metre SLR, higher the vulnerability of the state
Floods	2007	National Disaster Management Guidelines 2008	Flood prone area Total geographic area of the state	An increased share of flood prone area in the total geographical area of the state, would make it more vulnerable to climatic changes
Droughts	2002	Compendium of Environment Statistics 2002	Drought prone area Total geographic area of the state	An increased share of drought prone area in the total geographical area of the state, would make it more vulnerable to climatic changes

82 Available at http://planningcommission.nic.in/data/datatable/tab15.pdf last accessed on 21st April 2009
83 Available at http://agcensus.nic.in/project_01/state.asp last accessed on 21st April 2009
84 Available at http://cbhidghs.nic.in/chap9.asp last accessed on 21st April 2009
85 Population figures sourced from the projections made by the National Commission on Population for the O/o Registrar General and Census Commissioner of India

In gauging the vulnerability and coping capacity of the states of India, 6 socio economic indicators are used, first to develop a socio economic index, providing relative coping capacity of the states. The index values thus derived are used as weights to arrive at a weighted index to relatively rank states in terms of most vulnerable and least able to cope with: sea level rise (indicated by area affected by 1 metre SLR a percent of the total geographical area (TGA) of the state), floods (indicated by the area reported as prone to floods to 11th Plan working group as a percent of TGA of the state), droughts (area affected by droughts in 2002 as a percent of TGA of a state). Finally, a composite index is developed, that combines the physical impacts indicators and socio economic index as weights, to arrive at the composite relative ranking of the states of India.

Climate change vulnerability and coping capacity index: Results

Socio-economic index: weights

Based on 6 socio-economic indicators, as highlighted in Table 6.1, we ranked states in the order of increasing socio-economic capacity. The socio-economic conditions prevailing in a state generally have a bearing on the relative coping and adaptive capacity of a region to climate change impact in question. A high score is indicative of a low coping capacity. After arriving at a relative index score for socio-economic conditions, these were used as weights and superimposed on the relative vulnerability of the states to the impacts of 1 metre sea level rise (SLR), floods and droughts. The results of coping capacity index (weights) are presented in Table 1.2.

Table 6.2 Relative ranking of states based on socio economic indicators

States	Weights (%)
Bihar	6.82
Uttar Pradesh	5.81
West Bengal	5.45
Madhya Pradesh	5.39
Orissa	5.16
Assam	4.52
Maharashtra	4.46
Manipur	4.35
Rajasthan	4.29
Tripura	4.09
Karnataka	3.96
Kerala	3.87
Andhra Pradesh	3.81
Gujarat	3.80
Punjab	3.68
Nagaland	3.57
Tamil Nadu	3.46
Haryana	3.33
Meghalaya	3.20
Sikkim	3.12
Jammu & Kashmir	2.97
Mizoram	2.84
Himachal Pradesh	2.78
Goa	2.71
Arunachal Pradesh	2.56

The results indicate (Table 6.2):

- Bihar emerges to be the state with the weakest coping capacity based on socio-economic conditions on the indicators considered. This is mainly because Bihar had a high relative population density in 2008 as well as the lowest relative per capita net state domestic product in 2007-08. The state also has a higher number of people below poverty line as well as a poorer health infrastructure.
- Bihar is followed by Uttar Pradesh, as a state with a weak coping capacity on account of a poor relative health infrastructure and a low relative per capita net state domestic product. The state also has a high share of agriculture in its net state domestic product, a climate sensitive sector, thus depicting a relatively lower capacity to cope with the potential climate change impacts. The state also has a higher population density.
- The state that emerges to have better capacity to cope is Arunachal Pradesh. This is on account of better health care infrastructure of the state as well as a very low relative population density. States ranking in terms of other indicators is also relatively higher.

Sea Level Rise The results of the physical and the normalized weighted index for differing vulnerability and capacity to cope with 1 metre seal level rise of the coastal states along with the relative ranks is presented in Figures 6.2a and 6.2b respectively.

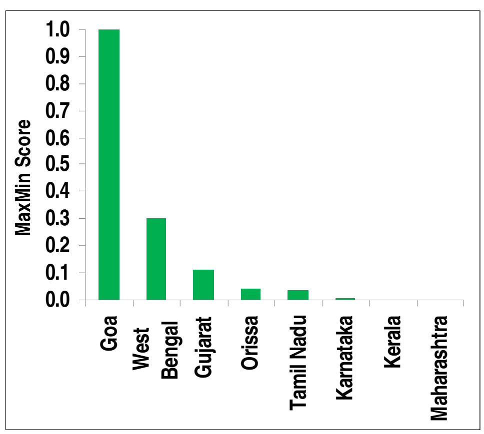


Figure 6.2a Ranking of Coastal states based on physical vulnerability to 1metre SLR

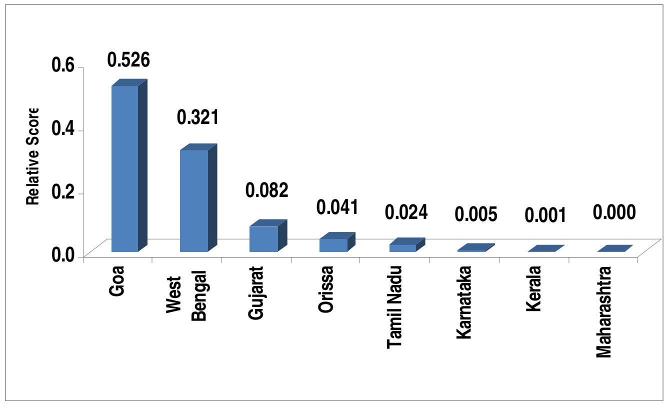


Figure 6.2b Weighted index depicting relative ranking of coastal states based on vulnerability and coping capacity to 1 metre SLR and socio-economic conditions

The results indicate (Figure 6.2a and 6.2b):

Figure 6.2b, shows that the state of Goa emerges as the most vulnerable relatively to the potential impacts of 1 metre SLR based on the weighted index(Figure 6.2b). This is evident, even when we look at only the physical vulnerability of the states to 1metre SLR (Figure 6.2a). After taking into account the socio-economic indicators, Goa still ranks first, thereby, suggesting support to the state on account of its high vulnerability to 1metre SLR.

Goa, is followed by the state of West Bengal, with a high ranking both on account of vulnerability of the state to 1metre SLR as well as given the socio-economic conditions, a low coping capacity.

It is also, noticeable from the figures that the state of Maharashtra, amongst the coastal states, is both least vulnerable and best able to cope with any potential impacts of SLR.

Floods

The results of the physical and the normalized weighted index for differing vulnerability and capacity to cope with states area prone to floods along with the relative ranks is presented in Figures 6.3a and 6.3b respectively.

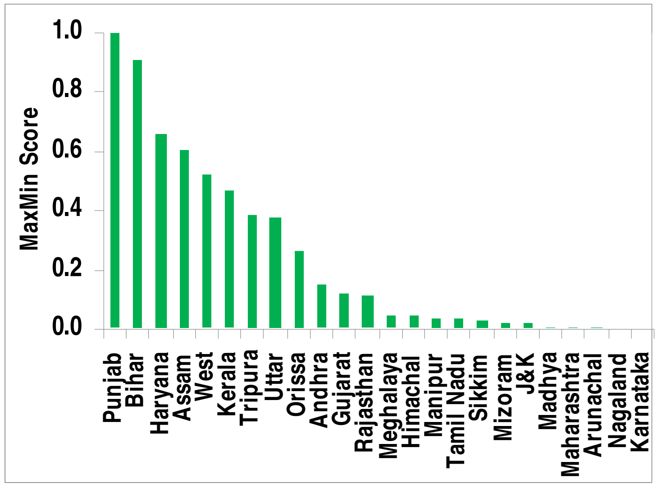


Figure 6.3a Ranking of states w.r.t area prone to floods

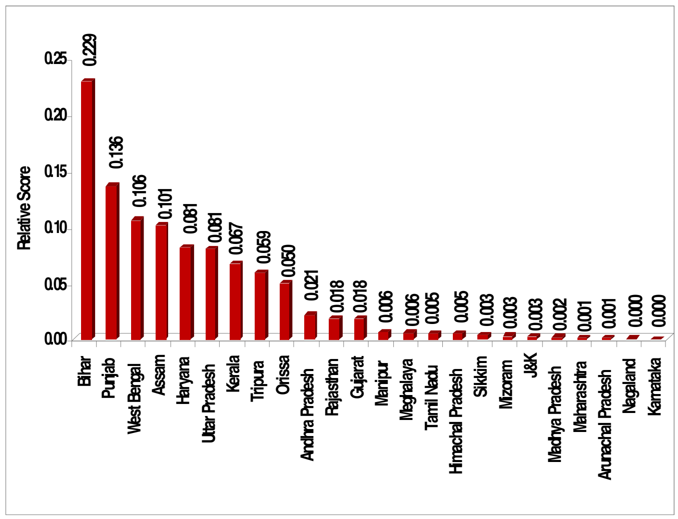


Figure 6.3b Weighted index depicting the relative ranking of states based on vulnerability and coping capacity to floods and socio-economic conditions

The results indicate that the state of Bihar is both most vulnerable and least able to cope with potential impact due to a large area prone to floods. The State ranks 2nd in the area prone to floods and first for the socio-economic conditions (Table 6.2), on account of the indicators considered as explained before.

Bihar is followed by Punjab, which ranks high in terms of vulnerability and relatively moderate ranking on account of social conditions on the indicators considered.

The state, which emerges to be least vulnerable and best able to cope is Karnataka. This is on account of comparatively, smallest area of the state prone to floods and the relatively, moderate rank of state in terms of socio economic conditions (Table 6.2).

Droughts

The results of the physical and the normalized weighted index for differing vulnerability and capacity to cope with area affected by droughts along with the relative ranks is presented in Figures 6.4a and 6.4b respectively

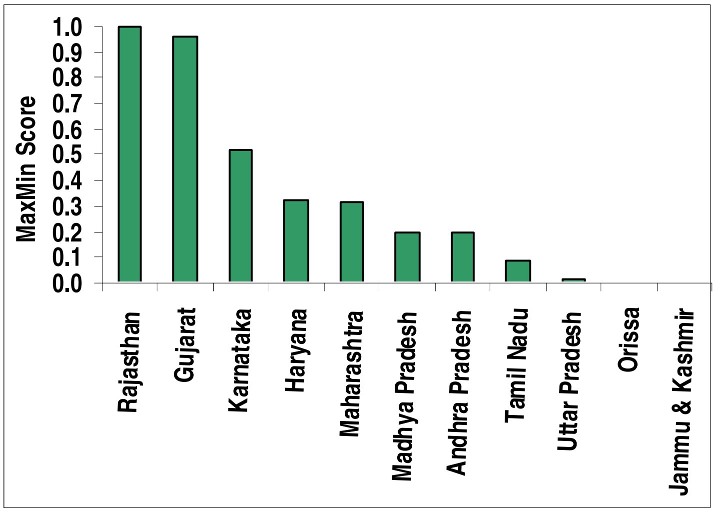


Figure 6.4a Ranking of states w.r.t area affected by droughts

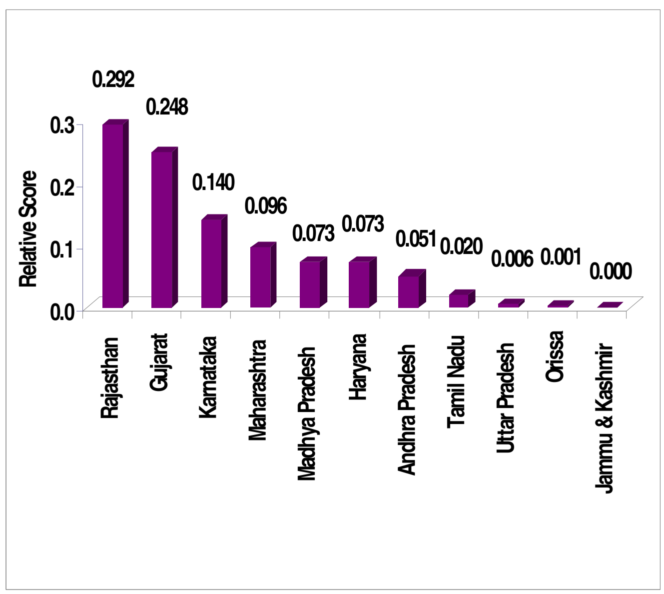


Figure 6.4b Weighted index depicting the relative ranking of states based on vulnerability and coping capacity to droughts and socio-economic conditions

The results indicate (Figure 6.4a and 6.4b), that Rajasthan, Gujarat and Karnataka are most vulnerable to droughts and least able to cope with potential impacts, thereby demand higher shares in the total disbursal of grants for coping with potential impacts of droughts, accentuated by climate change.

The state of Jammu & Kashmir emerges as least vulnerable and best able to cope, with regard to area affected by droughts. This is on account of a comparatively lower area amongst the states affected by droughts, and better comparative socio economic conditions.

Combined Vulnerability and coping capacity index

In order to address the three impacts considered in this analysis, together based on the vulnerability and coping capacity to floods, SLR and droughts a combined vulnerability and coping capacity analysis was conducted. Figure 6.5 presents the ranking of the states based on their relative vulnerability to the impacts of area prone to floods, SLR and droughts. It is calculated taking the average of the Max Min score of individual impacts as presented in the previous figures. For the purpose of this analysis, zero score was given to a state, not vulnerable to a particular impact. For example, the state of Punjab not being a coastal state is not vulnerable to SLR, thereby it was given a value of zero, while calculating the average of three scores.

In order to weight the numbers thus arrived (Figure 6.5), in terms of the socio economic conditions in a state, the weights as calculated in Table 6.2 were assigned to arrive at the composite relative ranks for the states. The results of this are presented in table 6.3.

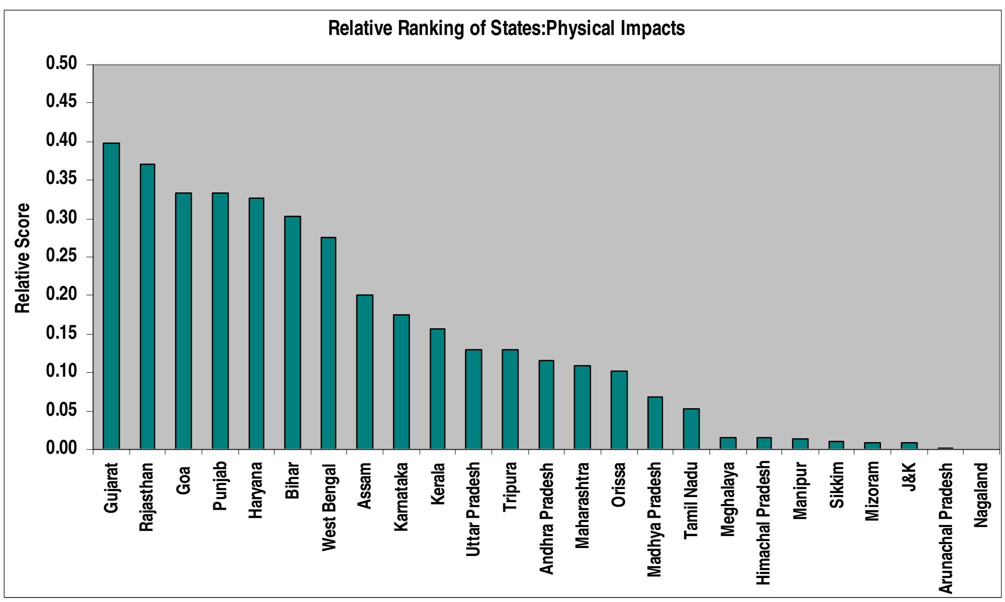


Figure 6.5 Ranking of states w.r.t area prone to floods, SLR and area affected by droughts (Combined Index Score)

Table 6.3 Composite relative ranking of states based on vulnerability and coping capacity to physical impacts and socio-economic conditions

States	Relative Ranking Score
Bihar	0.1321
Rajasthan	0.1019
Gujarat	0.0970
West Bengal	0.0963
Punjab	0.0786
Haryana	0.0696
Assam	0.0582
Goa	0.0578
Uttar Pradesh	0.0483
Karnataka	0.0445
Kerala	0.0387
Orissa	0.0338
Tripura	0.0338
Maharashtra	0.0309
Andhra Pradesh	0.0283
Madhya Pradesh	0.0237
Tamil Nadu	0.0116
Manipur	0.0036
Meghalaya	0.0032
Himachal Pradesh	0.0027
Sikkim	0.0020
Mizoram	0.0016
J&K	0.0015
Arunachal Pradesh	0.0003
Nagaland	0.0001

Results indicate (Table 6.3) that the state of Bihar emerges to be most vulnerable and least able to cope with potential climate change impacts. This is mainly on account of large area of the state prone to floods and the socio-economic conditions of the states on the indicators considered in this analysis. The state of Bihar is followed by Rajasthan, which accounts for a high share on account of high ranking of the state with regard to droughts and relatively moderate ranking for floods.

The states, which are least vulnerable and best able to cope with the three impacts considered in this analysis, are Arunachal Pradesh and Nagaland. This is on account of low vulnerability of the states to floods, non-vulnerability to SLR and the states did not report any area affected by droughts in the year 2002 (an indicator of droughts used for this analysis). However, it should be noted that the better vulnerability-coping results for Arunachal Pradesh and Nagaland, could also be on account of exclusion of other impacts of climate change, on account of data availability, from the analysis that may be crucial for these states, e.g. impacts on forests, glacial melt, etc..

Caveats to the Analysis:

- The above analysis is more indicative in nature and exemplifies how a vulnerability analysis could be undertaken, thus laying ground for further analysis. Both impacts and socio economic indicators used are only indicative in nature to exemplify a preliminarily analysis. This list could to subsequently extended, depending on data availability of other variables.

- Past data is used to gauge the standing of a state with regard to a particular indicator, and a common year for all indicators could not be used due to data limitations,.

- States of Jharkhand, Chattisgarh and Uttrakhand had to be excluded, as recent data were not available for most indicators. And the data available for past years could not be distributed between geographical areas of the states.

- The analysis uses the set of 6 socio-economic indicators likely to impact the coping capacities of the states to potential climate change impacts, to develop weights, for vulnerabilities. This list can be further expanded, but for the purpose of this analysis, only these were considered. However, this holds potential for further detailed analysis.

- With regard to drought data, only one-year data has been used to generalize the area prone to droughts in a state. This is a rough assumption, taken only on account of data availability

- With regard to vulnerability indicators of impacts, only area indicators are used. In order to measure exposure, numbers for population likely to be affected by a potential impact are needed. In wake of lack of such data and any state level analysis, only area indicators are used. However, by including the population density indicator in the coping capacity index, this issue has been addressed to an extent.

CHAPTER 7 Provisioning of minimum environmental protection services

A key aspect of environmental sustainable development is that citizens have access to minimum environmental protection services such as drinking water supply, sanitation, sewerage, and solid waste management. In the Indian context, moreover, minimum environment protection services should also extend to access to clean energy given that the use of traditional biomass for cooking and kerosene for lighting create poor environmental health conditions, and large sections of India's population are still in the dark and exposed to indoor air pollution from cooking.

Despite the fact that there have been numerous schemes and programmes since independence to ensure universal coverage of such basic services, this outcome has been elusive. There are several reasons for the lack of effectiveness of such schemes, ranging from technical to social to institutional. One important reason is lack of effective decentralization in service delivery and inadequate O & M expenditures.[86] Even if the infrastructure is set in place for ensuring supply to all, it is imperative that local bodies have enough finances to meet O&M costs for the schemes to achieve their objective. This Chapter examines ways in which the XIII Finance Commission could strengthen the role and effectiveness of local bodies in the provisioning of such services.

Provision of Water, Sanitation and Municipal Solid Waste

The methodology adopted for the suggested grants disbursal by the Finance Commission (FC) is needs based. The grant amount is equal to the difference in outlays for environmental protection services in the 11th Five Year Plan and the monetary equivalent of the requirement for extending such services to the as yet uncovered population. The monetary equivalent is arrived at by using the prevailing norms, which mostly entail 100% coverage, for service provision. Three aspects are covered here:

1. Services that can be classified as minimum environmental protection services;
2. Prevailing norms that identify the minimum standards of these services; and

86 See The World Bank, Review of Effectiveness of Rural water Supply schemes in India, June 2008, in case of water supply

3. Current levels of environmental protection services provision in states i.e. the current coverage and resource gaps

Minimum environmental protection services

The minimum environment protection services considered in this study: i.e., (i) clean water supply and sanitation and (ii) clean energy for cooking and lighting. Sanitation includes access to drainage, toilets and solid waste management (SWM)[87]. Provision of clean energy refers to providing people dependent on traditional biomass energy sources for cooking with cleaner options and people move from Kerosene based lighting to use of solar lantern. Other services are not included in this section since norms for provision of such services are ill defined. However, over time there should be a move to ensure that all such services are provided. Also, water supply and sanitation are the most basic services that a citizen of any area should be provided with. Despite the focus on 100% coverage since independence, there is a fair proportion of population that does not have access to these services.

Specific purpose grants can be used for bridging the gap in service provision by augmenting budgets of states for such services. It is assumed that the various central programs and strategies such as Bharat Nirman[88] in rural areas and JNNURM in urban will create some of the capital assets that are needed to extend coverage in rural and urban areas respectively. It is important that these assets created from central funds belong to the Gram Panchayats. Over time, the O & M to provide the services should be borne through local bodies raising their own resources. However, a one-time grant can help local bodies tide over their limited resources, augment their revenue raising capabilities and strengthen their financial capacity. The grant amounts suggested here are towards stimulating local bodies in urban and rural areas to ensure that they are able to do their part in providing minimum environmental protection services to all and stimulating the use of clean energy for cooking and lighting. However, these grants should only bolster the service provision and not undermine or substitute a state's/local body's resource generating potential. Conditionality is important to judge future allocation of grants to states. Money in the ensuing periods should only be released to those states that achieve a certain minimum requirement of coverage as laid down by the

87 The 11th Five Year Plan includes solid waste management in sanitation
88 A focused strategy where 6 rural schemes, including drinking water supply (ARWP) have been put on the fast track. It is a central government program that seeks to cover habitations not covered by CAP99 and that will also address problems of slippage and water quality over a four year period, 2005-06 to 2008-09.

FC and monitored and when it can be certified that required infrastructure has been installed.

Norms for delivery of minimum environmental protection services

Agencies and expert committees like the Zakaria Committee (1963) , Rakesh Mohan Committee (1996), Town and Country Planning Organisation, Planning Commission (1983), Five Year Plans of the Indian government, National Institute of Urban Affairs, etc. have suggested the standards for provision of mostly urban infrastructural services. Some of the studies have also calculated the monetary equivalent of these physical requirements. However, the norms estimated vary widely across the studies. For example, physical standards of provision of water as recommended by the Zakaria Committee are 45 liters per capita per day (lpcd), while the Gujarat government recommends 100 lpcd and NIUA calculates a range of 95-125 lpcd (Mathur et al 2007). Also, the absence of any uniformly accepted standards or norms across the nation causes different studies to arrive at divergent estimates of norms. The variation in the estimates is mainly because of the difference in needs, technology, reference year, sources of data and methodology adopted.

The only report that works out the operations and maintenance expenditure is the Zakaria Committee report. The Zakaria Committee norms are dated since they are available for 1963. Since 1963 the population increase and the changes in technology have greatly altered the requirements for minimum levels of service provision. It is difficult to update the Zakaria Committee norms to reflect changes in technology and costs since they are based on actual data collected from cities of different sizes, differing operations and maintenance costs and the estimates prepared by the Town and Planning Organisation. Despite such caveats, the Zakaria Committee norms are the most comprehensive norms and the only ones that account for operations and maintenance expenditure on water supply and sewerage. Zakaria Committee norms are available for 4 services by 5 categories of towns (Annexures 7.1 and 7.2). A high-powered expert committee on urban infrastructure under the chair of Dr Isher Judge Ahluwalia has been set up by the government. One of the mandates of the committee is to review the norms for service provision as estimated by previous studies and to recommend norms that best meet the current requirements. Till the report of the committee is made available, and accepted by the government, the updated Zakaria Committee norms can be used, and have been used in this study, as a standard of the minimum levels of service delivery. The other consideration while calculating requirements is that most of the norms available are for urban areas. Using the same norms for rural areas may be a miscalculation, but is the best proxy available as of now.

For toilets, the cost estimates for provision of toilets by Sulabh International serve as a benchmark. State-wise requirements for solid waste management worked out by the Infrastructure Professionals Enterprise for the 12th Finance Commission are used in this study.

State-wise needs for delivery of water supply & sanitation

The needs of each state for the above services have been worked out based on the coverage as estimated in Census 2001 as follows.

R = N* UP

where

R = requirement of states to cover the deficit in coverage

N = Zakaria committee norms and other norms as relevant updated for 2000-01 prices

UP = uncovered population of state which is calculated by multiplying the average size of the households by the number of households uncovered by the service

Population fetching water from far away is used as a proxy for population without access to water supply. The Zakaria Committee estimates the norms for provision of sewerage services. On the other hand, Census provides details on population without access to drainage. For the purposes of this study sewerage and drainage are considered to be the same .i.e. the population with no access to drainage should be covered by sewerage. A simple average of the Zakaria Committee norms for each class of city (Annexures 7.1 and 7.2) is used as the indicator of norm for the rural and urban areas in a state.

The basic toilet model as reported by Sulabh International requires a substructure cost of Rs. 1100 for 5 users for 2 years. This is treated as the operations and maintenance costs and it works out to Rs. 110 for one person for one year. Operations and maintenance costs for solid waste management are obtained from the study by IPE for the 12th Finance Commission (Table 7.1). All prices are worked out at 2000-01 prices using Wholesale Price Index for all commodities.

Table 7.1 Norms for minimum environmental protection services

Services	Updated norms (in Rs at 00/01 prices)	Source	Remarks
Water supply	185.21	Zakaria Committee 1963	The norms are updated at 2000-01 prices in a study by NIPFP 2004. A simple average of the norm for all classes of cities has been considered
Sanitation	208.14	Zakaria Committee 1963	The norms are updated at 2000-01 prices in a study by NIPFP 2004. A simple average of the norm for all classes of cities has been considered. It is assumed that households that do not have access to drainage should be covered with sewerage
Toilets	110	Sulabh International	The substructure cost for the basic model for 5 users for 2 years is Rs 1100. Hence for 1 person for a year it assumed that operations and maintenance cost is Rs 110. The year is not specified however it is assumed to be at 2000-01 prices since according to Bharat Nirman the cost of a unit is Rs 1600 in 2008
Solid Waste Management		IPE study for the 12th FC	Total operations and maintenance costs worked out for each state

Using this methodology the total amount required to meet the O & M costs for the minimum environmental protection services in all states for both rural and urban areas **is Rs. 24848 crores per annum at 2000-01 prices (or Rs. 32892 crores at 2006-07 prices)** [Table 7.2].

Of this total amount, Uttar Pradesh requires the highest share at 12% for 100% coverage followed by Madhya Pradesh and West Bengal at nearly 10% for water supply, sanitation and solid waste management. On the other hand, the North-eastern states require the least percentage of the total amount with the requirement being less than 1% for all these states. The needs for 100% coverage of rural areas are more than those of urban areas for all states and for all services. (Figure 7.1)

The total outlay for water supply and sanitation in the 11th Five Year Plan is Rs. 175000 crores (assumed to be at 2006-07 prices) or Rs 35000 crores annually. We were unable to establish the share of O & M in this, but were given to understand[89] that over the 10th plan, the North East states spent 10-15% of their outlay on O & M. if we use this as an approximation, then Rs.3500-5250 crores can be expected to be used for this purpose. This implies that there is still a gap of Rs.27642-29392 crores that needs to be met towards these minimum environmental protection services, according to this methodology. The Finance Commission can consider meeting

89 Planning communication- personal communication part of this need, say 25%, which will mean an annual specific grant of Rs.6910.5 - 7348 crores for each of the 5 years

Table 7.2 State-wise O & M fund requirements in rural and urban areas for access to water, drainage and toilets and solid waste management

(in Rs crores at 06-07 prices)

States	rural water	Rural drainage	rural toilets	urban water	urban drainage	urban toilets	Swm	total requirement	% of total reqt
Andhra Pradesh	297.6	894.0	660.3	68.8	101.5	66.4	306.1	2394.7	7.58%
Arunachal Pradesh	4.4	18.3	6.9	0.6	2.0	0.4	0.7	33.3	0.10%
Assam	139.2	543.3	136.6	8.8	44.4	2.7	19.1	894.0	2.74%
Bihar	229.0	1333.5	931.4	18.3	75.2	38.4	62.2	2687.9	8.23%
Chhatisgarh	90.9	405.6	229.2	14.1	42.9	29.0	24.5	836.1	2.57%
Goa	2.5	12.9	5.3	1.4	6.0	3.1	2.0	33.1	0.10%
Gujarat	161.4	754.2	361.6	30.1	113.0	53.5	308.3	1782.1	5.72%
Haryana	97.8	116.9	155.8	11.1	19.5	17.2	48.0	466.3	1.46%
Himachal Pradesh	19.2	104.8	57.9	0.9	2.3	2.0	2.4	189.6	0.58%
J&K	59.6	153.3	64.4	3.7	12.5	4.8	16.7	315.0	0.97%
Jharkhand	137.4	476.1	285.7	24.6	45.7	29.1	35.5	1034.1	3.18%
Karnataka	223.5	621.3	419.7	61.0	94.4	64.9	235.0	1719.8	5.46%
Kerala	78.1	546.2	64.2	15.1	158.0	9.6	67.4	938.7	2.92%
Madhya Pradesh	297.5	980.6	588.7	60.1	106.1	75.2	151.3	2259.5	7.02%
Maharashtra	235.7	904.9	664.5	57.0	140.6	250.9	671.7	2925.4	9.55%
Manipur	14.0	31.5	5.6	3.3	7.1	0.4	2.6	64.4	0.20%
Meghalaya	15.0	38.6	16.6	2.1	3.2	0.6	1.9	78.0	0.24%
Mizoram	3.7	8.3	1.2	1.9	4.1	0.1	2.3	21.5	0.07%
Nagaland	13.1	27.1	8.2	1.6	2.3	0.3	1.5	54.1	0.17%
Orissa	248.5	734.3	420.6	28.1	64.4	32.3	32.2	1560.4	4.78%
Punjab	16.5	97.2	138.5	3.0	23.4	16.3	69.5	364.4	1.18%
Rajasthan	303.3	916.6	538.4	26.5	72.0	45.9	128.7	2031.3	6.30%
Sikkim	2.6	9.4	3.0	0.1	0.2	0.1	0.2	15.5	0.05%
Tamil Nadu	114.0	698.5	435.2	70.3	227.1	142.8	297.2	1985.1	6.33%
Tripura	20.8	56.8	8.7	1.2	6.5	0.2	2.4	96.6	0.30%
Uttar Pradesh	363.2	1270.3	1548.9	45.5	72.4	100.4	357.4	3758.2	11.78%
Uttaranchal	31.6	112.9	62.7	2.8	7.1	4.2	9.5	230.9	0.71%
West Bengal	289.1	1336.8	613.9	65.4	202.8	49.4	483.5	3040.9	9.72%
Total	3509.2	13204.0	8433.5	627.4	1656.8	1040.3	3339.8	32892.0	

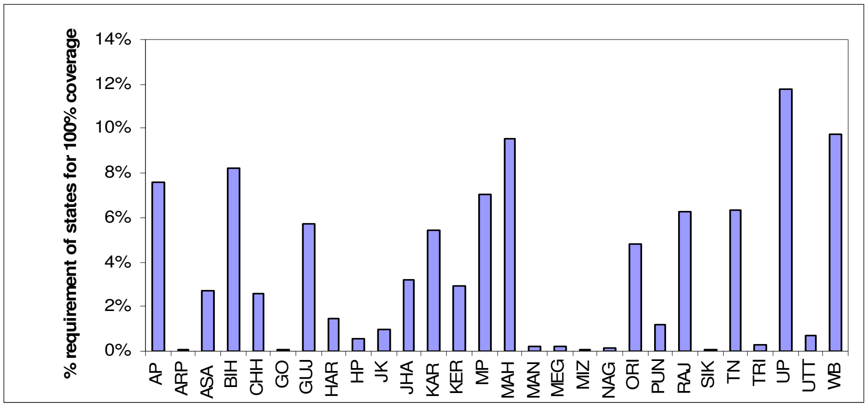


Figure 7.1 State-wise resource gap for universal provision of drinking Water Sanitation, toilets, solid waste disposal

Caveats

Mathur et al 2007, note that many municipal bodies find it difficult to meet the Zakaria Committee norms since they represent 'the most desirable levels of services – a kind of optima'. For toilets, cost estimates for the most basic model as recommended by Sulabh International have been used and it is likely that the costs of provision are more.

At the same time, the amount of approximately Rs 33000 crores arrived at in this section is not necessarily a true reflection of the actual needs. It could be an overestimate, since access data from Census 2001 has been used. Since, 2001, access to water supply and sanitation have increased due to various Centrally Sponsored Schemes initiated. Or it could be an underestimate given that population has increased over the period 2001-2008; migration also has occurred across States which may change access coverage across states.

Zakaria Committee recommends norms for urban infrastructure provision. The costs and physical requirements for rural areas are very different from urban areas. Also, the data on access to basic sanitation and water supply relates only to the infrastructure provision and not the functionality of the resource-this definitional aspect could probably be one of the reasons for the low fund requirement to meet the norms.

Provision of clean energy to those dependent on traditional biomass for cooking

In rural India about 126 million households rely on biomass as the primary energy source for cooking and 13 million biomass dependent households habit the urban agglomerations (NSSO 61st round 2004-05)[90] Traditional cookstoves emit several pollutants including particulate matter, carbon monoxide, nitrogen dioxide and carcinogenic materials. The environmental health concerns worsen as these are not vented out of the kitchen and expose both women and children in poor households to pollution levels 10-30 times those recommended by the WHO.

The IEP does say that clean cooking energy such as LPG, natural gas, biogas or kerosene should be available to all within 10 years. The Finance Commission could consider assisting households below the poverty line[91] (about 44 mn households) who are dependent on traditional biomass to make the transition to clean energy.[92] A grant of Rs. 8800 crores to States would be needed to facilitate the transition.[93]

For these groups that will continue to be biomass dependent, it is essential that they have cleaner options. Over the years, the Government has been implementing several programmes to enhance access to cleaner fuel and options for cooking to the households through the National Programme on Improved Chulha which started in 1983 and the Biogas program introduced around the same time. Improved cook stoves which have higher combustion efficiency, reduce the need for fuel and produce lower smoke. There are various models of cook stoves with varying efficiencies ranging between 20%-30% as compared to 8-10% of traditional cookstoves. Despite several years of being in existence, however, the improved cook stoves programme of the government has had limited success. The key responsible factors for this as per M & E studies done relate to its being a target driven rather than a needs driven programme, insufficient understanding being provided to users of the health benefits around the use of improved stoves, and absence of decentralized production. A key factor has also been technical

90 Data accessed from NSSO 61st round available at http://www.mospi.gov.in/mospi_nsso_rept_pubn.htm
91 See Annexure 7.3 for the state wise break up of population below poverty line
92 The Integrated Energy Policy suggests that clean cooking energy such as LPG, NG, biogas or kerosene should be available to all within 10 years.
93 TERI estimates indicate that the annualized cost (device / connection cost plus fuel cost) of clean cooking energy options (improved biomass stoves, biomass gasifier stoves and subsidized LPG) range from around Rs 1500 to Rs 2500 per household

design defects, not only in turns of the combustion, but also that technology has not been sufficiently customized to meet local cooking customs and requirements. Since there is a wide diversity of food type and preparation patterns across the country, it is important that this be considered to improve adoption rates. More research is needed on this issue.

The Improved cookstove initiative and the Biogas program can be taken forward if there are adequate investments to address the issues around technical, social and environmental parameters. This is something that can be addressed through the innovation fund which is discussed in chapter 8 and through a concerted action with Gram panchayats to help increase adoption rates.

Provision of clean energy to those dependent on kerosene for lighting

A declining trend in kerosene consumption is evident for the past 4 years; this is likely be accelerated by the success of newly introduced programmes such as Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) (Ministry of Power, Government of India), and the Village Energy Security Program and Remote Village Electrification Program (Ministry of New and Renewable Energy, Government of India). Conservative estimates reveal that at least 30 million households would still be using kerosene for lighting by 2012 end. (Figure 7.2) Figure 7.3 provides the state wise break up.

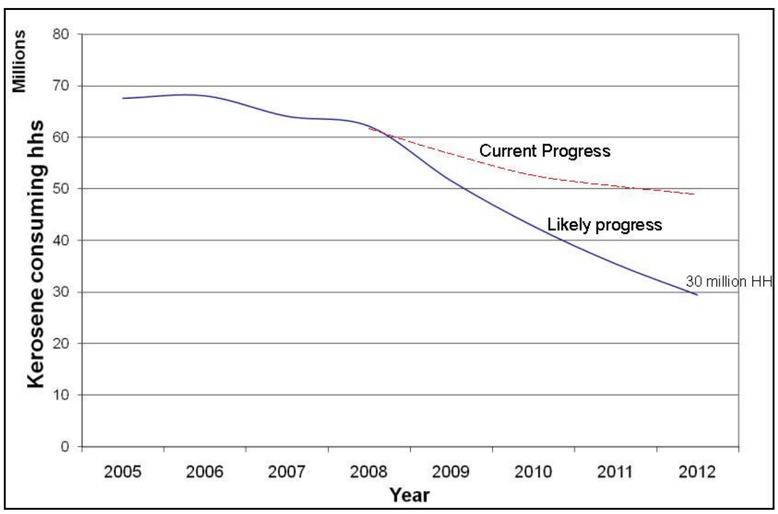


Figure 7.2 Households using Kerosene in lighting (2005-2012)

The spread of these households across states is shown in figure 7.6 below.

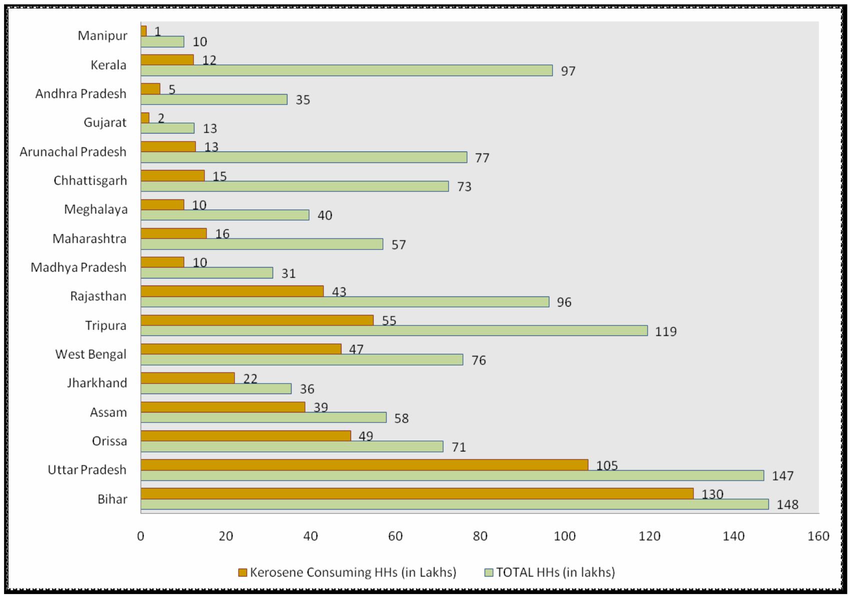


Figure 7.3 Statewise distribution of Kerosene used for lighting

Until households are connected with electricity, those households using kerosene for lighting could be benefited by solar lanterns, and these can remain in use even after grid based electricity is provided. (IEP, 2008) A solar lantern is a portable lighting device that uses either CFL or LEDs, and has an inbuilt rechargeable battery that is charged using a solar panel of adequate size. Solar lanterns are being promoted in the country for the past several years, but their dissemination is limited[94] due to high upfront costs (Solar PV is inherently an expensive technology, though it is the most matured and user friendly among various renewable energy technologies available). Inadequate institutional mechanisms and delivery channels for sale and after-sales service has further hampered the penetration of this system in rural areas.

To overcome the above challenges, village based solar lantern charging centres can be set-up that would rent out charged lanterns on daily basis at minimal costs (Rs. 3-5 per day) which is affordable to the household. These centres would not only provide affordable and clean lighting services to rural households, each centre would also offer employment opportunity to at least one local person who would be trained to manage the centre. Gram Panchayats could be ideal institutions that can facilitate setting up these centers in villages and offer clean lighting services. Thirty million households (or 150 million people) can be serviced by 300,000 of such centres[95], which would thus create 300,000 jobs in rural areas. The

94 6.97 lakh so far
95 Each centre on an average can rent 100 lanterns

capital required for setting up each centre would be to the tune of Rs. 5 lakh. In order to seed this market and build the capacities of Gram Panchayats across states, a facilitation phase of 10,000 centres can be taken up, which would require funding of about Rs. 500 Crore. Subsequent to the facilitation phase, low cost loans to SHGs, micro-enterprises etc. could be arranged for taking this initiative forward.

Conclusions and recommendations

Using the coverage estimates from Census 2001 and the norm as 100% coverage for water supply and sanitation, we find there is still a gap of Rs.27642-29392 crores that needs to be met towards water supply and sanitation services, according to this methodology. The Finance Commission can consider meeting part of this need, say 25%, which will mean an annual specific grant of Rs.6910.5 - 7348 crores. A grant of Rs. 8800 crores to States would be needed to facilitate the transition to clean energy. Another grant of Rs. 500 crores can be earmarked towards facilitating the uptake of solar lanterns.

CHAPTER 8 Incentivizing states and local bodies towards improved environmental and ecological management

To redress concerns related to environmental degradation and provision of local environmental services in India requires a treatment of the underlying causes rather than the symptoms. Preceding chapters touch on some of the factors that underlie poor environmental performance of states. These include inadequate capacity in the state pollution control boards and local bodies, lack of coordination among multiple agencies dealing with a resource, weaknesses in the devolution process, persistence of environmentally perverse subsidies and insufficient use of policy instruments to deter pollution. There are also factors intrinsic to a region which may confer an element of environmental disability, such as recurring floods or extreme arid conditions.

To deal with environmental issues in a comprehensive manner, each state government needs to prepare **a long term environmental strategy supported by time-bound action plans**. The National Environment Policy, 2006, in fact, encourages state and local governments to design their own environmental strategies. In its preamble, the NEP 2006, notes that it is *intended to be a guide to action: in regulatory reform, programmes and projects for environmental conservation; and review and enactment of legislation, by agencies of the Central, State, and Local Government* (page 3, NEP 2006). It goes on to say that *Action plans would need to be prepared on identified themes by the concerned agencies at all levels of Government Central, State/UT, and Local. In particular, the State and Local Governments would be encouraged to formulate their own strategies or action plans consistent with the National Environment Policy* (page 15, NEP 2006).

The Finance Commission could incentivize this process through **a grant of Rs. 5000 crores towards the setting up of a non lapsable National Environmental Fund**. The grants from this Fund can be given in two parts. The first part (about Rs. 100 crores) should be available to all states to enable the preparation of State Environmental Strategies and Action Plans. The second part of the funding should be aimed at supporting specific action plans/proposals from states after their evaluation and periodic monitoring (for continuation of support). The Fund can be overseen by an independent body such as the Inter state Council. It is important that this fund be non lapsable and the initiative be sustained by future Finance Commissions for this system of incentives and rewards to succeed in bringing all States on par. As environmental governance is strengthened in states, the need for such incentives should reduce over time, so that eventually grants could be linked entirely to a more comprehensive index of environmental performance.

By supporting the preparation and implementation of a state environmental strategy and action plan, the Finance Commission would ensure that while the environmental performance of states is rewarded on the basis of the EPI, laggard states are assisted to move up the EPI. In other words, the principles of equity and efficiency that shape Finance Commission transfers in general, are as applicable in case of environment-linked transfers from the centre to the lower tiers of the government. These transfers need to be cognizant of the fact that states have different environmental (along with fiscal) capacities and needs, as well as inherent differences in the cost of providing environmental services. While deficiency in environmental (and revenue) effort should be effectively discouraged, deficiency in environmental (and fiscal) capacity needs to be redressed.

Identifying areas that need to be addressed to improve environmental performance

In this section, we recapitulate some important factors that underlie environmental performance of states and which they could be incentivized to address through grants from this Fund. Some of these are issues that states must integrate in their environment strategy. These are broadly aimed at building environmental management and governance infrastructure including data systems, putting in place policies to internalize environmental externalities, local and regional, preserving areas of incomparable value, and encouraging greater energy efficiency and renewable energy penetration. Others are issues that manifest across state boundaries and where grants from the Finance Commissions can be designed to encourage inter-state cooperation.

Strengthening institutions of environmental governance

As discussed in Chapters 1 and 3, institutions for environmental governance including those involved in pollution monitoring and control as well as those responsible for natural resource management face a number of technical and financial constraints.

As noted in Chapter 3, the State pollution control boards have largely remained agencies for control of industrial pollution and most of their potential powers remain un-utilized due to inadequate regional networks, financial and technical constraints. Similarly, local bodies which are responsible for several environmental functions (e.g. management of household waste) are still unable to effectively discharge their functions in a financially independent manner despite several government initiatives to assist reforms of local governance. This has happened largely because they lack the required technical skills and have not been able to raise financial resources as envisaged in the 73rd and 74th Amendments to the Constitution.

It also needs to be reiterated here that the reason why decentralized management of natural resources has been inadequate is not always the lack of policies and intentions but rather the lack of political will and action to implement these. As noted in Chapter 3, demands for decentralization reforms are normally met with insufficient power transfers and inappropriate local institutional arrangements that compromise the actual decentralization process. This is manifested both at the centre-state and the state-sub state levels.

Another institutional issue that is often noted as an impediment in the effective management of resources is the lack of institutional convergence amongst the multiple agencies involved in their management. Perhaps in no sector is the challenge of integration as important as that in water which is dealt by a number of ministries/departments both at the central and state levels. The fragmented approach to water management creates a false dichotomy across (1) sectors or uses and (2) source (surface and groundwater) TERI 2003[96]. Recognizing this issue, states like Maharashtra and Gujarat have enacted legislation to enable the setting up of a Water Regulatory Authority that would inter alia regulate sectoral allocation, water rates, changes/diversion in water use and compensation for such changes in use. Karnataka is in the process of setting up a State Water Council to ensure coordination in the multiple water management and decision making authorities.

One aspect of water management that been grossly neglected across the country is legislation on groundwater extraction. There is an urgent need for states to put in place effective groundwater legislation and set up a decentralized regulatory framework for monitoring its implementation.

96 Issues paper on water management prepared for DFID at the Cross-sectoral dialogue on sustainable development, TERI, 17th December, 2004

Strengthening the pollution management infrastructure

There is a severe shortage of pollution management infrastructure in the country, especially for the treatment of sewage. Only about 13.5% of the sewage that is generated in the country is treated due to inadequate treatment capacity and the sub-optimal utilization of the existing capacity. This is the main cause of pollution of rivers and lakes in the country (CPCB 2008). There is an urgent need to augment the sewage treatment infrastructure in India including wastewater collection systems. The maintenance of existing infrastructure is also a key concern since nearly 39% of the plants do not conform to the standards prescribed for discharge into streams (CPCB 2008). One of the main reasons behind this is the inadequate technical expertise in the operation of sewage treatment plants in India and clear accountability for the management of these systems.

Again, several states in the country still do not have adequate pollution monitoring infrastructure. Several North Eastern states, Union Territories, and other states like Jammu and Kashmir, and Jharkhand could not be included in the estimation of the EPI due to non availability of data. In these states, air quality and water quality monitoring was either non existent or present to a limited degree.

A related issue where funds from the Finance Commission can incentivize state action is the GIS mapping of the water supply distribution network. In the absence of systematic records and data on the distribution network, this mapping is a prerequisite for maintenance and conservation measures.

Use of economic principles in environmental decision making

Worldwide, a combination of policy instruments has been used to address environmental problems. Some of the available options are categorized Table 8.1. Underlying many of these options are the economic principles of cost-recovery, polluter-pays, definition of property rights, correcting asymmetric information etc.

Given the preponderance of resource-related subsidies as well as the lack of effective disincentives for polluters, the issues of rational pricing of natural resources and pollution charges need immediate attention. The issue of pricing is especially crucial in the water and energy sectors as discussed in Chapter 1 and needs to be addressed. While there is abundant recognition of the link between cheaply priced energy and overuse of natural resources, there is need to push for corrective action, which combines prices which reflect real costs of producing the service with targeted subsidies where needed. The Electricity Policy 2005 recognises that rational and economic pricing of electricity can be one of the major tools for energy and water conservation. The Policy states that while fixing tariffs for agricultural use the imperative of the need of using groundwater resources in a sustainable manner needs to be considered in addition to the average cost of supply. Section 62(3) of the Electricity Act 2003 suggests that the geographical position of any area could be one of the criteria for tariff differentiation. A higher level of subsidy could be considered to support poorer farmers of the region where adverse ground water table condition requires larger quantity of electricity for irrigation purposes subject to suitable restrictions to ensure maintenance of groundwater levels and sustainable groundwater usage. Implementation of such corrective actions on the pricing front by States should be encouraged to help reduce the overuse of natural resources.

The absence of wastewater charges has also been noted in the report. In the case of municipal solid waste also, only a few municipal bodies in the country have made use of economic instruments such as water charges to manage waste, relying instead on the general revenue of the local governments or grant funding from the central or state governments, as discussed in Chapter 3. This is one of the reasons why waste management is among the most poorly rendered of the civic services to be provided by municipal authorities. It is worth noting the developed countries are increasingly moving towards a system of pay-as-you-throw in order to incentivize waste minimization while recovering costs of the service provision.

Table 8.1 Classification of instruments in the environmental policy matrix

Using markets	Creating markets	Environmental regulations	Engaging the public
Environmental taxes and charges	Property rights and decentralization	Standards	Public participation
User charges	Tradable permits and rights	Bans	Information disclosure
Subsidy reduction		Permits and quotas	
Deposit refund schemes		Zoning	
		Liability	

SOURCE: STERNER (2003)

The National Environment Policy 2006 rightly recognizes the importance of incorporating the costs associated with degradation and depletion of natural resources into the decisions of economic actors at various levels, *to reverse the tendency to treat these resources as free goods and to pass the costs of degradation to other sections of society or to future generations of the country*. The NEP 2006 also calls for a review of environmental legislation in the country including pollution charges.

Institutionalizing 'green accounting'

It is now widely recognized that that GDP is of limited usefulness to gauge long-term sustainable growth. Conventional national accounts neglect the scarcities of natural resources that threaten the sustained productivity of the economy and the degradation of environmental quality, mainly from pollution and consequences on human health and welfare (Bartelmus and Tongeren, 1994). Thus, exclusion of depletion and environmental degradation from GDP gives an overestimation of the growth rate of the economy and future consumption possibilities. In response to such concerns, efforts to extend the measure or develop an alternative to the system of national accounts are increasing in several countries. In general, the environmentally adjusted net domestic product (EDP) allows for the consumption of produced capital and the depletion and degradation of natural capital, taking into account trends of depletion and degradation that can be offset or mitigated by technological progress, substitution, discoveries of natural resources and changes in consumption patterns" (Bartelmus 1992). Such a system will also enable a systematic thinking of the application of the weak and strong sustainability paradigms. The central government has taken several initiatives to institutionalize such processes- the Central Statistical Organization has an ongoing initiative to evolve an accounting framework for major natural resources, towards which it has commissioned a number of resource accounting projects for different states. Likewise, the Ministry of Environment and Forests had commissioned a study on Evolving a Framework for Sustainable Development Indicators for India. Unless such initiatives are also taken by state governments, they will serve limited policy relevance. The Finance Commission should seek to encourage states to adopt green accounting by 2015.

Incentivizing the transition to sustainable energy

Enhanced efficiency at all stages of the energy cycle and the greater use of renewable sources of energy in both grid and off-grid applications is crucial for environmental and energy security of the country and for making universal energy access a reality.

The National Mission for Enhanced Energy Efficiency in the National Action Plan on Climate Change 2008 identifies various measures that are necessary to promote energy efficiency in the country (Box 8.1) State and local governments should identify instruments and programmes that can be implemented at their level to further the objectives of the Mission.

Box 8.1 Incentives for energy efficiency

The National Mission for Enhanced Energy Efficiency in the National Action Plan on Climate Change 2008 identifies the following initiatives for the promotion of energy efficiency

- A market based mechanism to enhance cost effectiveness of improvements in energy efficiency in energy-intensive large industries and facilities, through certification of energy savings that could be traded
- Accelerating the shift to energy efficient appliances in designated sectors through innovative measures to make the products more affordable.
- Creation of mechanisms that would help finance demand side management programmes in all sectors by capturing future energy savings.
- Developing fiscal instruments to promote energy efficiency.

http://pmindia.nic.in/Pg01-52.pdf .. page 7

Some measures that state governments could take in this direction include[97]:

- Procurement of energy efficient goods (e.g. star rated appliances) by urban local bodies, government buildings and public sector agencies
- Strengthening the institutional set up for energy efficiency such as through the creation of energy cells, DSM cells in municipalities and other public sector agencies
- Putting in place fiscal instruments such as differentiated taxation to promote energy efficient products

One area where improved efficiency can have direct and immediate environmental and social spin-offs is the cookstove. As noted in Chapter7, the improved cook stoves programme of the government has had limited success, one of the responsible factors being design defects[98]. To address this, states need to be encouraged to undertake more region-specific research on the

97 As discussed with the Bureau of Energy Efficiency
98 Source: Dr Hafeez Ibrahim, Director, Social Transformation. TERI

design of cookstoves and fuels. In recent years, research activities in cook stove development and dissemination have moved forward with the arrival of some major commercial players such as Shell, Philips and BP, in the cook stove market. Stove designs have moved beyond natural draft to turbo-charged controlled draft technology for better combustion efficiency. However, considering that efficiency levels are still hovering below 35% which is much less than the 60% or more efficiency levels of LPG stoves there is a need for further research. Also, an improved cooking technology will serve its purpose only when it is used by households voluntarily. Since there is a wide diversity of food type and preparation patterns across the country, it is critical that any "improved biomass combustion" technology needs to be customized to meet local requirements as technical efficiency alone does not determine "improved" cook stove adoption. Action research is necessary to identify and assign weights to multiple social, technical, economic and environmental determinants that interact to influence the adoption of cook stove by households. Thus investments are required for promoting technical research for developing the core combustion technology options that can use different (or multiple) feeedstocks and can be incorporated into various customized cookstove designs.

The other equally important issue is that performance of any biomass stove can be optimized by using processed fuel that has higher efficiency. Hence, there is a need to research and promote options for processing of fuel and for setting up of delivery chains for the processed fuel and improved cookstoves. Processed fuels have relatively higher calorific value and generally produce less smoke. Since there are no major initiatives focussing on development of a supply value chain for processed fuel, specific investment and public private partnerships are desirable to take the same forward.

We therefore propose that the Finance Commission constitute an Innovation Fund under the Environment Fund to provide financial support for the following:

- research and development of cook stove design focussing on technical, social and environmental parameters;
- promotion of research on fuel processing and for establishing delivery mechanisms,
- financial support and incentives for dissemination particularly for adoption by the poor households.

The fund could help leverage private investment, venture capital, social investment funds etc.

The integration of renewable energy generation into the power grid system is fundamental to successfully addressing the need to move off the fossil fuel path. One of the ways this is sought to be incentivised is through the Tariff Policy 2006 which mandates that the SERCs should fix a minimum percentage for purchase of energy from such sources taking into account availability of such resources in the region and its impact on retail tariffs. This was discussed in Chapters 1 and 5. A number of states have already committed to different levels of renewable purchase obligations (RPOs). In Chapter 5, we have suggested that States be rewarded for moving towards achieving their RPOs. Some States, not as well endowed as others in renewable energy potential may find it difficult to meet the norms of mandatory procurement of renewable power. One way of meeting the mandates is to create a market for trading in renewable energy credits. Under the concept of renewable energy credits, States with lower renewable potential can fulfil the renewable purchase obligations by buying power from States that have a higher potential. However a market needs to be created to provide a platform for trade in renewable energy credits. There is also need to build capacity to help entities use these credits in order to increase the share of renewable energy based grid interactive power, as well as for verification of credits and oversight of this trade. This can be supported by the Finance Commission.

For off grid technologies, we propose that the Innovation Fund mentioned above should also support the development and uptake of local renewable energy resources - biogasifiers, micro hydro, hybrids, wind, by promoting research and assisting technology extension from the lab to markets.

There is also need to strengthen the role of nodal Renewable Energy Development Agencies in States to enable their active role in all the above interventions and make them into stronger instruments of change.

Conserving critical environmental and related socio-cultural resources

The National Environmental Policy (NEP) 2006 while defining the basic principles of environmental conservation and management emphasizes the need for priority allocation of societal resources for conservation of Entities of Incomparable Value (EIV), both natural and man-made, which may impact the well-being, broadly conceived, of large number of persons. These are areas that need to be preserved in line with the strong sustainability argument and the precautionary principle.

Some of the ecologically rich and sensitive areas are currently covered through the protected areas (PA) network and eco-sensitive zones, deriving power under diverse legal instruments and/or regulatory frameworks but the provisions of extant legal instruments have not been translated into regulatory frameworks and guidelines, and they do not fully cover certain EIVs such as biosphere reserves, natural heritage sites and man-made monuments, wetlands, mangroves, and sacred groves (MoEF 2008). Certain grasslands can also be of incomparable value such as the montane grasslands in the Western Ghats that serve as unique habitats of the Nilgiri tahr.

One such instance of ecosystems that need to be preserved is the *khazans*, which are managed wetlands found in Goa, Coastal Maharashtra and coastal Kerala. These comprise lands that have been reclaimed over the centuries from marshy mangrove swamps. *Khazans* support agriculture, traditional salt manufacture, coconut plantation and traditional fisheries and thrive on inter-linked components including a variety of flora, fauna and microbes. The khazans have historically been managed by self-governing village institutions (gaunkaris and later communidades in Goa). Unfortunately, this system of institutions that embodies rich social capital has been significantly eroded over the last few decades primarily through legislative and administrative change with serious consequences for the ecosystem and its biodiversity. Given their socio-ecological importance, such lands need to be protected from wide spread conversion for tourism and built up settlement areas.

It has therefore become necessary to set up a harmonized system for identification, constitution, rationalization and management of the diverse EIVs under a unified regulatory framework within the ambit of Environment (Protection) Act, 1986 (MoEF 2008). States should undertake this process as part of their environmental strategy. In doing so it is necessary that the process be consultative involving the central government and local communities. These action plans can be supported by specific grants from the proposed environment fund. In this context, the ongoing effort of the Ministry of Environment and Forests to define national criteria for identifying an EIV needs to be furthered and also more widely debated in order to ensure state and public participation and hence acceptability (Box 8.2).

Box 8.2 Potential criteria for the identification of entities of incomparable value or "no go" areas

A site may be considered an Entity of Incomparable Value (EIV), if it meets the following criteria:

a. Unique biodiversity (genetic, species and ecosystem). It includes species and ecosystems characterized by endemicity, rarity and representativeness (such as relevant components of biosphere reserves, natural heritage sites and other fragile ecosystems).
b. Life support systems (water, soil, geology, glaciers) impacting the wellbeing and health of large number of people, i.e. at least 100,000 population.
c. Entities of cultural, aesthetic and religious significance to large number of people, i.e. at least 100,000 people.
d. Large economic potential in the context of specific unique natural resources to be conserved i.e. at least 25 crores potential annual income at 2007 prices and/or major livelihood support to 100,000 population
e. Natural entities providing eco-system resilience

Source: Draft report on Action Plans and Regulatory Framework for Entities of Incomparable Values (EIV), MoEF 2007

In addition to the above issues that need to be addressed in the state environment policies, grants from the Finance Commission could also be designed to provide an incentive for inter-state cooperation on management of transboundary and shared environmental and resource management issues.

Inter-state cooperation to address trans-boundary and shared resources

Effective management of environmental problems requires action at various levels. While some environmental issues are best handled at the central (e.g. global environmental concerns, technology research and development, fuel standards) or the local level (e.g. management of local refuse), others which entail spill over effects on neighboring regions e.g. air and water pollution pose a special challenge for environmental federalism. In case of water quality for instance, even if the MINAS is met, the targeted water quality cannot be achieved due to lack of adequate dilution in the river. This can lead to interstate conflicts and calls for a more basin wide approach to water management in order to enhance water or ecological flows through conservation or augmentation measures. These issues can be addressed through inter-state regional cooperation, which the Finance Commission could incentivize. Other examples would include mutually supportive legislation in the case of transboundary environmental issues such as groundwater extraction and water pollution; design of common facilities for management of waste such as regional landfills; improved mechanisms to harvest rain water; and cooperation in the protection of biodiversity through the collective management of protected areas and corridors. Funds from the

Finance Commission could facilitate this process through dialogue and preparation of joint management plans.

Finally, it may be noted that in addition to the above factors, there are also factors intrinsic to a region which may confer an element of environmental disability. These include:

- Topography
- Recurrent floods
- Extreme arid conditions
- Natural fluoride or arsenic presence in ground water

These conditions could result in recurring environmental problems. Some of these concerns were addressed through specific grants by the XII Finance Commission. These include grants to provide drinking water supply to fluoride–affected areas in Andhra Pradesh and address arsenic contamination of ground water in West Bengal. The other factors- notably topography and floods- are already an integral component in central assistance to states. Therefore, while intrinsic environmental disabilities may be an important consideration in differential environmental performance, it may be left out from general Finance Commission grants. States could, however, apply for case-specific grants to remediate impacts on environmental resources from such disabilities.

In conclusion, a word on the importance of awareness creation in ensuring the transition to an environmentally sustainable society. There is a strong need to educate and make aware relevant professionals, including policymakers, as well as the general public about the causes and implications of environmental degradation and the how individual action can sum up to make large impacts. This aspect needs to be recognized in the environmental strategy and action plan of each state. A conscious citizenry is perhaps the best way to ensure the necessary political will and public buy-in for seemingly unpopular measures and ensure the success of legislation and policy on environmental and resource management.

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Annexures

Annexure 1.1 Oak ridge air quality index

For the meaningful and simple representation of vast amount of air quality data, an AQI (Air Quality Index) has been used. Currently, a wide variety of indices are adopted by different authorities; there is no single uniform AQI. The current study used the Oak Ridge AQI developed by the Oak Ridge National Laboratory, for three pollutants (SO2 [sulphur dioxide], NOX [nitrogen oxides], and SPM [suspended particulate matter]), defined as follows (Joshi 1984):

$$ORAQI = [39.02\sum_{1}^{3}(X_i / X_s)]^{0.967}$$

where Xi and Xs denote the pollutant concentration and the respective limits or standards.

The ORAQI categories are as follows: Excellent, 0–20; Good, 20–39; Fair, 40-59; Poor, 60-79; Bad, 80-99; and Dangerous, 100 and above. Although well-defined descriptor categories are given, no correlation with health effects is implied by its developer.

Annexure 1.2 Relative performance of states using compliance indicators

Air quality

The exceedence indicator for RSPM levels is constructed by comparing the pollutant's concentrations at various stations with respect to its specific NAAQS (National Ambient Air Quality Standards) to compute the exceedence factors[99]. The exceedence indicator compares the compliance of the given station vis-à-vis the prescribed standards. Stations with exceedence factors higher than 1 are considered to be violating the standards. Higher the percentage of stations violating the standards, lower is the air quality of the state. It can be seen from Figure 1 that states such as Goa have the highest percentage of their monitoring stations complying with the RSPM standards.

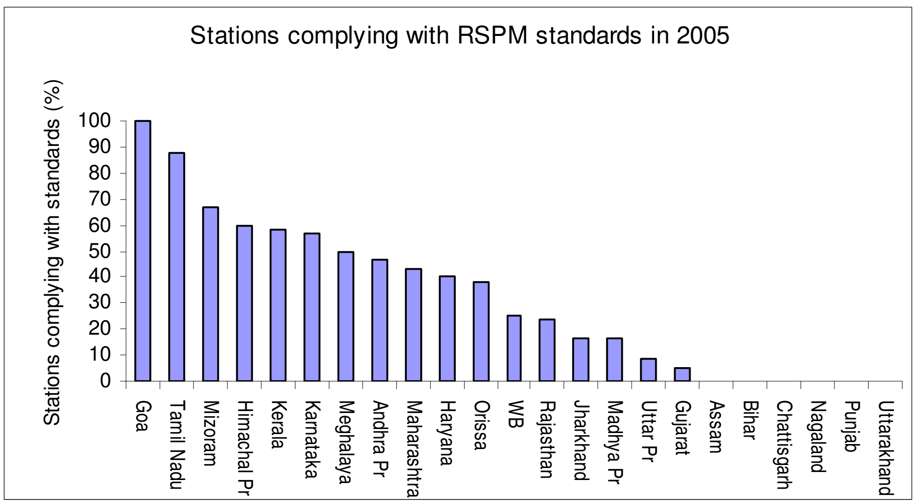

Figure 1 Percentage of stations complying with RSPM standards in 2005

While the exceedence indicator depicts the change in the air quality status, a refined approach for gauging the extent of impacts due to pollution levels is through weighting the index using population of the given location.

Water quality

The exceedence indicators were constructed for measuring water quality (surface and ground). In case of surface water the proportion of monitoring stations complying with the norms (Class C of Designated Best Use Classification) in a given year were considered (Figure 2), while for ground water compliance vis-à-vis BIS drinking water norms was used to assess water

[99] Defined as ratio of observed mean concentration and ambient standard of that pollutant

quality (Figure 3). The extent of compliance reflects the state's ability to manage water quality.

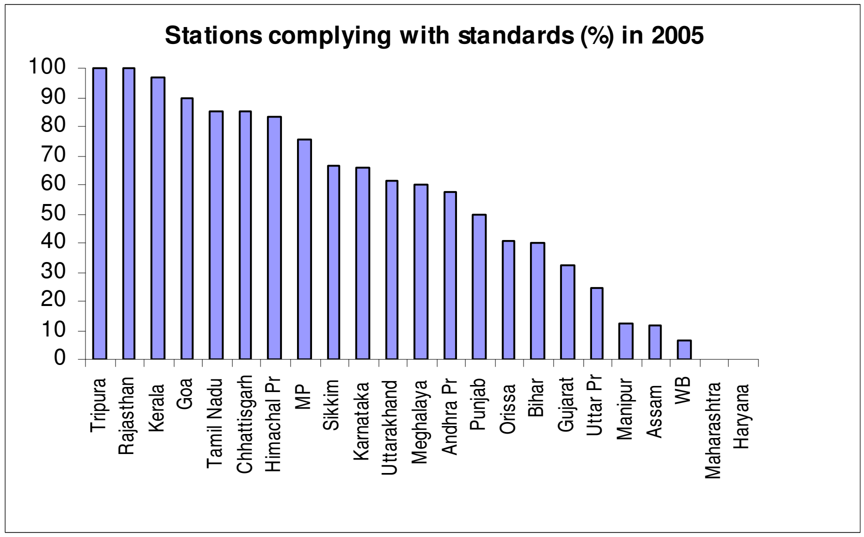

Figure 2 Extent of compliance of the stations with CPCB norms for surface water quality in 2005

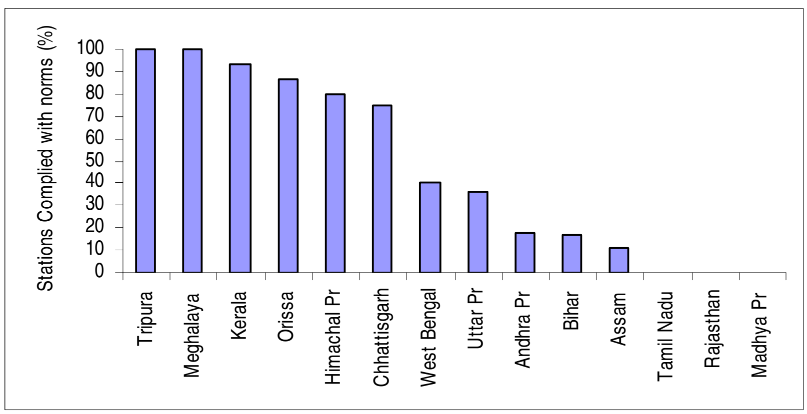

Figure 3 Extent of compliance (%) of the stations with BIS norms for groundwater quality (2005)

Forests

An indicator that can capture the extent of forests is the forest cover[100] expressed as a proportion of the geographical area (with

100 All land with more than 10% canopy cover and of more than 1 hectare area is formally defined as forest cover. Some of this land may not be legally recorded as forest, while some land legally recorded as forest may not have forest cover. In other words, forest cover is defined irrespective of ownership and legal status. Clearly, ecosystem goods and services associated with forests are obtained only from land with forest cover, and not necessarily from all land that is recorded as forest. Tree patches outside recorded forest area with an area less than 1 hectare are defined as tree cover; these patches would be associated with some of the ecosystem goods and services that are provided by forests, but would typically

and without inclusion of tree cover).[101] Figure 4 shows that the north eastern states fare much above the rest of the States in terms of forest cover. The other indicator that captures the quality of the forest is depicted in Figure 5 i.e. dense forest as a proportion of total forest area. It can be seen that while Madhya Pradesh has the highest total forest cover (absolute numbers), Arunachal Pradesh has the highest dense forest cover.

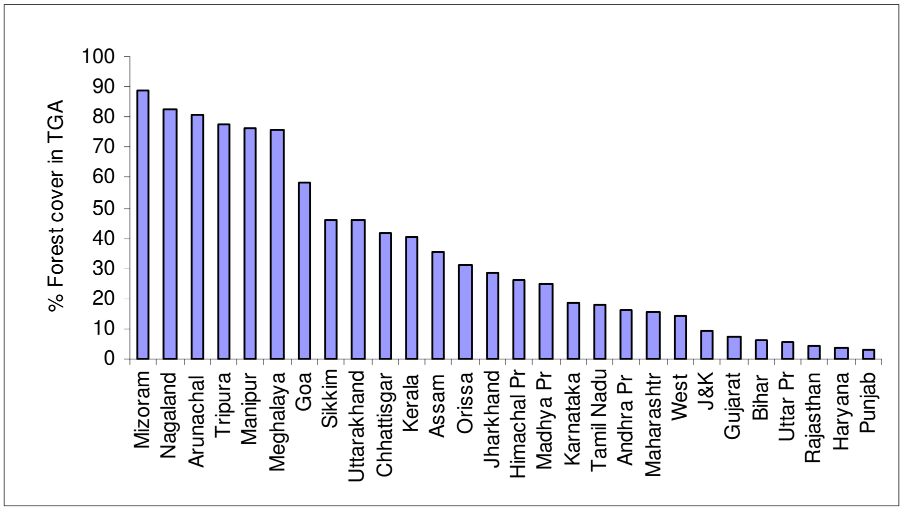

Figure 4.Forest cover in states as a percentage of total geographical area

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provide relatively smaller amounts of regional-scale services such as watershed and wildlife habitats.

[101] Forest cover data (for assessing biennial changes) for any year will typically reflect the result of management effort in the previous few years.

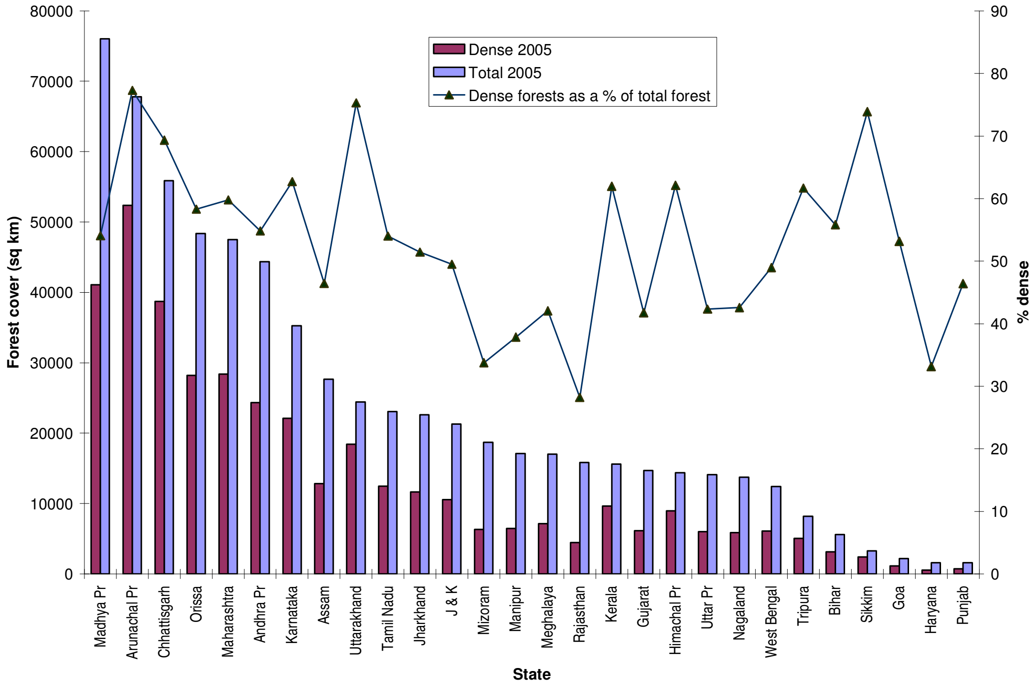

Figure 5 Total and dense forest cover for 2005

Land quality

An indicator to measure land quality is the extent of land not degraded as a percentage of total geographical area of the state. Sikkim fares well on this followed by J&K, Punjab (Figure 6).

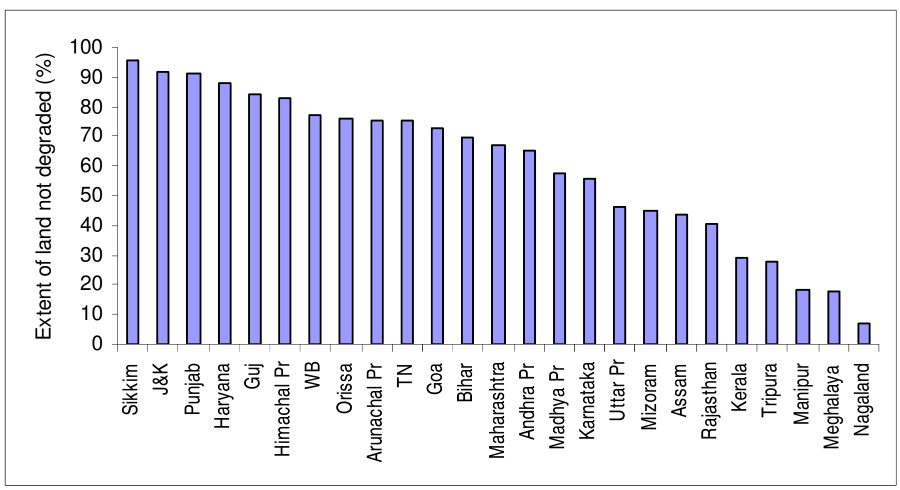

Figure 6 Extent of land not degraded as a percentage of total geographical area of the state (2008)

SOURCE: NRAA, ICAR, NRSA AND NAAS 2008

Energy intensity

As mentioned in Chapter 1, the energy intensity is a useful indicator reflection energy productivity. Its interpretation however needs to be done carefully. As seen in Figure 7 Meghalaya has the highest energy intensity followed by Chhattisgarh, Orissa, Jharkhand and Madhya Pradesh.

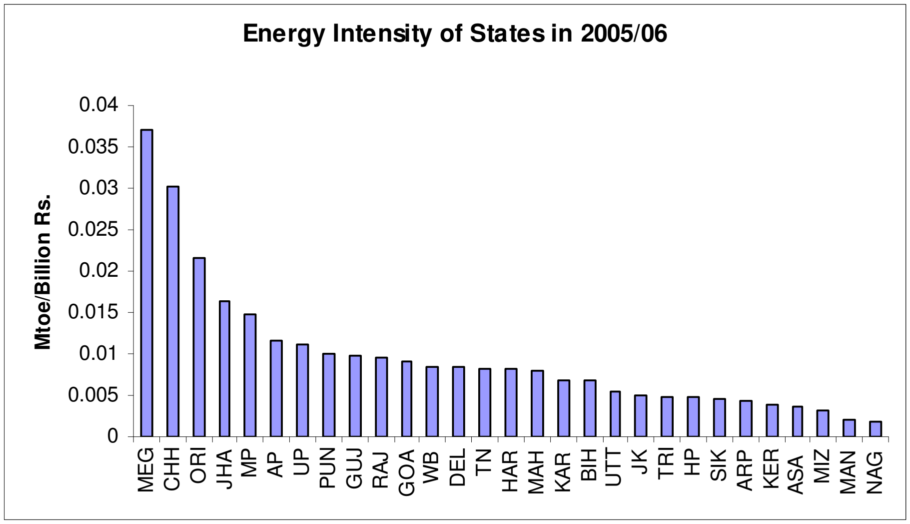

Figure 7 Energy intensity of states, 2005-06

SOURCE: COAL DIRECTORY OF INDIA 2005/06, INDIAN PETROLEUM AND NATURAL GAS STATISTICS 2005/06 & ALL INDIA ELECTRICITY STATISTICS (GENERAL REVIEW) 2007

Annexure 1.3 CPCB designated best use classification

Designated-Best-Use	Class	Criteria
Drinking Water Source without conventional treatment but after disinfection	A	1 .Total Coliforms Organism MPN/100ml shall be 50 or less
		2. pH between 6.5 and 8.5
		3. Dissolved Oxygen 6mg/l or more
		4. Biochemical Oxygen Demand 5 days 20oC 2mg/l or less
Outdoor bathing (Organised)	B	1 .Total Coliforms Organism MPN/100ml shall be 500 or less
		2. pH between 6.5 and 8.5
		3. Dissolved Oxygen 5mg/l or more
		4. Biochemical Oxygen Demand 5 days 20oC 3mg/l or less
Drinking water source after conventional treatment and disinfection	C	1. Total Coliforms Organism MPN/100ml shall be 5000 or less
		2. pH between 6 to 9
		3. Dissolved Oxygen 4mg/l or more
		4. Biochemical Oxygen Demand 5 days 20oC 3mg/l or less
Propagation of Wild life and Fisheries	D	1 .pH between 6.5 to 8.5
		2. Dissolved Oxygen 4mg/l or more
		3. Free Ammonia (as N)
		4. Biochemical Oxygen Demand 5 days 20oC 2mg/l or less
Irrigation, Industrial Cooling, Controlled Waste disposal	E	1 .pH between 6.0 to 8.5
		2. Electrical Conductivity at 25oC micro mhos/cm Max. 2250
		3. Sodium absorption Ratio Max. 26
		4. Boron Max. 2mg/l
	Below-E	Not Meeting A, B, C, D & E Criteria

Annexure 1.4 Land quality

Deterioration in the quality of land, referred to as land degradation. While analysing food security prospects in India, MSSRF &WFP (2004) outlines some common causal factors of land degradation (Table 1). These are largely manifestations of improper land management practices that impact the productivity of land.

Table 1 Factors causing land degradation

Factors	*Causes*
Unsustainable agricultural practices	Extensive and frequent cropping of agricultural areas, excessive use of fertilizers, shifting cultivation without adequate period of recovery, inappropriate choice of crops and technologies
Unsustainable water management	Excessive use of groundwater without recharge, depletion of groundwater table, poor and inefficient irrigation technologies, saline intrusion into groundwater aquifers due to over-abstraction of groundwater (especially in coastal areas)
Land use changes	Conversion of prime forest land into agricultural land, converting agricultural land, pasture land, etc into urban areas
Unsustainable use of forest land	Uncontrolled logging and illegal felling, forest fires, shifting cultivation without allowing for the regeneration of forests, grazing in forest land, unsustainable use of fuel wood
Industrial and mining activities	Discharge of industrial effluents, dumping of mine refuse etc.
Increased livestock pressure	Inadequate regeneration of vegetation due to continuous overgrazing

SOURCE MSSRF & WFP (2004)

Data[102]

The figures for land degradation/wastelands in India vary widely, as different agencies have varied objectives; methodologies used and define land degradation differently. For the present analysis we have used three sources of data on land degradation in Indian states, two of which, namely, Government of India (1986-00 and 2005) and NBSS&LUP (2005) [103] are the most commonly used datasets for studying the land quality issues in India. The third dataset from Government of India 2008 is the latest and overrides and subsumes any of the previously available data on land degradation. The details

[102] Detailed datasets used in the chapter are provided as part of the Appendix

[103] http://www.indiastat.com/india/ShowData.asp?secid=422354&ptid=51&level=3

and the methodology used for this are given in the following sections.

While the data sources of Government of India 2005 and NBSS&LUP 2005 have been analysed just to provide a comparative analysis and status of land degradation, the Government of India 2008 data form the basis of indicator construction and is used in the combined Environment Performance Index construction for all the states.

The Wasteland Atlas of India (Government of India 2005) identifies the following categories of wastelands in each state and union territory, in a district-wise manner: gullied and/ or ravinous land; land with and without scrub; waterlogged and marshy land; land affected by salinity/ alkalinity; area under shifting cultivation; degraded land under forests, pastures and plantation crops; sandy land (inland or coastal); mining and industrial wastelands; barren/ rocky/ stony waste/ sheet rock area; steep sloping area; and snow covered and/ or glacial area. Two data sets are available with respect to the above: average figures for the period 1986-2000, and figures for 2003.

NBSS&LUP categorizes land degradation by type of causation, as land affected by water erosion, wind erosion, water logging, salinity/ alkalinity, soil acidity, and complex problems. While the wasteland atlas identifies tracts of land which can be brought back under cultivation with different degrees of effort (Government of India 2005), the NBSS&LUP study takes into account land that is still under cultivation but is encountering declining degrees of productivity[104]. NBSS&LUP estimates are based on the methodology outlined by Sehgal and Abrol (1994)[105], wherein soil degradation is often related to decline in soil quality, caused through its misuse by humans. As noted by them (p. 15), the processes leading to land degradation are generally triggered by excessive pressure on land to meet the competing demands of the rapidly growing population for food, fodder and timber.

Further, direct/ indirect human interventions have caused soils to degrade. These include factors such as: deforestation and removal of natural vegetation; overgrazing; agriculture-related activities (unscientific); overexploitation of vegetation for domestic use; etc. Thus, it can be deduced that the NBSS&LUP estimates of land degradation do not take into account lands under permanent snow cover, water bodies, etc.

104 Personal communication with Dr. C.M. Pandey, Deputy Commissioner, MOA, DAC, NRM Division, Government of India
105 Personal communication with Dr. J.P. Sharma, Regional Head, NBSS&LUP, Delhi office, on 21 July 2008

The third data set that is available is the Government of India 2008 Harmonised set on wasteland and the degraded land area.

Data based on harmonization of different wasteland/degraded land datasets

As mentioned in the section above different sources define wasteland differently. As a result of which estimates of wastelands/land degradation by National Remote Sensing Agency (NRSA), Indian Council of Agricultural Research (ICAR), Ministry of Agriculture, and other agencies greatly vary from say 63.85 to 187.7 million hectares due to different objectives, definitions and methodologies adopted by them. Given this wide variation in the wasteland estimates, there was a need to provide a harmonized and a commonly agreed data of wastelands/degraded lands by eliminating chances of multiple counting of areas. Such an exercise was also essential as the percentage of wastelands/degraded lands and rain fed area are some of the important criteria on which funds need to be allocated at central, state and district level. Therefore, given the need for harmonized estimate of wastelands and degraded lands, which respond to management interventions necessary for macro and micro level planning, National Academy of Agricultural Science (NAAS) of India initiated a rationalizing and harmonizing activity to arrive at a common estimate based on various datasets.

According to harmonized database 120.72 M ha of land can be classified as degraded land across India.

Table 2 Harmonized area statistics of wastelands/degraded lands of India (million ha)

S No	Type of degradation	Arable land (M ha)	Open forest land (<40% Canopy) (M ha)	Data source
1	Water erosion (>10 t/ha/yr)	73.27	9.30	Soil loss map, CSWCR&TI
2	Wind erosion (Aeolian)	12.4	-	Wind erosion map, CAZRI
	Sub total	**85.67**	**9.30**	
3	Chemical degradation			
	a) Exclusively salt affected soils	5.44	-	National salt-affected soil map, CSSRI, NBSS&LUP, NRSA and others
	b) Salt-affected and water eroded soils	1.2	0.10	
	c) Exclusively acidic soils (pH<5.5)#	5.09	-	Acid soil map of NBSS&LUP
	d) Acidic (pH < 5.5) and water eroded soils	5.72	7.13	
	Sub total	**17.45**	**7.23**	
4	Physical degradation			
	a) Mining and industrial waste	0.19		Wasteland map of NRSA
	b) Water logging (permanent surface inundation)$	0.88		
	Sub total	**1.07**		
	Total	**104.19**	**16.53***	
	Grand total (Arable land and Open forest)	**120.72**		

Note: Forest survey of India map (1999) was used to mask degraded land under dense forest

Acid soils under paddy growing and plantation crops were excluded from degraded land

$ Sub-surface water logging was not considered

* Another 8.3 M ha was exclusively open forest which did not correspond to any land degradation class. This may be due to excessive biotic interference or open canopy due to ecological factors like aridity and has not been included in the wasteland/degraded land map/figure.

Annexure 1.5 Renewable energy potential

State-wise Estimated Potential and Achievements under Grid-Interactive Renewable Power in India (As on 30.09.2006)

(In MW)

					Bio Power					
	Wind Power		Small Hydro Power		Biomass Power/Cogen.		Cogeneration		Waste to energy	
States/UTs	Potential (In MWe)	Ach. (MW)	Potential (In MWe)	Ach. (MW)	Potential (In MWe)	Ach. (MW)	Potential (In MWe)	Ach. (MW)	Potential (In MWe)	Ach. (MW)
Andhra Pradesh	8275	121.6	254.63	178.81	616.7	200	300	86.05	123	22.5
Arunachal Pradesh			1059.03	44.3	5.35					
Assam			148.9	2.11	135.81				8	
Bihar			194.02	50.4	673.55		300		62	
Chhattisgarh			179.97	11	121.69	55			20	
Goa			2.6	0.05						
Gujarat	9675	391.4	156.83	7	883.54	0.5	350		112	
Haryana			30.05	62.7	1171.18	4	350	2	23	
Himachal Pradesh			1624.78	132.08					1	
Jammu & Kashmir			1207.4	111.49					10	
Jharkhand			170.05	4.05	31.35					
Karnataka	6620	696	652.61	351.13	650.11	73.5	450	165.78	151	1
Kerala	875	2	466.85	84.62	639.63				37	
Madhya Pradesh	5500	50.9	336.32	41.16	1419.79	1			92	2.7
Maharashtra	3650	1242.8	599.47	207.08	1031.33	11.5		50.5	287	1
Manipur			105.63	5.45					2	
Meghalaya			181.5	30.71	11.08				2	
Mizoram			190.32	14.76					1.5	
Nagaland			181.39	20.67						
Orissa	1700		156.76	7.3	135.77				22	
Punjab			65.26	122.55	3223.05	16	300	12	45	1
Rajasthan	5400	385.8	27.26	23.85	1293.6	23.3			62	
Sikkim			202.75	38.6						
Tamil Nadu	3050	3175.5	338.92	77.7	1376.11	81.5	450	134	151	1.75
Tripura			9.85	16.01					1.5	
Uttar Pradesh			267.06	25.1	2855.25		1250	121.5	176	5
Uttaranchal			1478.24	75.45	58.71				4.5	
West Bengal	450	1.1	182.02	98.3	547.91				147	
Andaman & Nicobar Islands			6.4	5.25						

State-wise Estimated Potential and Achievements under
Grid-Interactive Renewable Power in India
(As on 30.09.2006)

(In MW)

Chandigarch									6	
Dadra & Nagar Haveli										
Daman & Diu										
Delhi									131	
Lakshadweep										
Pondicherry									2.5	
Others		3.2	-						1020	*
India	**45195**	**6070.3**	**10476.87**	**1849.78**	**16881.51**	**466.5**	**5000**	**571.83**	**2700**	**34.95**

Source : Rajya Sabha Unstarred Question No. 1256, dated on 04.12.2006

Annexure 1.6 Renewable and total installed electricity generation capacity within States as on 31st March 2006

	Renewable Installed Capacity (MW)	*Total Installed Capacity (MW)*
Andhra Pradesh	4142	10729
Arunachal Pradesh	44	60
Assam	2	979
Bihar	75	769
Chhattisgarh	165	2712
Delhi	0	934
Goa	0	48
Gujarat	1068	11491
Haryana	954	3065
Himachal Pradesh	758	880
Jammu & Kashmir	320	518
Jharkhand	134	2726
Karnataka	4374	7768
Kerala	1879	2552
Madhya Pradesh	1638	4865
Maharashtra	3931	13916
Manipur	5	51
Meghalaya	187	210
Mizoram	15	67
Nagaland	29	39
Orissa	1925	4259
Punjab	2620	5166
Rajasthan	1332	4772
Sikkim	41	46
Tamil Nadu	4990	11816
Tripura	17	149
Uttar Pradesh	644	6903
Uttarakhand	1020	1124
West Bengal	228	5601

Source: CEA 2007

Annexure 1.7 Accelerated Power Development and Reforms Programme (APDRP)

The Accelerated Power Development and Reforms Programme (APDRP) had two components:

- Investment component – Government of India provided Additional Central Assistance for strengthening and up gradation of sub-transmission and distribution network. Additional Central Assistance covered 50% of the project cost in from of 50% grant and 50% loan. SEBs and Utilities had to arrange remaining 50% of the fund from Power Finance Corporation (PFC) and Rural Electrification Corporation (REC) or other financial institutions or from their own resources as counter-part fund. For Special Category States 100% of the project cost was provided as Additional Central Assistance in the ratio of 90% grant and 10% loan. (States of North-Eastern region, Jammu & Kashmir, Himachal Pradesh, Uttaranchal and Sikkim were covered under special category).
- Incentive component - An incentive equivalent to 50% of the actual cash loss reduction by SEBs/ Utilities, was provided as grant. The year 2000-01 was the base year for the calculation of loss reduction in subsequent years. The cash losses were calculated net of subsidy and receivables.

Table 1: Details of the cash loss reduction and incentives released to various states under APRDP (as on 31 March 2008)

Sl. No.	State	Claim Year	Incentive Amount Recommendedfor released to MoF (in Rs. Crore)	Amount Released by MoF (in Rs. Crore)
1.	Andhra Pradesh	2002-03	265.11	265.11
2.	Gujarat	2001-02	236.38	236.38
		2002-03	148.08	148.08
		2003-04	366.82	366.82
		2004-05	288.03	288.03
3.	Haryana	2001-02	105.49	105.49
4.	Kerala	2002-03	64.94	64.94
		2004-05	82.99	82.99
5.	Madhya Pradesh	2002-03	297.61	297.61
6.	Maharashtra	2001-02	137.89	137.89
7.	Rajasthan	2001-02	137.71	137.71
8.	West Bengal	2002-03	73.00	73.00
		2003-04	302.76	302.76

Sl. No.	State	Claim Year	Incentive Amount Recommendedfor released to MoF (in Rs. Crore)	Amount Released by MoF (in Rs. Crore)
		2004-05	5.88	5.88
		2005-06	115.10	115.10
9.	Punjab	2003-04	251.94	251.94
Total			**2879.63**	**2879.63**

Annexure 1.8 ATC Losses (%) for Discoms located in States

Energy Intensity of States in 2005/06

State	2004-05	2005-06	2006-07
Andhra Pradesh	21.2	17.4	18.5
Arunachal Pradesh	25.5	37.2	52.0
Assam	39.3	34.3	36.8
Bihar	82.5	78.2	42.6
Chattisgarh	32.3	37.8	36.1
Delhi	42.9	39.4	34.3
Goa	18.3	15.2	19.4
Gujarat	35.2	31.8	27.2
Haryana	43.7	41.4	31.7
Himachal Pradesh	21.7	15.2	13.2
Jammu & Kashmir	68.3	66.7	67.6
Jharkhand	62.8	51.7	52.5
Karnataka	33.7	38.8	32.2
Kerala	32.1	26.0	25.0
Madhya Pradesh	54.3	46.0	48.6
Maharashtra	28.0	36.7	39.4
Manipur	88.5	77.8	94.3
Meghalaya	38.2	33.4	37.3
Mizoram	24.6	17.2	45.0
Nagaland	43.2	44.8	52.2
Orissa	42.9	39.9	39.5
Puducherry	16.4	16.1	16.5
Punjab	24.0	25.8	24.9
Rajasthan	46.7	45.5	39.3
Sikkim	38.4	44.8	40.7
Tamil Nadu	19.4	20.5	20.1
Tripura	20.9	24.9	23.5
Uttar Pradesh	46.8	47.4	46.4
Uttarakhand	45.6	38.2	42.9
West Bengal	23.9	26.6	30.9
All India	**38.0**	**37.0**	**35.3**

Source: PFC, 2008

Annexure 5.1 Renewable Purchase Obligation within States

Status of Renewable Energy Quota across states			
S.No.	State	Quota/Renewable Purchhase Obligation	Time Period
1	Assam	Minimum 5% of its total consumption	2008-12
		Minimum 10% of its total consumption	2012
		Minimum 15% of total consumption	2015
2	Andhara Pradesh	Minimum 5% of total energy consumption (of this 1/2% is to be reserved for wind)	2005-06, 2006-07 & 2007-08
3	Arunachal Pradesh Bihar	-	-
4	Chattisgarh	Minimum 10 % of Total Energy consumption (5% from Biomass based plants, 3% from small hydel plants, 2% from Solar(PV&Thermal), wind, bagasse based cogeneration and others)	-
5	Delhi	-	-
6	Goa	-	-
7	Gujarat	Minimum 1% of total energy consumption	2006-07
		Minimum 1% of total energy consumption	2007-08
		Minimum 2% of total energy consumption	2008-09
8	Himachal Pradesh	Minimum 20% of total energy consumption	2007-10
7	Haryana	Upto 3% of total energy consumption	2007-08
		Upto 5% of total energy consumption	2008-09
		Upto 10% of total energy consumption	2009-10 & thereafter
8	Jharkand	-	-
9	Karnataka	Minimum 5% and maximum of 10% of total energy consumption	-
10	Kerala	Minimum 10 % of Total Energy consumption	2008-09
		Minimum 5% of total energy consumption (of this 2% from SHP, 2% from wind and 1% from all other NCE sources)	2006-09
11	Madhya Pradesh	Minimum 0.5% of total energy consumption inclunding third party sales from wind energy	2004-07
		Minimum 10 % of total energy consumption	2007-12
12	Maharashtra	Minimum 3% of total energy consumption	2006-07
		Minimum 4% of total energy consumption	2007-08
		Minimum 5% of total energy consumption	2008-09
		Minimum 6% of total energy consumption	2009-10
13	Orissa	450 MU	2005-06
14	Punjab	Minimum 1% of total energy consumption	2007-08
		Minimum 1% of total energy consumption	2008-09
		Minimum 2% of total energy consumption	2009-10
		Minimum 3% of total energy consumption	2010-11
		Minimum 4% of total energy consumption	2011-12
15	Rajasthan	Minimum 4.88% of total energy consumption	2007-08
		Minimum 6.25% of total energy consumption	2008-09
		Minimum 7.45% of total energy consumption	2009-10
		Minimum 8.50% of total energy consumption	2010-11
		Minimum 9.50% of total energy consumption	2011-12
16	Tamil Nadu	Minimum 10% of total energy consumption	2006-09

Status of Renewable Energy Quota across states			
S.No.	**State**	**Quota/Renewable Purchhase Obligation**	**Time Period**
17	Uttarakhand	Minimum 5% of total energy consumption	2007-08
		Minimum 5% of total energy consumption	2008-09
		Minimum 8% of total energy consumption	2009-10
		Minimum 9%of total energy consumption	2010-11
		Minimum 10% of total energy consumption	2011-12
18	Uttar Pradesh	5% of total energy consumption	-
		7.5% of total energy consumption	
19	West Bengal	Minimum:	
		WBSEB: 1.9% of total energy consumption	
		CESC Ltd.: 1.02% of total energy consumption	
		The Durgapur Projects Ltd.: 0.72% of total energy consumption	
		DPSC Ltd.: 0.43% of total energy consumption	2006-07
		WBSEB: 3.8% of total energy consumption	
		CESC Ltd.: 2.03% of total energy consumption	
		The Durgapur Projects Ltd.: 1.4% of total energy consumption	
		DPSC Ltd.: 0.95% of total energy consumption	2007-08
		WBSEDC Ltd: 4.8%of total energy consumption	
		CESC Ltd. 4.0%of total energy consumption	
		DPL: 2.5%of total energy consumption	
		DPSC Ltd: 2.0%of total energy consumption	
		DVC: 2.0%of total energy consumption	2008-09
		WBSEDC Ltd: 6.8%of total energy consumption	
		CESC Ltd. 6.0%of total energy consumption	
		DPL: 4.0%of total energy consumption	
		DPSC Ltd: 4.0%of total energy consumption	
		DVC: 4.0%of total energy consumption	2009-10
		WBSEDC Ltd: 8.3%of total energy consumption	
		CESC Ltd. 8.0%of total energy consumption	
		DPL: 7.0%of total energy consumption	
		DPSC Ltd: 7.0%of total energy consumption	
		DVC: 7.0%of total energy consumption	2010-11
		WBSEDC Ltd: 10.0%of total energy consumption	
		CESC Ltd. 10.0%of total energy consumption	
		DPL: 10.0%of total energy consumption	
		DPSC Ltd: 10.0%of total energy consumption	
		DVC: 10.0%of total energy consumption	2011-12

Source: SERC websites

Annexure 5.2 Environmental performance of states

States	Air	Water	Forests
Andhra Pradesh	0.16	0.53	0.72
Arunachal Pradesh			1
Assam	0.75	0.60	0.43
Bihar	0.75	0.34	0.80
Chhattisgarh	0.75	0.65	0.51
Delhi	0.75	0.69	0.75
Goa	0.75	0.60	0.69
Gujarat	0.83	0.55	0.58
Haryana	0.35	0.69	0.76
Himachal Pradesh	0.65	0.58	0.73
Jammu and Kashmir			0.77
Jharkhand	1.00		0.72
Karnataka	0.61	0.38	0.55
Kerala	0.88	0.70	0.77
Madhya Pradesh	0.75	0.72	0.00
Maharashtra	0.78	0.69	0.71
Manipur		0	1.00
Meghalaya	0.00	0.69	1.00
Mizoram			1.00
Nagaland	0.00		1.00
Orissa	0.26	0.55	0.76
Punjab	0.75	0.76	0.74
Rajasthan	0.89	0.69	0.74
Sikkim		0.80	0.78
Tamil Nadu	0.88	0.83	1.00
Tripura		0.69	1.00
Uttar Pradesh	0.73	0.71	0.74
Uttarakhand	0.75	1	0.73
West Bengal	0.53	0.76	0.77

Annexure 6.1 Socio-economic and biophysical indicators

States	Population below poverty line (%) (2004)	Gross unirrigated area % of Gross cropped area	States population per health center (persons/center)	Per Capita Net State Domestic Product (Rs Lakhs)	% share of Africulture and allied activites in NSDP (2007-8)	Population density in persons per sq. km (2008)	Area affected by SLR to the Total Geographical Area (TGA) (%)	%Area reported as prone to floods to the 11th Plan working group to TGA	Area affected by droughts as % of TGA (2002)
Andhra Pradesh	11.1	58.28	5572.07	25044.00	26.45	299.47		12.65	11.94
Arunachal Pradesh	13.4	42.79	2352.58	22518.00	23.13	14.31		0.98	
Assam	15	91.54	4790.86	16597.00	25.32	375.26		48.70	
Bihar	32.5		7260.05	7928.00	26.83	994.37		73.06	
Chattisgarh	32	82.02	4922.25	18815.00	25.61	171.05			
Goa	12	64.89	7188.78	52530.00	7.58	431.12	4.24		
Gujarat	12.5	76.95	6185.72	27027.00	19.17	288.87	0.59	10.46	54.50
Haryana	9.9	14.34	7706.83	38720.00	21.59	546.71		53.15	18.87
Himachal Pradesh	6.7	92.73	2453.91	30097.00	20.95	118.46		4.15	
Jammu & Kashmir	4.2	69.48	4652.65	17590.00	28.57	50.65		2.31	1.08
Jharkhand	34.8		5599.21	14913.00	11.86	378.62			
Karnataka	17.4	76.12	5451.71	23180.00	19.28	300.07	0.16	0.47	30.06
Kerala	11.4	71.33	5325.14	32961.00	14.01	869.77	0.14	37.83	
Madhya Pradesh	32.4	84.86	6240.83	12577.00	27.40	223.17		1.09	12.11
Maharashtra	25.2	72.00	8609.28	30750.00	14.58	350.89	0.13	1.07	18.74
Manipur	13.2	103.88	4431.10	15270.00	28.08	105.88		3.58	
Meghalaya	14.1		4641.62	20094.00	21.94	112.80		4.24	
Mizoram	9.5	95.43	2197.62	20618.00	16.47	46.01		2.56	
Nagaland	14.5	23.64	4119.52	18318.00	34.79	130.95		0.54	
Orissa	39.9	84.91	5118.95	16195.00	22.98	254.68	0.30	21.45	1.29
Punjab	5.2	0.89	7351.29	31616.00	33.50	530.60		80.42	
Rajasthan	17.5	66.34	5041.10	17310.00	29.87	188.56		9.53	56.75
Sikkim	15.2	77.58	3211.43	23761.00	19.18	83.29		2.82	
Tamil Nadu	17.8	36.26	6348.02	28526.00	13.02	508.28	0.28	3.46	5.73
Tripura	14.4	77.66	5352.66	22987.00	23.23	332.76		31.46	
Uttar Pradesh	25.5	36.25	7835.01	11188.00	30.60	789.67		30.47	1.91
Uttarnchal	31.8	84.51	4987.15	22178.00	19.52	177.83			
West Bengal	20.6	60.61	7167.58	21953.00	24.76	980.20	1.38	42.43	

SOURCE:

JNU 1993

INPUT SURVEY 2001-02

CENSUS 2001

PLANNING COMMISSION 2004

MINISTRY OF HEALTH AND FAMILY WELFARE 2004

NATIONAL DISASTER MANAGEMENT GUIDELINES 2008 (NDMA)

COMPENDIUM OF ENVIRONMENT STATISTICS 2002

CENTRAL STATISTICAL ORGANIZATION 2007-08

Annexure 7.1 Zakaria Committee Norms

Zakaria Committee norms are available for 5 services viz. water supply, sewerage, storm water drainage, roads, and street lightning

	All Services	Four Services	Water Services	Sewerage	Roads	Street Light
			At 1960/61 prices			
Class AA	43.50	28.50	10.80	12.20	2.50	3.00
Class A	39.03	27.15	10.20	11.90	2.20	2.85
Class B	33.40	24.90	9.80	10.80	1.80	2.50
Class C	27.62	21.59	8.64	9.30	1.35	2.30
Class D	24.27	19.61	7.56	8.70	1.20	2.15
Class E	21.07	18.72	7.42	8.20	1.10	2.00
			At 1997/98 prices			
Class AA	698.89	457.89	173.52	196.01	40.17	48.20
Class A	627.07	436.20	163.88	191.19	35.35	45.79
Class B	536.62	400.05	157.45	173.52	28.92	40.17
Class C	443.75	346.87	138.81	149.42	21.69	36.95
Class D	389.93	315.06	121.46	139.78	19.28	34.54
Class E	338.52	300.76	119.21	131.74	17.67	32.13
Average	535.36	390.22	150.76	169.43	29.14	40.88
			At 1998/99 prices			
Class AA	779.89	510.96	193.63	218.73	44.82	53.79
Class A	699.75	486.76	182.87	213.35	39.44	51.10
Class B	598.81	446.42	175.70	193.63	32.27	44.82
Class C	495.18	387.07	154.90	166.73	24.20	41.24
Class D	435.12	351.58	135.54	155.98	21.51	38.55
Class E	377.75	335.62	133.03	147.01	19.72	35.86
Average	597.41	435.44	168.23	189.07	32.52	45.62
			At 1999/2000 prices			
Class AA	814.60	533.70	202.25	228.46	46.82	56.18
Class A	730.89	508.42	191.01	222.84	41.20	53.37
Class B	625.46	466.29	183.52	202.25	33.71	46.82
Class C	517.22	404.30	161.80	174.16	25.28	43.07
Class D	454.49	367.22	141.57	162.92	22.47	40.26
Class E	394.57	350.56	138.95	153.56	20.60	37.45
Average	624.00	454.82	175.72	197.48	33.97	47.65
			At 2000–01 prices			
Class AA	858.57	562.51	213.16	240.79	49.34	59.21
Class A	770.34	535.86	201.32	234.87	43.42	56.25
Class B	659.22	491.46	193.42	213.16	35.53	49.34
Class C	545.14	426.13	170.53	183.56	26.65	45.40
Class D	479.02	387.05	149.21	171.71	23.68	42.43
Class E	415.86	369.48	146.45	161.85	21.71	39.47
Average	657.68	479.37	185.21	208.14	35.80	50.22
			At 2001/02 prices			
Class AA	902.54	591.32	224.08	253.13	51.87	62.24
Class A	809.79	563.31	211.63	246.90	45.65	59.13
Class B	692.98	516.63	203.33	224.08	37.35	51.87
Class C	573.06	447.95	179.26	192.96	28.01	47.72
Class D	503.55	406.87	156.85	180.51	24.90	44.61
Class E	437.16	388.40	153.95	170.13	22.82	41.50
Average	691.36	503.92	194.69	218.80	37.63	52.79

Annexure 7.2 Classification of Towns (Zakaria Committee Report)

Classification of towns

Class AA	Metropolitan cities like Bombay, Delhi and Calcutta with a population above 20 lakhs or in the case of industrial townships above 10 lakhs population
Class A	Cities with a population of 5 to 20 lakhs
Class B	Cities with a population of 1 to 5 lakhs
Class C	Towns with a population of 50,000 to 1 lakh
Class D	Towns with a population of 20,000 to 50,000
Class E	Small towns with a population below 20,000

SOURCE Zakaria Committee Report (1963)

Annexure 7.3 Population below poverty line in India (2006-07)

Below Poverty Line in India (2006-07)						
State/Union Territory	Rural		Urban		Combined	
	No. of Persons (Lakh)	%	No. of Persons (Lakh)	%	No. of Persons (Lakh)	%
Andhra Pradesh	26.97	4.58	41.75	18.99	68.72	8.49
Arunachal Pradesh	3.57	37.89	0.14	4.48	29.33	3.68
Assam	95.36	37.89	1.78	4.48	97.14	33.33
Bihar	482.16	44.81	54.74	32.69	536.91	43.18
Delhi	0.19	2	3.18	2	3.38	2
Goa	0.13	2	1.51	2	4.81	2
Gujarat	6.88	2	4.38	2	11.25	2
Haryana	3.3	2	1.51	2	4.81	2
Himachal Pradesh	1.18	2	0.14	2	1.32	2
Jammu & Kashmir	NA	NA	NA	NA	NA	NA
Karnataka	28.66	7.77	16.34	8	45	7.85
Kerala	4.03	1.63	8.01	9.34	12.04	3.61
Madhya Pradesh	192.07	28.73	74.46	31.77	266.54	29.52
Maharashtra	101.6	16.96	72.68	15.2	174.3	16.18
Manipur	8.1	37.89	0.27	4.48	8.37	30.52
Meghalaya	7.99	37.89	0.24	4.48	30.14	8.23
Mizoram	1.88	37.89	0.23	4.48	2.12	20.76
Nagaland	8.01	37.89	0.21	4.48	8.22	31.86
Orissa	139.12	41.72	23.57	37.46	162.69	41.04
Punjab	3.4	2	1.95	2	5.35	2
Rajasthan	54.41	11.09	23.44	15.42	77.86	12.11
Sikkim	2.08	37.89	0.03	4.48	2.12	33.78
Tamil Nadu	12.46	3.68	31.61	9.64	44.07	6.61
Tripura	10.7	37.89	0.28	4.48	10.98	31.88
Uttar Pradesh	373.16	24.25	111.25	26.17	484.41	24.67
West Bengal	137.53	21.98	22.21	8.98	159.73	18.3
Andaman and Nicobar Islands	0.1	3.68	0.14	9.64	0.24	5.82
Chandigarh	0.02	2	0.19	2	0.21	2
Dadra & Nagar Haveli	0.04	2	0.02	2	0.06	2
Daman & Diu	0.03	2	0.01	2	0.04	2
Lakshadweep	0.01	1.63	0.02	9.34	0.03	4.59
Pondicherry	0.13	3.68	0.7	9.64	0.83	7.72
India	**1705.26**	**21.07**	**495.67**	**15.06**	**2200.94**	**19.34**

Abbr : NA : Not Available.
Note : * : Estimates correspond to 30 day recall period.
Compiled from the statistics released by : Year Book 2003, Institute of Applied Manpower Research.
Year: Period of fiscal year in India is April to March, e.g. year shown as 1990-91 relates to April 1990 to March 1991.
Units: (a) 1 Lakh (or Lac) = 100000
(b) 1 Crore (or Cr.) = 10000000
Some part of the footnotes/units may not be applicable for this table
SOURCE: Indiastat online database on Incidence of poverty accessed on April 21, 2009