**UNDP Project Document**
Government of India

United Nations Development Programme

# ENABLING ACTIVITIES FOR THE PREPARATION OF INDIA'S SECOND NATIONAL COMMUNCIATION TO THE UNFCCC


**Brief Description**
The proposed project is in line with India's commitments to the United Nations Framework Convention on Climate Change (UNFCCC). It aims to enable India undertake activities to prepare its Second National Communication to the UNFCCC according to the guidelines provided by the Conference of Parties (COP) for non-Annex 1 countries (17/CP.8). Based on the experience and lessons learned from the Initial National Communication (INC), as well as the recommendations from the final evaluation of INC, the SNC will broaden and consolidate the network of stakeholders, including the researchers, industry, NGOs and the private sector to create a platform for policy interface in key climate change sectors. The activities proposed in the SNC are envisaged to make climate change assessments more policy relevant and enhance India's capacity to incorporate climate change in its development processes. In inventory analysis, the SNC will increase the reliability of emission data and the put in place a more sustainable inventory process, through a national inventory management system. Another key element of the SNC will be the enhanced reliability of vulnerability assessment for key sectors, such as agriculture, water, health and energy to identify appropriate adaptation polices and measures. The project would specifically address the gaps identified in the INC, particularly on capacity building needs, sector-specific data, developing/refining country specific emission/ sequestration factors, and developing integrated vulnerability and adaptation frameworks for identified climatically vulnerable hotspots.

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## Acronyms

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|---|---|
| 10/CP.2: | Decision 10 in Conference of Parties 2 |
| 17/CP.8: | Decision 17 in Conference of Parties 8 |
| AFOLU: | Agriculture, Forestry and Other Land Use |
| AOGCMs: | Atmosphere-Ocean Coupled General Circulation Models |
| APSIM: | Agricultural Production Systems SIMulator |
| CC: | Climate Change |
| CDM: | Clean Development Mechanism |
| CP: | Conference of Parties |
| CS: | Country Specific |
| CS-EF: | Country Specific Emission Factors |
| DNA: | Designated National Authority |
| DSSAT: | Decision Support System for Agro-technology Transfer |
| EF: | Emission Factors |
| EFDB: | Emission Factor Data Base |
| GEF: | Global Environment Facility |
| GHG: | Greenhouse Gas |
| GOI: | Government of India |
| GPG: | Good Practice Guidance |
| HadRM3: | Hadley centre Regional Model ver.3 |
| HEC-HMS: | Hydrologic Engineering Center- Hydrological Modeling System |
| INC: | Initial National Communication |
| INFO-CROP: | Information on Crops |
| IPCC: | Intergovernmental Panel on Climate Change |
| IPCC-AR4: | Intergovernmental Panel on Climate Change – Assessment Report 4 |
| IPPU: | Industrial Process and Product Use |
| MIASMA: | Modelling framework for the health Impact Assessment of Man induced Atmospheric changes |
| MDG: | Millennium Development Goals |
| MSW: | Municipal Solid Waste |
| MYFF: | Multi Year Funding Framework |
| NATCOM: | National Communication |
| NBSSLUP: | National Bureau of Soil Survey and Land Use Planning |
| NSCA: | National Capacity needs Self Assessment |
| NCV: | Net Calorific Value |
| NRSA: | National Remote Sensing Agency |
| NPD: | National Project Director |
| NSC: | National Steering Committee |
| PCMDI: | Programme for Climate Model diagnosis and Inter comparison |
| PMC: | Project Management Cell |
| POP: | Persistent Organic Pollutants |
| PRECIS: | Providing Regional Climates for Impacts Studies |
| QA/QC: | Quality Assurance and Quality Control |
| SIC: | Stakeholder Interaction Committee |
| SNC: | Second National Communication |
| SRES: | Special report on Emission Scenarios |
| SWAT: | Soil Water Assessment Tool |
| TAC: | Technical Advisory Committee |
| UN: | United Nations |
| UNDP: | United Nations Development Programme |
| UNFCCC: | United Nations Framework Convention on Climate Change |
| V&A: | Vulnerability Assessment and Adaptation |
| WTGROWS: | Wheat Growth Simulator |

# SECTION I: Elaboration of the Narrative

## PART I: Situation Analysis

### 1.1 Context and Global Significance

1. Climate variability and climate change are serious threats to poverty eradication. Such development challenges posed by the climate change are being grappled at national as well as international levels. India's vulnerability to climate change manifests into greater challenges due to its size, diversity and population (provide a link to the national circumstances). India's steady progress towards the goals of human development has been captured in Human Development Index, which has increased from 0.571 in 1999 to 0.602 in 2005 (HDR, 2005). However, regional and inter-state disparities and the increasing extreme events such as floods, earthquakes, and droughts reverse the development process to a great extent and worsen the situation of the disadvantaged and vulnerable groups. The need to integrate climate change concerns into development programmes would be a key to achieving the Millennium Development and sustainable development goals.

2. The United Nations Framework Convention on Climate Change (www.unfccc.int) recognizes common but differentiated responsibilities and respective capabilities towards achieving the sustainable development goals. Being a Party to the United Nations Framework Convention on Climate Change, India submitted its Initial National Communication (INC) to the UNFCCC on June 22, 2004, within three years of receipt of agreed full costs availed through GEF. INC was prepared, as per capacities permitted, according to the guidelines provided by the Conference of Parties for non-Annex 1 countries (10.CP.2, 1997). INC has identified many technical, scientific, financial, and policy-related capacity constraints (www.natcomindia.org/chap6.pdf ). UNDP, India supported INC and continues to support the proposed project for preparation of Second National Communication (SNC) as part of the Country Programme thematic focus for building national capacities to meet commitments to the international Conventions (UNDP India's Country Programme 2003-2007). The programme contributes towards the MYFF Outcome "National capacity built to contribute to global environmental agenda setting, and global environmental concerns mainstreamed in national development planning".

3. The Ministry of Environment and Forests is the nodal Ministry in India for all international, bilateral and multilateral environmental Conventions and Protocols. The Ministry has the primary role to coordinate with other Ministries. Currently 14 Ministries come under direct purview of the coordinating mechanism set up for Climate Change (www.envfor.nic.in). The developmental goals set by the Planning Commission (www.planningcommission.nic.in) along with the different policies/programmes and projects initiated by the different ministries address various climate change issues. The National Environment Policy (www.envfor.nic.in) and other legislations (forestry act, wildlife act) provide a framework for incorporating environmental considerations into their areas of interventions. Correspondingly, the sectoral policies, namely, urban transport, water, land use, etc. though now address environmental issues, but also in an indirect way address climate change issues too. The Ministry of Environment and Forests is the Operational Focal Point for Global Environment Facility in India. UNDP, India partners with the Ministry for various GEF and environmental programmes. Synergies would be with the ongoing GEF supported initiatives such as the National Capacity Needs Self Assessment and other regular projects.

4. Major thrusts relevant to the proposed SNC project complement the Ministry's programmes. A network of scientific, technical and other stakeholders established during the NATCOM-1 would be broadened beyond national communication for it to be the conduit for policymaking in the area of climate change in India.

**1.2 Threats, root causes and barriers analysis**

*Threats*

5. According to Article 1 of the Climate Convention, climate change means a change of climate that is attributed directly or indirectly to human activity and alters the composition of the global atmosphere, being in addition to natural climate variability observed over comparable time periods.

6. Even though climate has been varying due to natural causes, recent simulations using sophisticated climate and coupled climate-ocean-vegetation models have indicated that the excess of greenhouse gases has been producing changes in the behaviour of the atmosphere. These changes, some of them possibly irreversible, have resulted in modifications of the circulation, temperature and rainfall regimes all around the planet.

7. There is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities (IPCC, 2001). In the light of new evidence and taking into account the remaining uncertainties, most of the observed warming over the last 50 years is likely to have been due to the increase in GHG concentrations. Human influence will continue to change atmospheric composition throughout the 21st century.

*The Underlying Root Causes*

~~7.~~8. The Preamble of the UNFCCC recognizes that "change in the Earth's climate and its adverse effects are a common concern of humankind" and that "the global nature of climate change calls for the widest possible cooperation by all countries and their participation in an effective and appropriate international response, in accordance with their common but differentiated responsibilities and respective capabilities and their social and economic conditions."

~~8.~~9. The UNFCCC also recognizes that the largest share of historical and current global emissions of GHGs has originated in developed countries and that per capita emissions in developing countries are still relatively low and that the share of global emissions originating in developing countries will grow to meet their social and development needs.

*Barriers*

10. This Enabling Activity project aims at softening the main barriers identified in India related to climate change: lack of adequate capacity to address climate change concerns and there exists lack of financial resources to strengthen institutional capacity, strengthen methodologies and improve data gathering for reporting of the national communication to the UNFCCC in a continuous manner the future.

**1.3 Institutional, Sectoral and Policy Context**

11. The Ministry of Environment and Forests is the nodal Ministry in India for all international, bilateral and multilateral environmental Conventions and Protocols. The Ministry has the primary role to coordinate with other Ministries. Currently 14 Ministries come under direct purview of the coordinating mechanism set up for Climate Change. They include: Ministry of Water Resources, Ministry of Coal, Ministry of Agriculture, Ministry of Finance, Ministry Non-conventional Energy Sources, Ministry of Science and Technology, Ministry of Power, Ministry of Heavy Industries and Public enterprises, Ministry of Shipping Transport and Highways, Ministry of Petroleum and Natural Gas, Ministry of

Health and Family Welfare, Ministry of External Affairs, Department of Ocean Development and Planning Commission.

12. The developmental goals set by the Planning Commission (www.planningcommission.nic.in) along with the different policies/programmes and projects initiated by the different ministries address various climate change issues. For example, the goal of reduced poverty and hunger would enhance adaptive capacity of the population due to improved food security, health security and resilience to cope with risks from uncertain and extreme events. Reduced decadal population growth rates would lower GHG emissions, reduce pressure on land, resources, and ecosystems and provide higher access to social infrastructure. Increased reliance on hydro and renewable energy resources would reduce GHG and local pollutant emissions, enhance energy security and consequent economic benefits from lower fossil fuel imports, and provide access to water resources from additional hydro projects. Cleaning of major polluted rivers (Indian target 14) would result in enhanced adaptive capacity due to improved water, health and food security. Further, the National Environment Policy (www.envfor.nic.in) and other legislations (Forestry act, Wildlife Act) provide a framework for incorporating environmental considerations into their areas of interventions. Correspondingly, the sectoral policies, namely, urban transport, water, land use, etc. though now address environmental issues, but also in an indirect way address climate change issues too.

13. A network of scientific, technical and other stakeholders established during the NATCOM-1 have to be broadened beyond national communication for it to be the conduit for policy making in the area of climate change in India. The SNC process will aim to strengthen the networks particularly for institutionalization of GHG inventory development and assessment of vulnerability due to climate change and adaptation requirements. The NATCOM networks will aim to create synergies with the ongoing programmes of the existing institutions like the National Institute for Disaster Management, India Meteorological Department, Indian Space Research Organization, Department of Science and Technology, Department of Ocean Development and the Ministry of Information Technology all of which are working towards reducing vulnerability due to the impacts of extreme events. Additionally, it will create synergies with enterprises working towards risk mitigation due to climate change such as the insurance, the banking sectors and the local institutions such as the Panchayati Raj, which help implement some of these. Also as the Ministry of Environment and Forests is the Operational Focal Point for Global Environment Facility in India, the project would gain from ongoing initiatives such as the National Capacity needs Self Assessment (NCSA) and other regular projects.

14. Major thrusts relevant to the proposed SNC project complement the Ministry's programmes. These broadly focuses on institutional strengthening through research projects, and demonstration of clean technologies for emission control; promotion of research and development in multidisciplinary aspects of environment protection, conservation and development; information dissemination through establishing data centres and environmental information centres; capacity building for conservation of natural resources, with a particular emphasis on afforestation; and education, training and awareness creation on environment issues.

### 1.4 Stakeholder Analysis

15. The Government of India is the prime driver of climate change issues. After the adoption the Kyoto Protocol and guidelines formulated at the Marrakech Accords, the private sector has become active for tapping opportunities in CDM. The next category of stakeholders comprises of technical institutions and research organizations, which are deeply concerned with scientific aspects of climate change. The NGOs provide a linkage between the communities, public at large and the Government in addressing the environmental issues.

16. The development of the National Communication is a multidisciplinary effort. During the first National Communication, several policymakers, ministries, scientific institutions, industry associations, NGOs and experts were involved (www.natcomindia.org). Since there was further scope for intensifying their roles as well as include other key stakeholders, particularly at the state levels and in the private sector, the PDF phase widely consulted stakeholders from research organizations, universities, non-governmental organizations, industry associations, the private sector and policymakers at the national and state levels for identifying their role and participation in the NATCOM process. The detailed stakeholders' involvement plan during SNC is provided in Part IV of Section IV.

### 1.5 Baseline Analysis

17. A preliminary level of awareness has been generated in the country about climate change issues during the INC, and networks of research groups have been created. However, the information generated during INC, is not adequate enough to take informed decisions by the policy makers and the researchers. Also, for producing and collating necessary information for the national communication, no dedicated funds are made available by the government. It is envisaged that the GEF resources will enable India to fulfill its reporting obligation to the UNFCCC and will help in sustain the capacity built during the INC.

## PART II: Strategy

### 2.1 Project Rationale and Policy Conformity

#### *2.1.1 Project Rationale and Strategy*

18. India is a vast country covering 3.28 million square-kilometres, occupying only 2.4 per cent of the world's geographical area but supporting 16.2 per cent of the global human population. It is endowed with varied climate, rich biodiversity and a highly diverse ecology. About 67 per cent of the total crop land is rainfed, and hence subjected to the vagaries of climate. Climate change projections made up to 2100 for India indicate an overall increase in temperature by 2-4$^{o}$C with no substantial change in precipitation quantity. However, spatial variation in rainfall may occur. The projections also indicate increase in intensity and frequency of extreme events such as droughts, floods and cyclones[1]. Such changes are a matter of concern due to the high economic dependence of a majority of the population (70 per cent) on climate-sensitive sectors such as agriculture and forestry, and low resource availability across socioeconomic levels, gender and geographical locations leading to low adaptive capacities of the society as a whole. This concern is accentuated by the apprehension that climate change may impede the momentum of India's economic development. The past few years have seen rapid economic growth along with a structural shift towards the service sectors, which may manifest in structural changes in the GHG emissions source mix as well.

19. India submitted its Initial National Communication (INC) to the UNFCCC in 2004, and it was one of the first projects in India, wherein creation of awareness in a number of sectors about the potential developmental relationship between climate and sectoral planning was generated. It has also created the institutional systems for the periodic consolidation of climate change related data. Additionally, the project helped bring together teams from various sectors to work together. The process also brought in a large number of new and young researchers into the climate change arena. These young researchers would hopefully continue with climate change work in the future; thus creating a cadre of sectoral researchers whose research work in the future addresses climate change concerns. At the policy level, climate change is also now more important than it was prior to this project. The involvement of senior policymakers in the National Project Steering Committee helped sensitize them to the importance of the

[1] India's Initial National Communication, 2004

incorporation of the climate concerns in sectoral policymaking, including research priorities. This closer relationship built between senior policymakers and sectoral research institutions now drives the climate change research in India.

20. Inspite of these efforts, there is still insufficient information on climate change issues resulting in inadequate compliance with the commitments to the UNFCCC. Therefore enabling activities to prepare India's Second National Commmunication (SNC) is considered essential to strengthen the institutional and individual capacities created during INC in order to support the implementation of India's commitment to the UNFCCC and assisst India in incorporating climate change in the developmental process. The SNC will also draw upon programmes of the World Bank, CIDA, British High Commission, UNDP, UNEP and SDC.

21. The endeavor of SNC is to make climate change data more relevant and enhance India's capacity to address climate change concerns in the national framework. In order to do so, the SNC work plan will take into account the national circumstances, priorities and developmental needs. The elements of the communication have been designed so as to establish the linkages with the various developmental programmes of the government, such as poverty reduction, reduction in infant mortality, sustained access to potable water, increase in power generation, afforestation, energy efficiency policies, the national action plans for implementing the Montreal Protocol, Persistent Organic Pollutants (POPs), and others.

22. The SNC will aim to achieve all this through a broad-based participatory approach and building on the capacity base created by the INC. The major outcomes of this project will be the development of a GHG inventory by sources and sinks for the year 2000, development of a National Inventory Management System (NIMS) and assessment of the impacts of climate change in an integrated manner. The inventory analysis process will lay increased stress on reliability and precision of emission data which will provide inputs for enhancing energy efficiency in various industries as well as provide information to policymakers leading to better targeting of areas in order to contain emissions in the future. Another key element of SNC is the enhanced reliability of vulnerability assessment of key sectors like agriculture, water, health and energy and the inter-linkages that exist within them. This will lay the path for designing adaptation measures to ensure food security, water sufficiency, protection of forests, approaches to protect health from the perceived adverse effects of climate change and alternate measures for generating energy that will mitigate emissions. The project would specifically address the gaps identified in the first National Communication, particularly on the capacity building needs, sector specific data acquisitions, develop/refine country specific emission/sequestration factors, and develop integrated vulnerability and adaptation frameworks for identified climatically vulnerable hotspots.

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24. The Government of India fully supports the activities and outputs of the project. Most key components of the proposal have been designed to work within the existing government system and hence have the probability to continue. The objectives of the proposed project will be achieved in cooperation with various institutes, departments, research labs, non-governmental organizations, central ministries, state governments and local communities. The resource base and networks established during the NATCOM-I will be utilized, enhanced and strengthened during the full-scale SNC project implementation. It is expected that participation of various stakeholders in several project components will sensitize and enhance their understanding on different aspects of climate change and related issues and enthuse them to continue to participate on a continuous basis.

25. Moreover, because of the broad consultation processes among government, academic institutions, private sector and civil society organizations, this project ensures the input of expertise and consensus to design project interventions, further underscoring technical sustainability. This strategy will be maintained and enlarged for the SNC. The comprehensive involvement of stakeholders, in a decentralized process, will be sought and this high level of participation also indicates the strong social sustainability of the proposal.

26. Strategic partnerships among stakeholders in many sectors guarantees the compliance of project proponents with the principle of participatory planning and execution arrangements, necessary for the sustainability of a long-term climate change strategy, based on the future implementation of CDM projects in the country.

27. Some institutions that worked in the preparation of the NATCOM-1 have already allocated some human and financial resources for the development of climate change related activities. With the enlargement of the number of institutions involved in this SNC, it is expected to result in more capacity building (including staff trained) and the enhancement of research on climate change in India, particularly in areas where few researchers have been working.

28. From the point of view of environmental sustainability, the results of the project, especially regarding inventory and vulnerability and adaptation assessment, will provide methodological references that will be important for the formulation of adaptation projects, as well as important inputs for the scientific literature assessment review periodically undertaken by IPCC.

*Scenario without GEF:*

29. The Ministry of Environment and Forests as per the provisions of the Article 4(3) of the UNFCCC proposes to access GEF funds for enabling activities towards the preparation of SNC. The Ministry has fulfilled its obligation earlier through timely submission of the First National Communication Report with funding from the Global Environment Facility. With GEF support, this Ministry is also currently undertaking the National Capacity needs Self Assessment for the three Rio Conventions that takes into account the capacity needs for National Communication Activities. In the absence of the GEF funds, it is unlikely that the Ministry would be able to draw synergies with various relevant activities, ensure participation of the stakeholders, develop institutional frameworks and

mechanisms to follow Good Practices Guidance and mobilize resources for preparation of the Communication.

30. Most importantly, as also indicated in the independent final evaluation, the networks established through the NATCOM-I needs to be sustained. Further, it was noted that the co-financing available in kind is not geared towards the sustenance and strengthening of these networks. It is in the above context, GEF interventions become significant.

*Scenario with GEF:*

31. The proposed project aims to institutionalize the process of NATCOM with a view to not only comply with the obligations under Article 12, para 1 of the Convention and in line with the Decision 17/CP.8, but also develop capacities to implement the commitments under the Convention. GEF resources would be deployed for:

- Establishing institutional arrangement to streamline the process of preparation of NATCOMs and a mechanism to ensure participatory approaches for involvement of concerned stakeholders
- Enabling a systematic assessment of various elements of the SNC Report leading to timely submission of the same to the UNFCCC. During the SNC project period, monitoring of the project and review of the deliverables will be made at regular intervals to ensure the quality of the work done and the timely submission of the report to the UNFCCC.
- Addressing capacity issues at systemic, organizational and individual levels.
- Developing knowledge base for informed decision-making at policy level.

32. The commitments of the developing countries, including India, as Parties to the UNFCCC are described under paragraph 1 of Article 4 of the Convention, which establishes common obligations for all Parties, taking into account the common but differentiated responsibilities of countries and their specific national and regional development priorities, objectives and circumstances. One of the main commitments is to develop, periodically update, publish and make available to the Conference of the Parties, inventories of anthropogenic emissions by sources and removals by sinks of all greenhouse gases (GHGs) not controlled by the Montreal Protocol.

33. Developing country Parties have committed themselves to providing the UNFCCC with adequate information on the status of implementation of such obligations, as called for under Article 12.1. National communications are required to include the above mentioned inventory of net anthropogenic emissions of GHGs not included in the Montreal Protocol, and a general description of the steps taken or envisaged to implement the Convention.

34. According to Article 4.3 of the UNFCCC, "the developed country Parties and other developed Parties included in Annex II shall provide new and additional financial resources to meet the agreed full costs incurred by developing country Parties in complying with their obligations under Article 12, paragraph 1". The financial mechanism of the UNFCCC (Article 11) is the Global Environment Facility - GEF.

35. This project has been prepared according to UNFCCC guidelines for National Communications (the project brief is in accordance with Decision 17/CP. 8 - guidelines for the preparation of national communications from Parties not included in Annex I to the Convention) and, therefore, fits in Enabling Activities strategies of the GEF. It additionally conforms to the strategic area of support of capacity building under GEF operational program on "Enabling Activity (EA)".

The Country Programme envisages UNDP's role for strengthening national capacities for developing mandatory reports under conventions. At the same time, as the implementing agency of GEF, it would facilitate mobilization of resources for meeting the goals of the Convention.

### *2.1.2: Policy Conformity*

36. This project will conform to the GEF operational program on "Enabling Activity (EA)" which pertains to the GEF Focal Area on "Climate Change". The priority areas that the project will focus on will be drawn from the tenets of the Convention to which India is a Party and the latest guidelines for preparation of National Communication for non-Annex 1 Parties (17/CP.8) enabling India to report National Communication to the UNFCCC on a continuous basis.

### *2.1.3: UNDP's strategy for policy development and strengthening national capacity and partnerships*

37. Based on the successful experience of the Initial National Communication project implementation, lessons learned and recommendation of the evaluation of INC, the strategy of implementation of INC would continue to encompass the engagement of the vibrant NATCOM network for technical coordination, participation of the stakeholders including the private sector and create platforms for policy interface with the stakeholders in key climate change sectors. UNDP would proactively partner with the Ministry to focus on strengthening national capacities, enhancing national ownership, advocating for and fostering an enabling policy environment, seeking south-south solutions, promoting gender equality, and forging partnerships for results. The approach will be as follows:

- Fostering an enabling policy environment: The SNC envisages involving policymakers in the various science-policy workshops to enable them to take informed decisions on issues related to climate change. UNDP will support by mobilizing active participation of policymakers in these workshops.
- Strengthening national capacities: SNC already focuses on building capacities at various levels for mainstreaming climate change issues. UNDP would draw resources from its knowledge networks and provide lessons and best practices on development and assessment of capacities.
- Enhancing national ownership: UNDP recognizes national ownership as a key to successful programme. Efforts would be made to have continuous dialogue with the government partners to effective serve their needs through streamlined business processes and results management.
- South-south solutions: UNDP will make efforts to ensure participation of the national focal points in key regional exchange workshops
- Promoting gender equality: In various technical assessments, UNDP would provide access to resources and tools for integrating gender constraints in analysis.
- Forging partnerships for results: In line with the Country Programme, UNDP will consolidate partnerships initiated under the INC and also vigorously pursue new opportunities for partnership.
- UNDP will support the government in development of frameworks for results management through effective coordination with key partner agencies at all levels, including centre and state level agencies, private sector, civil society and NGOs, donors and international agencies.

## 2.2 Project Goal, Objective, Outcomes and Outputs/activities

### *2.2.1 Project Goal*

38. The project will strengthen technical and institutional capacity to assist India mainstream climate change concerns into sectoral and national development priorities.

### *2.2.2 Project Objective*

39. The project will enable India prepare and submit its Second National Communication to the UNFCCC and meet its Convention obligations.

40. The SNC will build on the results of the Initial National Communication. The coverage of the SNC will be more extensive and indepth as compared to INC. It will address the more extensive reporting requirements of the 17/CP.8 with respect to 10/CP.2, address the gaps identified in INC and will focus on prioritized activities taking into account the national circumstances, priorities and developmental needs. An interim PDF-B grant from GEF has been utilized to develop the scope of work for the SNC through a countrywide consultation process involving concerned stakeholds.

41. The project is composed of 4 outcomes, which are summarized below.

### *2.2.3 Outcomes and Outputs/Activities*[2]

Activity 1: Greenhouse Gas Inventory

*Outcome:* A consistent, comparable, comprehensive, and transparent national GHG emission inventory for the year 2000 with reduced uncertainties.

42. *Rationale:* In INC, greenhouse gas emissions of $CO_2$, $CH_4$ and $N_2O$ were reported as per the 10/CP.2 guidelines (for non-Annex 1 communications to the UNFCCC) and estimated according to the methodologies provided in the IPCC 1996 guidelines for preparation of national greenhouse gas inventories. The INC also established measurement protocols and GHG emission measurement techniques for developing the country specific emission factors (see Column 7 of Table 1, Annex A).

43. A review of the GHG inventory prepared in the INC indicates that there were constraints in acquiring data for some sectors, and that high levels of uncertainties are still associated with some of the emission factors used for estimates. The SNC envisages to prepare GHG inventories for the base year 2000 and include additional gases (CO, $NO_X$, NMVOC, $SO_2$, HFC, PFC and $SF_6$), new categories (GPG, 2000), and GHG pools identified in GPG (2003) not included in INC. Further the SNC will improve upon the estimation methodologies for some of the key sectors and develop new country specific emission factors.

44. The data gaps encountered in the INC included detailed data on the various types fuel used in the informal un-organized and small scale industry sectors; data on coal consumption in aluminum production, ceramics and glass. Some of the sub categories under chemical industries could not account for the non-energy product use of fuel. Industries such as electronic industries were not covered. Biomass consumption data was extrapolated based on small studies carried out earlier in some parts of the country.

45. Furtner, details of annual municipal solid waste generation, quantity dumped and dumpsite characteristics of MSW for major sites were not available.

46. The inventory estimation in SNC also will need to reflect the changing structure of the Indian economy as well as the differences in the rate of growth of various GHG emitting sectors between 1994 to 2000. In addition, emission estimates of the new gases included in the GPG's imply that additional

[2] For a work plan of the activities described here see Part II of Section II of this document and for the technical details/terms of reference of each activity (objective, rationale, approach/methodology, expected output and approx. budget) see Annexure A.

sectors of the economy will also need to be assessed for their GHG emissions. This requires a reassessment of the contributions of GHG emissions from the different categories with respect to the total GHG emitted in India in 1994, and the uncertainities associated with the emissions from the categories. This analysis also helps in prioritising the sectors where focused activities will be required.

47. A key source analysis of the 1994 GHG emission categories, identifies fifteen key categories which emit 95 percent of the total GHG emissions in that year (see Table 1, Annex A). In descending order of emissions, these key categories are Energy and transformation industries, mainly represented by power generation (emitting 29 per cent of the total $CO_2$ equivalent), Enteric fermentation, (15.3 per cent of the total $CO_2$ equivalent emissions); Energy intensive industries (iron and steel, cement, ferroalloys, aluminum, textile, bricks, fertilizer, paper, sugar, food and beverages); Rice cultivation; Transport (mainly road transport); Iron and steel production; Residential sector using fuel for energy; Biomass burnt for energy; Cement production; Commercial and institutional sector; Manure management; Ammonia production and Land use, land use change and forestry sector. Table 1 presents the results of a level analysis carried out to detrmine the key sources of emission amongst the categories reported in the 1994 GHG inventory.

48. Attempts in SNC will be made to refine existing GHG inventory estimation, by developing new country specific (CS) emission factors (EF) or by improving some existing EFs and by improving the activity data for some of the key categories identified above (see Table 1, Annex A). Development of CS emission factors for these categories is essential, as the default emission factors given for Asian region in the IPCC 1996 methodologies, may not specifically represent the Indian activity conditions. The strategy for developing the CS emission factors would include either direct measurements or estimation of the EFs, based on secondary data sources for the key sources selected. Direct measurements would involve standardised protocols and all necessary QA/QC measures. Similarly, targeted surveys will be conducted to improve the activity data as well as estimation of EFs (for e.g. feed intake pattern of domestic dairy livestock will be evaluated through surveys which will lead to improved activity data as well as a bottom up estimation of EF from this source using satndardsised IPCC 1996 methodology). The identified direct measurements will be incremental in nature to the activities that are already being carried out by the prospective participating institutions and consequently the budget requirements reflected in (Table 1 & 2 of Section III of this document) are of an 'add-on' nature.

49. The emission estimates of some of the non-key categories will also be tartgeted for improvement, as the activity data of these category sectors show a high growth trend in the years subsequent to 1994. The details of the improvesments to be made in SNC are summarised in Table 2 (See Annex A). Though QA/QC procedures were followed in INC while making measurements for developing the various emission factors (like calibration of standard samples and inetrcalibration of instruments), however, a comprehensive standardised QA/QC plan covering the entire inventory development process needs to be in place for certain key categories integrated within a National Inventory Management System (NIMS).

50. The following outputs and respective activities therein for each sector are envisaged. The activities have been prioritized according to the considerations outlined above and are aimed at strengthening the research networks, enhancing institutional capacity and technical expertise of researchers for GHG inventory preparation.

*Output 1.1:* GHG inventory by sources and sinks for the year 2000

51. The SNC will prepare a GHG inventory by sources and sinks for the base year 2000 and develop, to the extent capacities permit a time series up to 2005 from Energy, Industrial Process and Product Use; Agriculture, Forests and Other Land Use, and the Waste sectors by using the IPCC 1996 guidelines for preparing national greenhouse gas inventories (or the IPCC 2006 guidelines, if it is available at the

starting of the project). The gases that would be included will be $CO_2$, $CH_4$, $N_2O$, CO, $NO_X$, NMVOC, $SO_X$, HFC, PFC and $SF_6$, thereby covering the more extensive reporting requirements of 17/CP.8 as compared to 10/CP.2. The GHG inventory would bridge the data gaps (indicated in the section above) of the INC, improve/refine the GHG emission estimates for key categories as identified in Table 1; estimate the emissions from the additional categories and new pools identified in GPG (2003) and apply the new methodologies identified therein; refine the existing country specific emission factors developed during INC and generate new ones for additional categories as identified and indicated in Table 2 (see Anne-I).

52. Uncertainties in GHG inventory estimations in the INC will be addressed in the SNC. Table 2 (Annex A) indicates the rationale and the proposed activities for reducing uncertainties in order to get accurate data. The shaded categories represent key categories.

The detailed activities to be carried are as follows:

53. Energy Sector: (1) Development of an energy balance matrix to ascertain energy flow across sectors. Though India does generate an energy balance matrix but this activity proposed in SNC will create linkage between top-down energy balance and bottoms-up inventory estimation.; (2) Refine NCV of coking, non coking and lignite consumed in thermal power plants (3) Measure plant-level emission factors of $CO_2$, CO, NOx and $SO_2$ by taking into account the combustion technology, capacity, vintage, efficiency, and fuel variability; (5) Refine the GHG emission estimates from the road transport sector by conducting surveys to apportion the fossil fuel used in various types of road transport vehicles and (5) by refine emission factors for different types of gasoline and diesel driven vehicles incorporating driving cycles; (6) Develop methodology to generate data related to oil and natural gas venting, flaring, transmission and distribution. Though contribution of the oil & natural gas sector to the national GHG emission is not very significant, but it has been considered as a major activity in the inventory development because it is one of the rapidly growing sectors of the economy. The INC only used the Tier-I approach to estimate the emission from this source and the SNC envisages to a bottoms-up approach. (7) Carry out GHG inventory estimation for the entire sector.

54. Industrial Processes and Product Use: (1) Refine GHG emissions estimates from iron and steel manufacturing process by monitoring the stack emissions at representative integrated steel plants (the most common mode of production of iron and steel in India) and by developing correction factors for emissions related to electrode consumption and emissions from the combustion of fuels such as coke oven gas; (2) Reduce uncertainties in GHG emissions from cement production by determine technology specific (dry, wet and semi dry) emission factors through measurements; (3) As ammonia has been identified as a key category, therefore efforts will be made to measure country specific emission factors to reduce uncertainties in emissions from this category; (4) Estimate and compile GHG emission inventories from the IPPU sector.

55. Agriculture, Forestry and Other Land Use (AFOLU): (1) Improve $N_2O$ emission inventory from croplands by making campaign mode measurements to cover all croplands under different agro climatic regions having different fertilizer management practices; (2) Improve $CH_4$ emission estimates from rice cultivation by ascertaining the role of the factors such as soil types, genotypes, water management, manure management practices etc. in the emission factors from the hotspots identified in INC; (3) Undertake region-wise surveys of livestock feed intake, milk production; (4) Undertake region wise direct measurements of $CH_4$ emission due to enteric fermentation specifically for dairy cattle; (5) Develop a matrix on land use and land use change of area under crops, forests, wasteland, settlements and others as per the IPCC-GPG, 2003; (6) Assess biomass stock, carbon fraction of biomass, biomass growth rates of various types of species (crops/forests) to be considered under this category.

56. Waste sector: (1) Refine $CH_4$ emission estimates from the MSW handling process by generating data on MSW handling practices for urban areas, by undertaking detailed composition analysis of MSW and develop country specific $CH_4$ emission factors. (2) Undertaking all year round flux measurements in representative managed and unmanaged landfill areas to develop $CH_4$ emission factors; (3) Improve GHG emission estimate from wastewater generation by undertaking detailed chemical analysis of wastewater in key industries and by developing country-specific emission factors; (4) Estimate and compile emission inventory from all categories under the waste sector.

*Output 1.2:* A National Inventory Management System

57. Within the framework of the SNC, India will focus on the development of a National Inventory Management System to ensure the sustainability of the inventory process. It will address institutional arrangements, database management and methodological issues, among others. The development of the inventory management system will be based on the experience gained in the preparation of the 1994 and 2000 national GHG inventories.

58. For supporting a sustainable inventory process, an Inventory Management System (NIMS) will be created under the aegis of the Ministry of Environment and Forests, the implementing and executing agency of this project, with participation of all stakeholders that produce, synthesize and use the information. NIMS will thus, address the requirements of documentation, archiving and continuous updating of the databases as well as the QA/QC and uncertainty management issues of the inventory. A separate steering group will be instituted to oversee the operations of the NIMS and provide technical guidance. Figure 1 shows the schematic representation of the proposed NIMS, including the activities, management arrangement and coordination to be pursued therein.

59. The activities to be pursued for NIMS are as follows:

60. Develop systemic tools and procedures: This will include activities such as developing procedures for documenting methodologies, creating a database of emissions factors, activity data and assumptions; data management and collection; strategies for data generation and improvement; systems for data archiving and record keeping; mechanisms for synchronization and cross-feeding between emission inventories, national energy balances and relevant sector surveys; guidance for technical peer reviews, procedures for QA/QC and uncertainty management.

61. Design web based management system: This will involve the utilisation of resources for developing a web based management system, which will be used to archive the inventory, the emission factors, the meta data base and develop modules for disseminating information on the steps of inventory management and the tools of inventory management to be used for each sector i.e modules for QA/QC and uncertainty analysis, the steps of peer review etc.

62. For supporting a sustainable inventory process, a National Inventory Management System (NIMS) will be created under the aegis of the Ministry of Environment and Forests, the implementing and executing agency of this project, with participation of all stakeholders that produce, synthesize and use the information. NIMS will thus, address the requirements of documentation, archiving and continuous updating of the databases as well as the QA/QC and uncertainty management issues of the inventory. Further, development of the GHG inventory time series will be assessed with the technical teams responsible for the GHG inventories and with institutions that are data providers and/or involved in the compilation of the data. A NIMS steering group will be instituted, to oversee the operations of the system and provide technical guidance.

63. Since the activities under the NIMS are closely interconnected with the inventory preparation, archiving and reporting, financing of several of these activities are covered under the inventory preparation component itself. During the implementation of the NIMS activities, the approach would duly focus on documentation, archiving and building sustainable inventory management system. Further, adequate resources will be allocated to meet the objectives, and is proposed to be supplemented by adequate co-financing from the government to the tune of US$1M. Furthermore, the in-house capacity of the relevant institutions would also be available.

*Output 1.3:* Strengthened institutional networks and improved scientific measurements, monitoring, reporting, and learning capacities and informed decision-making

64. Given that there is limited expertise available to put such a comprehensive plan into action, there is urgent need to bolster indigenous capacity. Such a thing can be achieved by engaging the existing capacity created during INC and also by involving the high level of expertise available in the various centres of excellence in India. The activities that need to be pursued for broad basing the capacity at the national level would include: (1) Conduct technical training programmes on IPCC methodologies, IPCC good practice guidance; Measurement, standardization and calibration techniques; and Development of measurement protocols; (2) Conduct science-policy workshops and prepare appropriate material for information dissemination related to inventory development; (3) Undertake awareness-raising activities on GHG inventory focused on promoting the importance of an institutionalised inventory process beyond the national GHG inventories to policymakers. The proposed target group would include the researchers for enhancing their monitoring and measuring capabilities, the industry and the policymakers at the national and state level for making informed decisions on climate related policy, legislation, strategies and programmes.

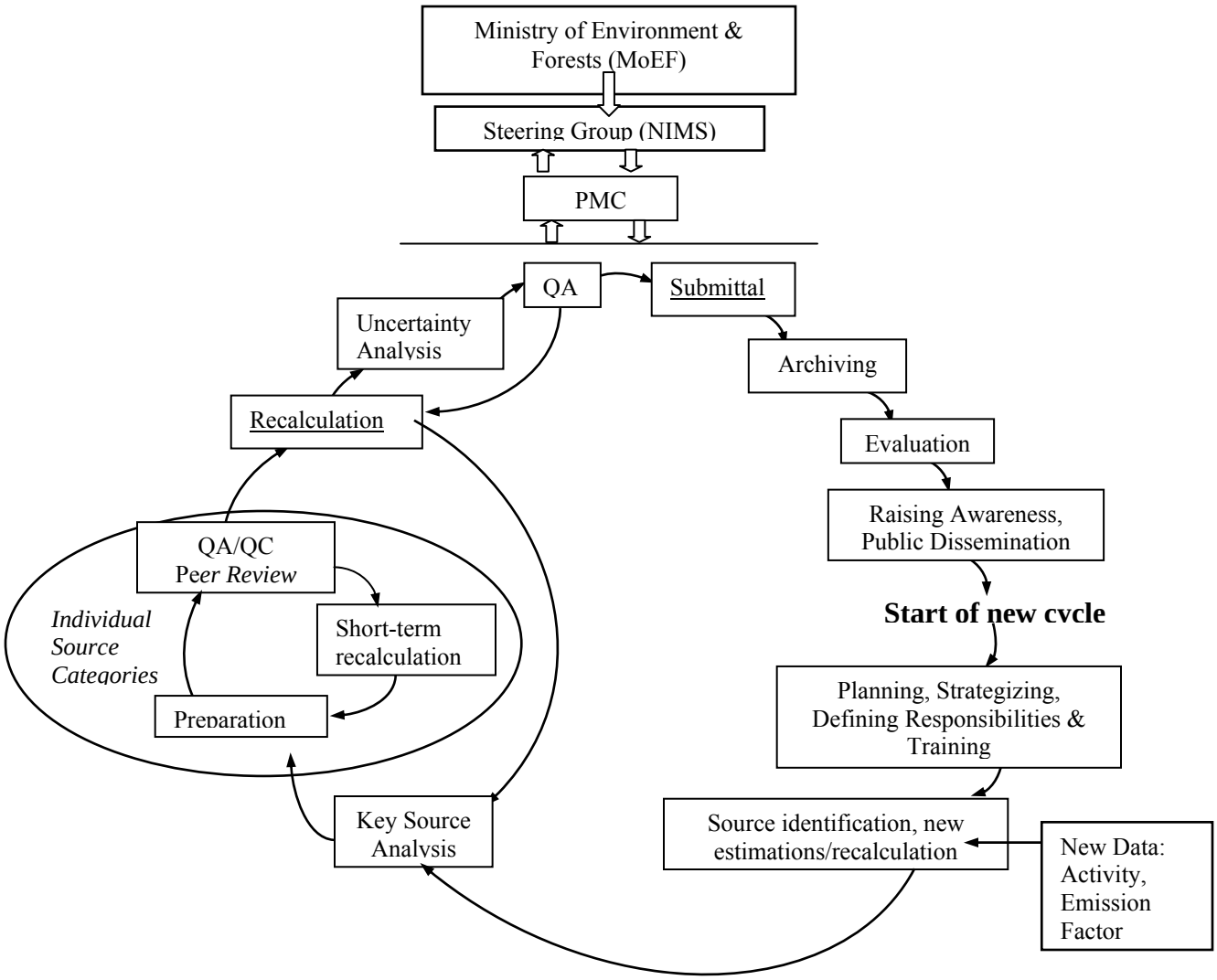


**Figure 1:** The schematic representation of the proposed national inventory management system

Activity 2: Vulnerability Assessment and Adaptation

*Outcome:* An integrated assessment of the impacts of climate change and associated vulnerabilities in the various regions of India

65. *Rationale:* India is a vast country covering 3.28 million square-kilometers, occupying only 2.4 per cent of the world's geographical area but supporting 16.2 per cent of the global human population. It is endowed with varied climate, rich biodiversity and a highly diverse ecology. About 67 per cent of the total crop land is rainfed, and hence subjected to the vagaries of climate. Climate change projections made up to 2100 for India1 indicate an overall increase in temperature by 2-4 $^{o}$C with no substantial change in precipitation quantity. However, spatial variation in rainfall may occur. The projections also indicate increase in intensity and frequency of extreme events such as droughts, floods and cyclones[3]. Such changes are a matter of concern due to the high dependence on climate-sensitive sectors such as agriculture and forestry, and low resource availability and hence low adaptive capacities. This concern is

[3] India's Initial National Communication, 2004

accentuated by the apprehension that climate change may impede the momentum of India's economic development. The past few years have seen rapid economic growth along with a structural shift towards the service sectors, which may manifest in structural changes in the GHG emissions source mix as well.

66. In the INC, sectoral assessments were carried out to assess the impacts of climate change on water resources, agriculture, forestry, natural ecosystems, coastal zones, human health, energy and infrastructure based on a single realization of the regional model HadRM2 run on only one scenario IS92a, for a future time slice 2041-60. The impact assessments carried out during INC were mostly sectoral in dimension and did not explicitly look at the inter-sectoral connections. The objective in SNC, will be to move a few steps further. The SNC will improve the existing climate scenario projections and the sectoral impact assessments; will develop socio economic scenarios; will carry out studies, at climatically hotspot areas, using an integrated approach to understand the inter-sectoral linkages affecting the physical and socio economic vulnerabilities and carry out analysis to formulate adaptation frameworks at these scales which along with other studies (UNDP PDF-B on adaptation Framework) is envisaged to provide inputs for the development of a national adaptation plan for combating the adverse effects of climate change.

67. The scope of work in SNC thus would include generation of climate change scenarios derived from the recent generation of regional or global climate models (HadRM3, PRECIS, and other AOGCMs) and mapping of climatically vulnerable regions. The SNC would also develop multiple short, medium and long term future socio economic scenarios representing its social and economic aspirations and the global drivers. Further, it will improve the impact assessments of climate change on water resources, agriculture, forestry, natural ecosystems, coastal zones, human health, energy and infrastructure carried out in INC. The SNC will develop the socio economic scenarios at national level, which will be analogous to the relevant SRES scenarios capturing India's developmental path. The SNC would identify climate hotspots, where case studies will be undertaken to develop integrated vulnerability frameworks and adaptation options (and hence adaptation frameworks) that would identify the linkages between socio economic scenarios and water resources and agriculture productivity and hence food security; human health associated with climate change and the changing profile of extreme events; vulnerabilities due to the impacts on forests and other natural ecosystem products; sea level rise and vulnerabilities of a coastal zone; and an assessment of the vulnerabilities of energy systems and infrastructure due to the changing temperature and precipitation patterns.

68. The SNC will provide an opportunity to facilitate policy dialogue, by engaging policy makers at various stages of the V&A studies through consultations to ensure policy inputs throughout the process of SNC preparation. Further through the SNC process, linkages will be established with agencies associated with activities related to biodiversity and desertification in the process of implementation of the integrated V&A assessment case studies for developing adaptation frameworks. It should be mentioned here that, MoEF is the executing agency for climate change convention as well as the other two conventions mentioned here.

69. The outputs of the V&A assessment component of the SNC, such as the critical climate risks of India, the socio-economic scenarios, the sectoral analysis of climate vulnerability specially in water and agriculture sectors, and the integrated vulnerability assessments in identified climatically hotspots will have direct linkages to several projects on Adaptation in India, including the recently submitted PDF-B project to GEF on "Climate Resilience Development and Adaptation" (CRDA) which aims to identify, test and build capacity for replicable implementation of climate risk reduction strategies. These two projects are likely to be implemented in parallel by the MoEF, and it is important to develop linkages between the two, considering the complementary activities being carried out in the two projects. The linkage between the two will be established through exchange of feedbacks, which will identify and recommend any adjustments in the activities of the projects and by monitoring approaches adopted for

complementary activities so that they are consistent and programmed to respond to the needs of both the projects. To undertake this coordination, a sub-committee will be constituted, chaired by Secretary (E&F), who will be the Chairman of the NSC's of both SNC as well as the CRDA. Members of this sub-committee will comprise of representatives of the concerned Ministries (namely, agriculture, water resources, rural development, etc.) and technical experts. The inception workshops would provide opportunities to agree, with the relevant stakeholders, on a strategy to make the best use of complementary resources and technical capacity. Thus, capacity building activities and backstopping that are relevant to both projects will be identified and designed jointly, including a strategy for training in common areas. Lessons learned in the implementation of both project will be shared as a mechanism to learn from each other. Similarly, preliminary results, where relevant, will be discussed to encourage technical feedback.

70. The section below provides a description of the expected outputs, the activities required to achieve these outputs including the capacity building requirements.

*Output 2.1:* Development of Climate Change and Socio Economic Scenarios

71. During the INC, only one realization of the regional model HadRM2, for one future time slice (2041-60) for one scenario IS92a was achieved. As impact studies need to give a multiple projections, the following activities are proposed.

(1) Regional climate change projections for India will be developed for a number of selected SRES emission scenarios using HadRM3 and PRECIS – the latest versions of the regional Hadley Centre climate regional model. The projections will also include extreme weather and climate events such as storm surges, extreme temperature and rainfall events. (2) Comprehensive diagnostics will be carried out of the nature of climate simulation for current climate as well as future projections under different scenarios by 15 AOGCMs for which data has been distributed by the PCMDI as part of IPCC-AR4 process. (3) Historical runs of the 20$^{th}$ century will be compared with available observed climatic data to represent various important facets of the climate variability over India. This evaluation will help in short-listing the models, which display reasonable skill in depicting the monsoon for further detail analysis. (4) Develop future socio economic scenarios for India. The approach would require representation of the important factors in society and economy i.e. the national plans for development and associated projections for population and economic growth; the integration of effects of climate variability and change on society and economy; exploration of several coherent directions for the future (i.e., different storylines) which will be in line with the IPCC SRES scenarios (SRES, 2000)[4]; and input from stakeholders to ensure usefulness of the scenarios.

*Output 2.2:* Improved sectoral impact analysis: A Comprehensive assessment of impacts of climate change on key sectors.

72. Water resources: Due to climate change, it is expected that there will be a change in the amount, timing, and distribution of rain and runoff, leading to changes in water availability as well as in competition for water resources. Changes are also likely in the timing, intensity, and duration of both floods and droughts, with related changes in water quality. In this context, it is essential to assess the likely water demands of the various sectors such as the agriculture (irrigation and livestock), industry, domestic sectors etc. In this study to assess the future scenario, firstly an assessment of the present sectoral demand of water and the sources which meet these demands will be made. The assessment of the

[4] SRES, 2000. IPCC special Report on Emission Scenarios, Cambridge University Press, Cambridge.

future demand under the climate change scenario will be based on projected economic indicators of the various sectors along with the projected scenario of precipitation and run off.

73. During the INC, a distributed hydrological model (SWAT) was used to assess the impacts of climate change on water resources in India on major river basins using HadRM2 daily weather data. A total of 40 years of simulation over 12 river basins of the country had been conducted. However, prediction of the impact of climate change on the water resources was projected using only a single realization with the assumption that the land use shall not change over time. The study determined the present water availability in space and time without incorporating any man made changes like dams, diversions, etc.

74. All these 12 river systems together account for a cumulative catchments area of 252 million hectares and contribute more than 80% to the total surface water resources of India. Therefore these 12 river basins constitute a highly significant portion of the total water resources available in India, and hence require further investigation as only one climate change scenario was considered for the analysis. During the SNC, the SWAT model will be run on more than one climate scenario (regional), the SWAT model will upgrade the modeling topography (Digital Elevation Model for India created from 1:250,000 scale topographic map), land cover data (NRSA data base at less than 1 km resolution), digital soil map and derived soil properties obtained from NBLSSUP data base, HadRM3 derived climate data. Additionally man made interventions in the form of major and medium projects on the respective river basins shall be incorporated for basins where such data is available.

75. Additionally in SNC, the HEC-HMS model will also be run for Damodar, Mahanadi, Subarnarekha, Ajoy and Howrah river basins. These river basins lie in the flood-prone eastern areas of the country and would provide opportunities of comparison of output results of different hydrological models. This region was chosen, as the outputs of the HadRM2 indicate increase in the projected precipitation intensity and annual number of rainy days with respect to the current climate.

76. It is proposed to conduct pilot studies for determining the stream flow of selected snow-fed rivers as snow fed-river systems contribute to a great deal in the overall availability of water resources. Assessment of impacts of current climate variability and climate change on water demand of various sectors under different climate change scenarios is also proposed to be carried out during SNC. In the present study, the impact of climate change on the melt runoff, rainfall runoff and total stream flow of the Sutlej River basin up to Bhakra (Indian part) is proposed. No such study was carried out for the snow and glacier fed river basins under INC.

76. Additionally case studies will be carried out at selected glaciers as the retreat of the glaciers are the best piece of evidence of climate change. This is so because the process integrates the effect of gradual warming and changes in precipitation over long periods. Time series analysis suggests that the summer temperatures at 4000 metres above sea level have increased in last 40 years in the Chenab and Ganga headwaters. Glaciers like Chota Shigri and the Gangotri which lie in these regions have been identified for the study. In situ survey, satellite data, hypsometric techniques and atmospheric temperature lapse rates will be used to assess the impact of climate change on the said glaciers.

77. The Gangotri glacier has been identified as one of the study areas as it is the largest glacier in India and feeds into the Ganga River which is an eastern flowing river and is the life line of northern plains of the country. Similarly Chhota Shigri glacier has been selected as it feed into the Chenab river which is a western flowing river, a tributary of the Indus River. Further at both these glaciers, Indian scientists are already carrying out in-situ studies leading to the generation of data that will facilitate the proposed activity of SNC.

78. Agriculture: During the INC, the impacts of climate change on agricultural productivity of main crops such as wheat and rice along with other crops such as sorghum was evaluated. Integration of the climate outputs of the regional models with the crop assessment models (WT Wheat Grows, CERES, and INFOCROP) could not be done during INC. The sensitivity of different components of the agricultural sector to climatic variability could not be carried out due to constraint of time and resources.

79. In the SNC, it is proposed to undertake an assessment of impacts of climate change on the major crops rice and wheat and rainfed crops (which constitutes 40 per cent of the total crops, produced in the country). The focus of the rainfed crop studies will be on the sorghum and groundnut crops. The assessments will be carried out using crop-simulation models (APSIM – a cropping system modelling framework having a suit of crop modules, DSSAT, INFO-CROP, WTGROWS etc.) and using field experimentation. Though most of the models were used in the INC assessments, in SNC the focus will be on integrating the HadRM3 inputs with these models. For the major crops, in addition to the changing climate scenarios, socio-economic projections will also be integrated to assess the impacts. The 'field experimentation' refers to the primary collection of field-level data needed to calibrate and validate the crop simulation models, in conjunction with corresponding daily weather data for selected locations.

80. The SNC also proposes to assess the impacts of climate variability and change on other agriculture activities such as livestock and fisheries. The impacts on livestock will be studied in terms of the changing pattern in the feed stock availability with climate change. The sea-surface temperature projections of the HADRM3 will be used to assess the conditions fishing habitats in respect of breeding and movement of fish along the Indian coastline.

81. Forests and Natural Ecosystems: India is one of the 12 mega-diversity nations with a rich variety of flora and fauna. It is home to 7 per cent of world's biodiversity and supports 16 major vegetation types. The assessments made in INC was limited by the use of a single vegetation response model (BIOME3) run on a single climate change scenario, and the model did not incorporate specific soil and water data for different forest types and the transient vegetation responses to climate change was not assessed. The assessment also lacked in evaluating the implications for biodiversity and socio-economic impacts and policy impacts of climate change on forest ecosystems. Further, BIOME-3 model was used which is an equilibrium model, and the projections only showed how one forest type can replace another type of forest under the climate change scenario.

82. Natural systems are especially vulnerable to climate change because of their limited adaptive capacity and some of these systems may undergo significant and irreversible damage. During INC, a stock of the current status of mangroves, wetlands, coral reefs and grasslands was undertaken, which indicated that climate change impacts on natural ecosystems would require a systematic programme of documenting ecosystem processes, modelling climate change impacts and formulating strategies for adaptation.

83. The SNC will focus on assessment of the impacts of projected climate change on forest ecosystems, forest boundaries and extent, biodiversity and net primary productivity at the national level, dominant natural forest types, economically important species and, protected areas. In the SNC, it is proposed to use a dynamic model (HYBRID) along with BIOME (used in INC), which enables the development of climate change impact projections on the forest types in the transient phase. It is also proposed to carry out case studies in hot spot areas for more in-depth assessment for better understanding of implications.

84. During the SNC, for a reliable assessment of impacts of climate change on natural ecosystems, models will be adapted/adopted from literature to study the impacts of climate change on representative most climatically vulnerable (hotspots) mangroves and coral reefs in India, identified through the process

of ranking, based on the studies carried out in INC. The impacts, to be assessed would include survival, extent, geographic spread, biodiversity, regeneration and productivity with respect to the current status of these systems.

85. Coastal Zones: During the INC, a preliminary assessment of the sea level rise, derived from tide gauge observations, made over the last hundred years across the Indian Ocean was presented. Also, a study was undertaken to identify the coastal districts most vulnerable to cyclones that have occurred in the last 100 years. The vulnerability was measured in terms of loss of life, damage to assets, and livelihood systems and loss of employment.

86. The SNC envisages to take this work further by including assessments of loss of dry land without protection, loss of wetlands without protection, an assessment of damage to existing infrastructure (ports, bridges), human settlements, damage to commercial fisheries production, saline intrusion that adversely affect freshwater resources and agriculture in the 3 most vulnerable districts, namely, Kendrapara in Orissa, Nellore in Andhra Pradesh and Nagapattinam in Tamil Nadu out of the 5 most vulnerable districts identified in INC. The approach would include the development of vulnerability profiles, sensitivity analysis, indicator mapping, Monte Carlo analysis, strategic environmental impact assessments and expert judgments.

87. Energy and Infrastructure: In the present era of economic growth in India, huge investments are being committed in the infrastructure projects. However, the expected climate change and increased frequency and intensity of extreme events in the future can affect the infrastructure adversely if care is not taken in the design of the structure itself. Similarly, Climate warming would result in increased demand for cooling and decreased demand for heating energy, with the overall net effect varying with geographic region.

88. The scope of the work includes: i) assessment of CC impacts and adaptation strategies for energy services at national and key sector levels, ii) assessment of CC impacts and adaptation strategies for key energy related sectors like electricity and transport, using a few micro case studies and drawing macro conclusions using an integrated assessment framework.

89. During INC, a case study of climate change impacts for the Konkan Railway had been carried out by developing an impact matrix and potential climate change parameters having bearing on this kind of infrastructure project. However, INC effort was limited to only one case study using one climate change scenario. Similarly, energy demand at national level was estimated.

90. Therefore, in the SNC, it is proposed to identify current and potential impacts of climate change on diverse industrial services and infrastructure sectors with reference to energy, assess the current knowledge about the cost of such impacts and consider possible adaptive response in the context of characteristics and developmental pathways of the location or the sector. The adaptive responses will be in the context of the adaptation choices to be made, in terms of technologies, institutions and social and economic instruments. Options for risk mitigation and risk coverage through insurance will be explored.

91. The scope of the work includes: i) assessment of CC impacts and adaptation strategies for energy services at national and key sector levels, ii) assessment of CC impacts and adaptation strategies for key energy related sectors like electricity and transport, using a few micro case studies and drawing macro conclusions using an integrated assessment framework.

92. The approach will include the concepts from diverse areas like climate science, ecology, impact assessment, probability, decision analysis, macro and micro economics and technology. The framework developed during INC studies will be mapped to the socio-economic development scenarios for impact

assessment, decision analysis and a meta framework will be developed for integrating the analysis across the diverse sectors and disciplines. Tools and models used for the study will include GIS and other integrated framework developed during INC.

93. Human Health: In INC, the focus of the studies was limited only to the vector borne disease such as malaria. The study identified windows of transmission in terms of temperature, relative humidity and for the current climate and made projections of the impacts of future climate change on these windows in the various regions of the country. As a result the hotspots of malaria in the current climate and future climate have been identified.

94. It is proposed to assess the impacts of climate change on malaria in these hotspots by incorporating the socio-economic and land use change considerations along with climate parameters based on the outputs of the HadRM3 in the assessment at this micro level. Further, it is proposed to expand the scope of coverage to other diseases like dengue and assess impacts of heat stress.

95. For all the above health impact studies the MIASMA model (a Windows-based modelling application) will be used. The models are driven by both population and climate/atmospheric scenarios, applied across baseline data on disease incidence, prevalence and climate conditions. MIASMA will be linked with the HadRM3 outputs of climate change scenarios. Climate input in this model disease specific. For thermal stress, maximum and minimum temperatures are required. For vector-borne diseases maximum, minimum temperature and rainfall data is required. Additionally, other baseline data such as the data on partial immunity in the human population and the extent of drug resistant malaria in the region also go as inputs in this model.

*Output 2.3:* Integrated vulnerability assessment in selected areas to provide representative sample of climate change impacts and adaptation responses leading to the formulation of adaptation framework.

96. The SNC would identify hotspots, where case studies will be undertaken to develop integrated vulnerability frameworks and adaptation options that would focus on the linkages between water resources and agriculture productivity and hence food security; human health associated with climate change and the changing profile of extreme events; impacts on forests and other natural ecosystem products and the livelihoods dependent on them; sea level rise and vulnerabilities of the coastal zone; and an assessment of the vulnerabilities of energy systems and infrastructure due to the changing temperature and precipitation patterns.

97. In order to develop the integrated frameworks, case studies will be carried out in the identified hotspots to (1) assess the associated physical and socio-economic vulnerabilities; (2) analyse the current coping mechanisms operational at the local level (indigenous strategies / policies and programmes / institutional mechanisms / technological options and risk sharing measures) to combat climate variability; (3) identify the incremental measures required to cope with the adverse impacts of climate change and (4) develop adaptation frameworks for these case studies (using the UNDP-GEF technical guidance for adaptation policy framework) that will provide inputs for the development of national framework for adaptation, and hence help devise adaptation strategies through linkages to the Adaptation Learning Mechanism (ALM).

*Output 2.4:* Enhanced institutional capacity for undertaking V&A assessments and informed decision making .

98. Given that there is limited expertise available to put such a comprehensive plan into action, there is urgent need to bolster indigenous capacity.

99. Activities: (1) Conduct focused thematic training workshops for enhancing the assessment capacities of researchers; (2) Conduct inter-sectoral workshops to facilitate integration of the assessments; (3) Conduct workshops to sensitise the policymakers, media, and NGOs about the outputs of the assessments; (4) Disseminate results amongst the general public using web-based and print media.

100. The proposed target groups would include the researchers for enhancing their monitoring and assessment capabilities; the policymakers at the national and state level for enabling them to take informed decisions on climate related policy, legislation, strategies and programmes and the local stakeholders; NGOs, media and the general republic to make them aware of the likely consequence of climate change and enable them to take informed decisions.

Activity 3: A description of the Indian national circumstances and the steps taken or envisaged to implement the Convention.

*Outcome:* A compilation of information on Indian national circumstances and steps taken or envisaged to address climate change concerns and implement the convention as well.

101. *Rationale:* This activity will include a description of the reporting requirements of 17/CP.8 as per the para 3 and para 41 to 53. The outputs would thus include information on National circumstances; steps taken to integrate climate change; activities related to technology transfer; climate change research, research programmes; information on education, training and public awareness; information on capacity building, information and networking; the gaps and related financial and technical and capacity needs for implementing the convention.

102. The Government of India is not seeking any resources in this proposal for the assessment of programmes to mitigate climate change. The reporting requirements for paragraphs 37-40 of 17/CP.8 – the guideline for preparation of non-Annex 1 national communications to the UNFCCC (IV.C: Programmes Containing Measures to Mitigate Climate Changes) – would be addressed and integrated, as appropriate, into the Second National Communication.

*Output 3.1:* National Circumstances

103. This section will include national and regional development priorities, objectives and circumstances, based on which India will address climate change and its adverse impacts as contained in Article 4, paragraph 8, and, as appropriate, in Article 4, paragraphs 9 and 10, of the Convention.

104 *Activities:* (1) The national circumstances provided in SNC will give the description of national and regional development priorities, objectives and circumstances; (2) update the information with respect to INC in terms of the latest socio-economic parameters, trends of growth of various sectors, consumption patterns, energy flows, markets etc.

*Output 3.2:* Steps taken to integrate climate change

105. The strategy to integrate climate change concerns with national development priorities and policy making in SNC would include:

- Involvement of all concerned stakeholders.

- Activities in SNC will be carried out by sectoral experts, many of whom are also responsible for providing inputs to concerned ministries/departments for policy framing in respective areas. The involvement of such experts will ensure mainstreaming of climate change concerns into national/sectoral development priorities and policy making.

- The SNC envisages continuous dissemination of information through specialized products and thematic science-policy workshops which will facilitate internalization (as described in activities 1.2.1 and 1.2.2; 1.3.1 through 1.3.3; and 2.4.1 to 2.4.4 of Section II of this document and also in Annex B)

- The capacity building activities outlined in activities 2.4.1 to 2.4.4 will focus on facilitating the interlisation of V&A activities in the planning process and additionally, compilation and dissemination of the lessons learned in SNC will also be carried out for feeding into the Climate Resilience Development and Adaptation project and also to Adaptation Learning Mechanism .

106. This section will describe these activities and other information on steps taken in India to integrate climate change consideration into relevant social, economic and environmental policies and actions in accordance with Article 4.1 of the Convention.

Output 3.2.1: Steps taken to integrate climate change into relevant social, economic and developmental policies

107. *Activity:* Will collate information on major policies/programmes and projects that address climate change concerns directly or indirectly keeping the sustainable development concerns in view. The various Ministry publications will be consulted for doing this activity.

Output 3.2.2: Activities related to technology transfer

108. *Activities:* (1) Review the UNFCCC technical paper on the enabling environments for technology transfer and the IPCC special report on "Methodological and Technological Issues in Technology Transfers", (2) identify the activities relating to the transfer of access to environmentally sound technologies and the barriers to such transfers in the light of the decision 4/CP.7, its annex, and the implementation of Article 4, paragraph 5, of the Convention.

Output 3.2.3: Climate change research and systematic observation and research to adapt and mitigate to climate change

109. *Activities:* (1) Collate information on India's research initiatives, research networks, observing systems and other facilities that facilitate tracking the climate, making projections of climate change, (2) Collate information on India's contribution to activities and programmes, in national, regional and global research networks and observing systems; (3) Collate information on initiatives that designing new technologies which improve efficiency, and technologies which help in adapting to the adverse impacts of climate.

Output 3.2.4: Information on education, training, public awareness, and capacity building at the national and regional level.

110. *Activity*: (1) Collate information on the level of awareness and the means through which awareness has been generated on climate change issues, (2) Collate information on capacity building initiatives which directly or indirectly address climate change issues at the national and regional levels.

Output 3.2.5: Constraints and gaps, and related financial, technical and capacity needs

111. The scope of the information to be generated on constraints and gaps, and related to financial, technical and capacity needs, will be bound by the national circumstances and developmental paths taken.

112. *Activity:* (1) Will assess the technical support and financial resources contributed by India to produce the SNC, which will be in addition to the GEF support. (2) Perform an analysis on information, legal, capacity and technological constraints and needs of the inventory process and V&A assessment considering the INC experiences; (3) Formulate a list of projects giving brief project descriptions and the financial and technical requirements for improving the GHG inventory estimation, and for improving adaptive capacities which will be in accordance with Article 12, paragraph 4, of the Convention.

**Activity 4:** Preparation of SNC report

113. This activity will involve (1) collation and synthesis of information on the diverse activities generated during SNC project period through the various activities; (2) Day to day management and coordination, including monitoring and evaluation of the project on a regular basis through the aegis of the Project Management Cell (PMC) (for details see Part III and Part IV of Section I).

*Activity 4.1:* The PMC created during INC, will continue to be responsible for day to day coordination, management, and implementation of the project under the guidance of the National Project Director (NPD). It will also act on the inputs received from NSC, TAC and the SIC, and oversee the monitoring and evaluation of the project. Two national consultants, one full time manager supported by one project associate, and one accounts officer will assist the National Project Director in the implementation of this project.

*Activity 4.2:* Monitoring and Evaluation: For details see Part IV of Section I of the FSP. The M&E plan is according to the standard UNDP and GEF M&E Policy. The location of fund for the same is also indicated in Table 1, Part IV of Section I (Indicative monitoring and evaluation work plan).

*Activity 4.3:* Will involve collation, Synthesis & editing of information generated during the SNC, and also printing of the National Communication Report.

**2. 3 Project Indicators, Risks and Assumptions**

114. The main risks identified and assumptions made for the implementation of the SNC communication are applicable to all outcomes. The general assumptions that are common to all activities are that GEF financing will be available at the level requested for, the co-financing commitments will be maintained and a stable institutional support will be available. The institutional stability and commitment with the project is considered crucial for the project development.

115. Further it is assumed that all the reports and studies to be prepared under the SNC project will be completed on time and with the highest quality possible. Where competences are still to be developed or strengthened, capacity building activities have been included. To ensure the quality of reports and documents developed, peer reviews are also considered. Another underlying assumption is that outputs will give us the expected impacts assuming no major natural disaster or political variation takes place.

116. Another general assumption of the Project is that the political, financial and social conditions will not experience a great variability, showing a relative stability and that government regulations will not directly affect the project development.

117. The specific indicators, assumptions and risks for each of the outcomes are identified in the Project Logical Framework, in Annex II of the Executive Summary.

### 2.4 Expected global, national and local benefits

118. The Project will foster a global partnership for development and ensure environmental sustainability and strengthen institutional capacity and enhanced public awareness for addressing the climate change concerns. The main national and local benefits of this Enabling Activity project will be to strength capacity, strengthen methodologies, modeling capabilities and improve data gathering. Furthermore, it will provide focused financial resources for the development of activities related to climate change, which would not be possible without this project.

119. At global level, India's SNC can increase knowledge of some issues related to climate change, such as the assessment of emissions by sources and removal by sinks from the energy, industrial processes and product use, agriculture, forest and other land use, and waste sectors. Additionally, knowledge will be generated about impacts of climate change on climate sensitive sectors, which are also economically important that will lead to the development of an adaptation framework for consideration of the government.

### 2.5 Country Ownership : Country Eligibility and Country Drivenness

*Country eligibility*

120. India ratified the United Nations Framework Convention on Climate Change on November 1, 1993 and submitted its Initial National Communication to the UNFCCC Secretariat on June 22, 2004. India is, therefore, eligible for assistance from the GEF to initiate activities for preparing its SNC. The present full-scale proposal will enable India to initiate activities for preparation of India's Second National Communication to UNFCCC.

*Country Drivenness*

121 India is a Party to the UNFCCC and the Government of India attaches great importance to climate change issues. India's development plans are crafted with a balanced emphasis on economic development and environment. The planning process, while targeting an accelerated economic growth, is guided by the principles of sustainable development with a commitment to a cleaner and greener environment. Planning in India seeks to increase wealth and human welfare, while simultaneously conserving the environment. It emphasizes promotion of people's participatory institutions and social mobilization, particularly through empowerment of women, for ensuring environmental sustainability of the development process.

122. The past few years have witnessed the introduction of landmark environmental measures in India that have targeted conservation of rivers, improvement of urban air quality, enhanced forestation and significant increase in installed capacity of renewable energy technologies. The democratic and legislative processes have affirmed such measures. These deliberate actions, by consciously factoring in India's commitment to UNFCCC, have realigned economic development to a more climate friendly and sustainable path.

123. Additionally, the elements of the communication has linkages with the various developmental programmes of the government such as poverty reduction, reduction in infant mortality, primary education for all children, sustained access to potable water, increase in power generation, afforestation, energy efficiency policies, the national action plans for implementing the Montreal Protocol, Persistent Organic Pollutants (POPs) and others.

124. It is envisaged, that during the process of preparation SNC, a broad-based participatory approach similar to NATCOM-I will be pursued which will ensure the participation of the existing networks as well as state government representatives, industry associations, industries and other stakeholders.

**2.6 Sustainability**

125 The government of India fully supports the activities and outputs of the project. Most key components of the proposal have been designed to work within the existing government systems and hence has the probability to continue. The objectives of the proposed project will be achieved in co-operation with various institutes, departments, research labs, non-governmental organizations, central ministries, state governments and local communities. The resource base and networks established during the NATCOM-I will be utilized, enhanced and strengthened during the full-scale SNC project implementation. It is expected that participation of various stakeholders in several project components will sensitize and enhance their understanding on different aspects of climate change and related issues and enthuse them to continue to participate on a continuous basis.

126 Moreover, because of the broad consultation processes among government, academic institutions, private sector and civil society organizations, this project ensures the input of state-of-the-art expertise and consensus to design project interventions, further underscoring technical sustainability. This strategy will be maintained and enlarged for the SNC. The comprehensive involvement of stakeholders, in a decentralized process, will be sought and this high level of participation also indicates the strong social sustainability of the proposal.

127. Strategic partnerships among stakeholders in many sectors guarantees the compliance of project proponents with the principle of participatory planning and execution arrangements, necessary for the sustainability of a long-term climate change strategy, based on the future implementation of climate change related projects in the country.

128. Some institutions that worked in the preparation of the INC have already allocated some human and financial resources for the development of climate change related activities. With the enlargement of the number of institutions involved in this SNC, it is expected to result in more capacity building (including staff trained) and the enhancement of research on climate change in India, particularly in areas where few researchers have been working.

129. From the point of view of environmental sustainability, the results of the project, especially regarding inventory and vulnerability and adaptation assessment, will provide methodological references that will be important for the formulation of future environment and adaptation projects, as well as important inputs for the scientific literature assessment review periodically undertaken by IPCC.

**2.7 Replicability**

130 The capacity created through the various training programmes envisaged to be conducted in this project will enable researchers at both national and regional levels to prepare GHG inventory, undertake uncertainty management activities, generate climate impact scenarios and develop national adaptation

plans. Thus the pool of trained manpower will be able to take forward the research in the various areas of climate change ensuring replicability. Some of the outputs of this project like the development of indigenous emission factors that would capture regional circumstances may be useful for other countries as well in the region with similar activity scenarios.

**PART III: Management Arrangements**

131 The Ministry of Environment and Forests, Government of India would be the executing and implementing agency of the project. UNDP, New Delhi would be the GEF Implementing Agency.

**3.1 Prior Obligations and Pre-requisites**

132 National Steering Committee: The National Steering Committee (NSC), will be responsible for ensuring that the project is implemented in line with the agreed project design and consistent with national and state development policies. The NSC will meet at least once a year and it will provide the required oversight to this project and also ensure the overall co-ordination of the programme. The NSC will be chaired by the Secretary, E&F, and its membership would include representatives from MoEF, UNDP, DEA, Ministry of Water Resources, Ministry of Coal, Ministry of Agriculture, Ministry of Finance, Ministry Non-conventional Energy Sources, Ministry of Science and Technology, Ministry of Power, Ministry of Heavy Industries and Public enterprises, Ministry of Shipping Transport and Highways, Ministry of Petroleum and Natural Gas, Ministry of Health and Family Welfare, Ministry of External Affairs, Department of Ocean Development and Planning Commission.

133. National Project Director: The NPD appointed by the MoEF for this project will have the overall responsibility for facilitating the required level of inter-sectoral coordination with other relevant ministries and departments of GOI and also ensuring the required level of participation from state for dissemination of climate change knowledge and concerns which can be integrated in policy in the future.

**3.2 Implementation arrangements**

134. Project Management Cell (PMC): The PMC created during INC, will continue to be responsible for day to day coordination, management, and implementation of the project under the guidance of the National Project Director (NPD). It will also act on the inputs received from NSC, TAC and the SIC, and oversee the monitoring and evaluation of the project. Two national consultants, one full time manager supported by one project associate, and one accounts officer will assist the National Project Director in the implementation of this project.

135 The institutions that will be participating in the SNC will include institutions involved in INC along with institutional networks on inventory estimation, uncertainty reduction, vulnerability assessment and adaptation and other steps. These have been expanded further during PDF-Phase B of the project. The coverage includes the Ministries; research institutes of Council of Scientific and Industrial Research (CSIR), Indian Council of Agricultural Research (ICAR), Department of Science & Technology (DST); expert educational institutions like chapters of Indian Institute of Technology (IIT) and Indian Institute of Management (IIM); various Universities, Government Department, reputed NGOs working at national level and Industry Associations. Efforts will also be made to bring in new research institutions and other stakeholders, such as the state-level policymakers and the general public. Figure 2 shows the institutional arrangement for project management and implementation which includes the high level political oversight and coordination, project management and operational coordination and interrelation of the partners involved.

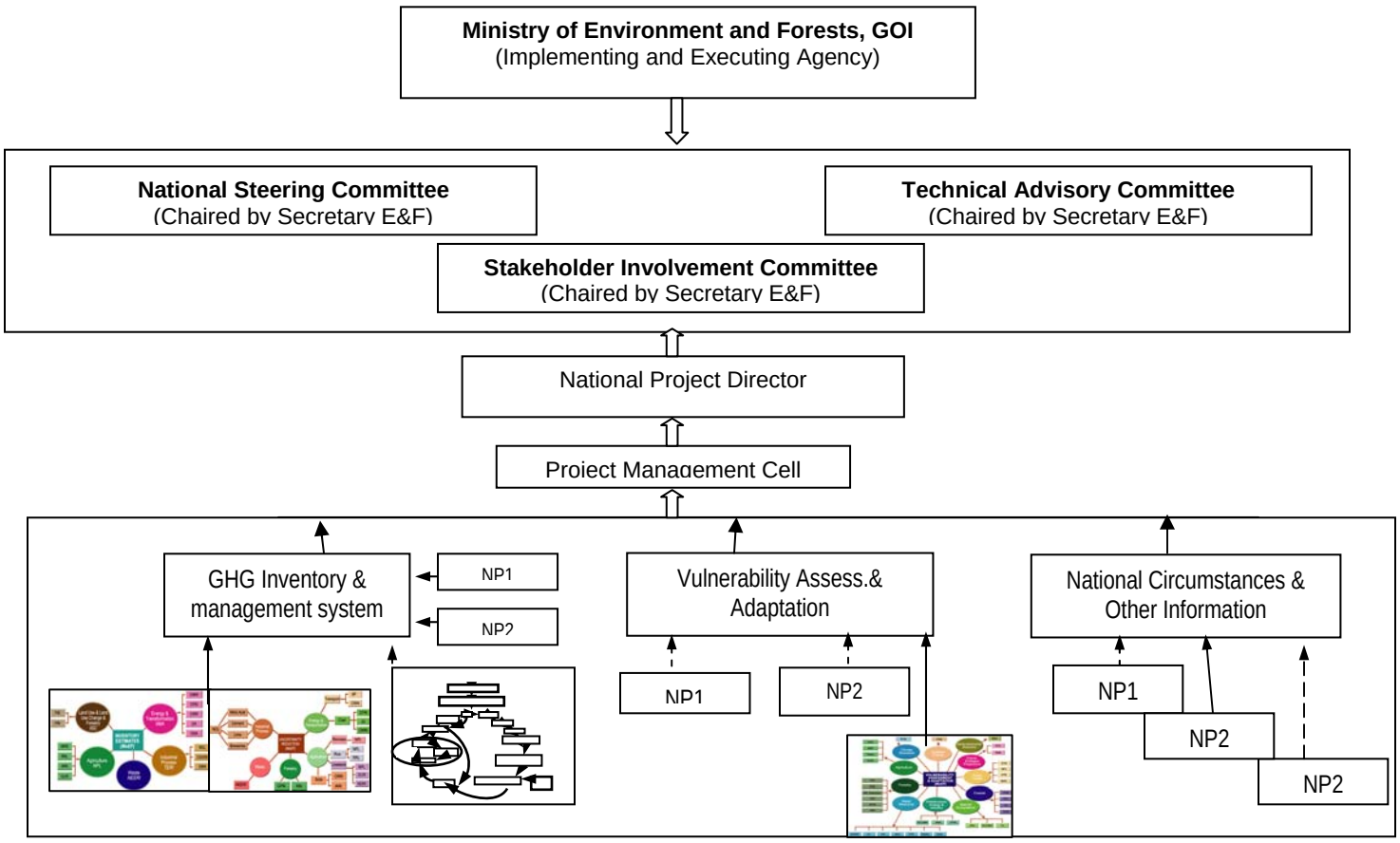


**Figure2:** A schematic view of the proposed institutional arrangement for project management (Here: NP1, NP2…. are the New Participating Institutions)

136. Technical Advisory Committee: The successful implementation of this project requires strong technical leadership and a high level of coordination due to its inter-sectoral and multi-disciplinary nature and its implementation at the national level. A Technical Advisory Committee (TAC), chaired by the Secretary, E&F, constituted during the PDF-Phase B of the project will continue to guide the technical aspects of the project. It will coordinate the technical inputs in the specific components of the project, provide guidance for the preparation of scientific and technical information for the communication. It will also provide inputs for developing detailed quarterly work plan and identify agencies to complete the specified activities as per the work plan.

137. UNDP, New Delhi, the GEF implementing agency of this project, will assume the role of Project assurance and will provide independent project oversight and carry out monitoring functions. The role of UNDP will be to ensure project implementation. The, UNDP Country Office will support project implementation by disbursing project funding on a regular basis. It will also monitor project implementation through Project Implementation Reports (PIRs) and mid-term and final evaluations.

Further, it will also ensure the proper use of UNDP/GEF funds. Financial transactions, reporting and auditing will be carried out in compliance with national regulations and UNDP rules and procedures.

138 The Ministry of Environment Forests has designated a National Project Director. The existing Project Management Cell under the direct supervision of the NPD will monitor the day-to-day execution of the project.

139 Stakeholder Interaction Committee (SIC): An SIC comprising of representatives of Project Monitoring Cell, Industry Associations, NGOs, Media Representatives and Educationists will ensure appropriate awareness generation and stakeholder participation. The Secretary, of the Ministry of Environment and Forests, will be chairman of these committees.

140 In order to accord proper acknowledgement to GEF for providing funding, a GEF logo should appear on all relevant GEF project publications, including among others, project hardware and vehicles purchased with GEF funds. Any citation on publications regarding projects funded by GEF should also accord proper acknowledgment to GEF. The UNDP logo should be more prominent -- and separated from the GEF logo if possible, as UN visibility is important for security purposes.

**3.3 Fund flow arrangements**

141. The administration of project funds will be the joint responsibility of the UNDP and the MoEF. The funds will be released based on the Annual Work Plan (AWP). UNDP will release funds quarterly based on the AWPs which will be part of the approved proposals in the first year. In subsequent years, IA's will submit an AWP to UNDP by the end of November of the previous year. Upon approval of the AWPs by the NPD, UNDP will release funds.

142. Unspent funds from the approved AWPs will be reviewed in early part of the last quarter of the calendar year and funds reallocated to other performing IAs as appropriate.

143. The implementing agencies shall maintain a separate savings bank account in order to receive and disburse UNDP funds. Separate books of accounts on cash basis of accounting shall also be maintained in order to ensure accurate reporting of expenditures and providing a clear audit trail. Any unspent balances at the end of the project will be returned to UNDP within three months of project closure.

144. The implementing agencies will report progress and disbursement on a quarterly basis to UNDP. Request for release of funds by UNDP will be made as per the UNDP Financial Report format. The Financial Report will contain, in addition to the information on funds required, information on expenditure during the quarter and available balance. UNDP will release funds for the project in advance every three months based on the approved annual work-plan and the financial report for the previous quarter which will contain the request for advance for the next quarter. Interest earned on UNDP funds will not be reported as part of the 'available funds' in the financial report, but will be reported as a footnote in the financial report and returned to UNDP every six months.

145. In accordance with UNDP's rules and regulations, approved by the UNDP Executive Board, Implementation Support Services (ISS) will be applied on services provided by UNDP including procurement of goods and services. .Direct payment procedures for payments to suppliers of goods and services and for payments to consultants, domestic or international, would be followed. The Executing Agency will request UNDP, in cases required, to make direct payments on their behalf. Similarly, Country office support services will be used at the request of the Executing Agency.

146. UNDP shall maintain accounts in respect of all disbursements made by them on behalf of the project which will be audited by UNDP's legal auditors.

## PART IV: Monitoring and Evaluation Plan and Budget

### 4.1 Monitoring and Evaluation

147. Project monitoring and evaluation (M&E) will be conducted in accordance with established UNDP and GEF procedures. The Logical Framework Matrix in Annex 1 of the Executive Summary provides indicators for project implementation along with their corresponding *means of verification*. These along with the logical framework given in Part II of Section II of this document will form the basis on which the project's Monitoring and Evaluation system will be built.

148. The following sections outline the principle components of the Monitoring and Evaluation Plan. The project's Monitoring and Evaluation Plan will be presented and finalized at the Project's Inception Report following a collective fine-tuning of indicators, means of verification, and the full definition of project staff M&E responsibilities.

149 A project Management Cell created during the NATCOM-1, and operating under the guidance of the National Project Director (NPD) even during the PDF-B phase of the SNC will continue to facilitate the project monitoring during the full scale project implementation. The following paragraphs give the details of the activities to be carried out as a part of the project monitoring and implementation activities:

#### *4.1.1 Monitoring and Reporting*

*Project Inception Phase*

150. A Project Inception Workshop will be conducted with the full project team, MoEF, other relevant ministries, research institutions, industry associations, NGOs, government departments, the UNDP-CO and representation from the UNDP-GEF Regional Coordinating Unit as appropriate.

151. A fundamental objective of this Inception Workshop will be to assist the stakeholders to understand and take ownership of the project's goals and objectives, as well as apprise them about the expected work required from them. This will enable discussion and finalization of the Annual Work Plan (AWP) with precise and measurable performance indicators, and in a manner consistent with the expected outcomes for the project.

152. Just before the inception workshop, meetings will be carried out of the National Steering Committee and the Technical Advisory Committee to explain the detailed roles, support services and complementary responsibilities, and overview of the project. The MoE, UNDP and the PMC will together decide on the reporting and monitoring and evaluation (M&E) requirements, with particular emphasis on the Annual Project Implementation Reviews (APIRs) and related documentation, the Annual Project Report (APR), Tripartite Review Meetings (TRM), as well as mid-term and final evaluations. Equally, the IW will provide an opportunity to inform the project team on UNDP project related budgetary planning, budget reviews, and mandatory budget rephrasing.

153. The IW will also provide an opportunity for all parties to understand their roles, functions, and responsibilities within the project's decision-making structures, including reporting and communication lines, and conflict resolution mechanisms. The Terms of Reference for project staff and decision-making

structures will be discussed again, as needed, in order to clarify for all, each party's responsibilities during the project's implementation phase.

*Monitoring responsibilities and events*

154. A detailed schedule of project reviews meetings will be developed by the PMC, in consultation with project implementation partners and stakeholder representatives and incorporated in the PIR. Such a schedule will include: (i) tentative time frames for Tripartite Reviews, Steering Committee Meetings, (or relevant advisory and/or coordination mechanisms) and (ii) project related Monitoring and Evaluation activities.

155. Day to day monitoring of implementation progress will be the responsibility of the NPD assisted by the PMC according to the project's Annual Work Plan and its indicators (AWP). The PMC will inform the UNDP-CO of any delays or difficulties faced during implementation so that the appropriate support or corrective measures can be adopted in a timely and remedial fashion.

156 Measurement of impact indicators related to global benefits will be undertaken through subcontracts or retainers with relevant institutions (e.g. land cover via analysis of satellite imagery, or populations of key species through inventories) or through specific studies that are to form part of the projects activities (such as the development of various country specific emission factors, climate change impact assessment and adaptation options etc.) or through periodic sampling (such as through measurement of the sink capacity of upland rice etc).

*Project Monitoring of implementation progress*

157. The PMC, TAC and NSC will undertake periodic monitoring of implementation progress through quarterly meetings with the project proponent, or more frequently as deemed necessary. This will allow parties to take stock and to troubleshoot any problems pertaining to the project in a timely fashion to ensure smooth implementation of project activities.

158. Annual Monitoring will occur through the ***Tripartite Review (TPR).*** This is the highest policy-level meeting of the parties directly involved in the implementation of a project. The project will be subject to Tripartite Review (TPR) at least once every year. The first such meeting will be held within the first twelve months of the start of full implementation. The PMC will prepare an Annual Project Report (APR) and submit it to UNDP at least two weeks prior to the TPR for review and comments.

159. The APR will be used as one of the basic documents for discussions in the TPR meeting. The project proponent will present the APR to the TPR, highlighting project activities, concerned issues and recommendations for the decision of the TPR participants. The project proponent also informs the participants of any agreement reached by stakeholders during the APR preparation on how to resolve operational issues. Separate reviews of each project component may also be conducted if necessary.

160 The terminal tripartite review (TTR) is held in the last month of project operations. The PMC is responsible for preparing the Terminal Report and submitting it to UNDP-CO. It shall be prepared in draft at least two months in advance of the TTR in order to allow review, and will serve as the basis for discussions in the TTR. The terminal tripartite review considers the implementation of the project as a whole, paying particular attention to whether the project has achieved its stated objectives and contributed to the broader environmental objective. It decides whether any actions are still necessary, particularly in relation to sustainability of project results, and acts as a vehicle through which lessons learnt can be captured to feed into other projects under implementation of formulation.

161. The TPR has the authority to suspend disbursement if project performance benchmarks are not met. Time frame is provided in Table 2 of this document and benchmarks are provided in the Executive Summary (Annex-B). These will be further fine tuned at the Inception Workshop. These benchmarks are based on delivery rates, and qualitative assessments of achievements of outputs.

*Project Monitoring Reporting*

The PMC will prepare the following reports as an indicator of monitoring:

162. Inception Report (IR): A Project IR will be prepared immediately following the Inception Workshop. It will include a detailed First Year/ Annual Work Plan divided in quarterly time-frames detailing the activities and progress indicators that will guide implementation during the first year of the project. This Work Plan would include the dates of specific field visits, meetings/workshops, as well as time-frames for meetings of the project's decision-making structures. The Report will also include the detailed project budget for the first full year of implementation, prepared on the basis of the Annual Work Plan, and including any monitoring and evaluation requirements to effectively measure project performance during the targeted 12 months time-frame.

163. The IR will include a more detailed narrative on the institutional roles, responsibilities, coordinating actions and feedback mechanisms of project related partners. In addition, a section will be included on progress to date on project establishment and start-up activities and an update of any changed external conditions that may affect project implementation.

164. When finalized, the report will be circulated to project counterparts who will be given a period of one calendar month in which to respond with comments or queries.

165. Annual Project Report (APR): The APR is a UNDP requirement and part of UNDP's Country Office central oversight, monitoring and project management. It is a self-assessment report by project management to the CO and provides input to the country office reporting process, as well as forming a key input to the Tripartite Project Review. An APR will be prepared on an annual basis prior to the Tripartite Project Review, to reflect progress achieved in meeting the project's Annual Work Plan and assess performance of the project in contributing to intended outcomes through outputs and partnership work.

166. The format of the APR is flexible but would include the following:

- An analysis of project performance over the reporting period, including outputs produced and, where possible, information on the status of the outcome
- The constraints experienced in the progress towards results and the reasons for these
- The three (at most) major constraints to achievement of results
- AWP, CAE and other expenditure reports (ERP generated)
- Lessons learned
- Clear recommendations for future orientation in addressing key problems in lack of progress

167. Project Implementation Review (PIR): The PIR is an annual monitoring process mandated by the GEF. It has become an essential management and monitoring tool for project managers and offers the main vehicle for extracting lessons from ongoing projects. Once the project has been under implementation for a year, the CO together with the PMC will write a Project Implementation Report. As recommended, the PIR will be prepared any time during the year (July-June) but ideally prior to the TPR. The PIR will then be discussed in the TPR so that the result would be a PIR that has been agreed upon by the executing agency, UNDP CO and the concerned RC.

168. Quarterly Progress Reports: Short reports outlining main updates in project progress will be provided quarterly to the local UNDP Country Office and the UNDP-GEF regional office by the PMC.

169. Periodic Thematic Reports: The project team along with the PMC will prepare specific periodic Thematic Reports. The first thematic report in terms of preliminary report would be ready within 6 months of inception of work, and submit interim thematic reports by the end of 1st year after the inception and submit the final report at the end of 3+1 years after the inception of the project. These reports can be used as a form of lessons learnt exercise, specific oversight in key areas, or as troubleshooting exercises to evaluate and overcome obstacles and difficulties encountered.

170. Project Terminal Report: Within 3 months of submission of the SNC to the UNFCCC, the PMC will prepare the Project Terminal Report. This comprehensive report will summarize all activities, achievements and outputs of the Project, lessons learnt, objectives met, or not achieved, structures and systems implemented, etc. and will be the definitive statement of the Project's activities during its lifetime. It will also lay out recommendations for any further steps that may need to be taken to ensure sustainability and replicability of the Project's activities.

171. Technical Reports: Technical Reports are detailed documents covering specific areas of analysis or scientific specializations within the overall project. As part of the Inception Report, the PMC will prepare a draft Reports List, detailing the technical reports that are expected to be prepared on key areas of activity during the course of the project, and tentative due dates. Where necessary this Reports List will be revised and updated, and included in subsequent APRs. Reports should be comprehensive, specialized analyses of clearly defined areas of research within the framework of the project. These technical reports will represent, as appropriate, the project's substantive contribution to specific areas, and will be used in efforts to disseminate relevant information and best practices at local, national and international levels.

172. Project Publications: Project Publications will form a key method of crystallizing and disseminating the results and achievements of the Project. These publications may be scientific or informational texts on the activities and achievements of the Project, in the form of journal articles, proceedings, books, multimedia publications, etc. These publications will be in terms of thematic reports of technical nature. The PMC will determine if any of the Reports merit formal publication in the form of papers, proceedings of workshops, and will also plan and produce these Publications in a consistent and recognizable format. Project resources will be defined and allocated for these activities as appropriate and in a manner commensurate with the project's budget.

**4.2 Independent Evaluation**

173. The project will be subjected to at least two independent external evaluations as follows:-

174. Mid-term Evaluation: An independent Mid-Term Evaluation will be undertaken at the end of the second year of implementation. The Mid-Term Evaluation will determine progress being made towards the achievement of outcomes and will identify course correction if needed. It will focus on the effectiveness, efficiency and timeliness of project implementation; will highlight issues requiring decisions and actions; and will present initial lessons learned about project design, implementation and management. Findings of this review will be incorporated as recommendations for enhanced implementation during the final half of the project's term. The organization, terms of reference and timing of the mid-term evaluation will be decided after consultation between the parties to the project document. The Terms of Reference for this Mid-term evaluation will be prepared by UNDP in consultation with the NPD/PMC.

175. Final Evaluation: An independent Final Evaluation will take place three months prior to the terminal tripartite review meeting, and will focus on the same issues as the mid-term evaluation. The final evaluation will also look at impact and sustainability of results, including the contribution to capacity development and the achievement of global environmental goals. The Final Evaluation should also provide recommendations for follow-up activities. The Terms of Reference for this evaluation will be prepared by the UNDP.

176. Audit Clause: The Government will provide the Resident Representative with certified periodic financial statements, and with an annual audit of the financial statements relating to the status of UNDP (including GEF) funds according to the established procedures set out in the Programming and Finance manuals. The Audit will be conducted by the legally recognized auditor of the Government, or by a commercial auditor engaged by the Government.

### 4.3 Learning and Knowledge Sharing

177. Results from the project will be disseminated within and beyond the project intervention zone through a number of existing information sharing networks and forums. In addition:

- The project will participate, as relevant and appropriate, in UNDP/GEF sponsored networks.
- The project will identify and participate, as relevant and appropriate, in scientific, policy-based and/or any other networks, which may be of benefit to project implementation though lessons learnt.

178. The project will identify, analyze, and share lessons learnt that might be beneficial in the design and implementation of similar future projects. Identify and analyzing lessons learned is an on- going process, and the need to communicate such lessons, as one of the project's central contributions is a requirement to be delivered twice , namely once, half way through the project and once at the end of the project. UNDP/GEF shall provide a format and assist the PMC in categorizing, documenting and reporting on lessons learned.

179. An indicative monitoring and evaluation work plan is given in the Table 1 below and the impact measurement of the project are given in Table 2. Table 2 provides the indicators for global benefits achieved by the project. These indicators will be fine tuned and detailed in the Inception Workshop

**Table 1:** Indicative monitoring and evaluation work plan

| Type of M&E activity | Responsible Parties | Time frame/ Indicative budget | Content |
|---|---|---|---|
| Inception Workshop (IW) | ▪ MoEF /PMC | Within first two months of project start up | Apprise stakeholders about the components of the NATCOM, the work plan and the inputs expected. |
| Project Inception Report | ▪ MoEF/PMC | Immediately following IW<br><br>Indicative budget: None | Detailed First Year Work Plan divided in quarterly timeframes detailing the activities, project budget for the first year and monitoring and evaluation requirements to measure project performance |

| Type of M&E activity | Responsible Parties | Time frame/ Indicative budget | Content |
|---|---|---|---|
| Progress Reports | ▪ MoEF /PMC | Quarterly<br><br>Indicative budget: none | Reports outlining main updates in project progress |
| Annual Project Reports | ▪ MoEF /PMC | Annually<br><br>Indicative budget: none | Reports outlining the achievements/status in the year under consideration |
| Technical Reports | • To be submitted by the project proponents to the PMC | At the start -Preliminary Report<br><br>At the end of the subcontracting period – Final Report<br><br>Indicative budget: none (will be part of the subcontracting done for each of the activities) | Report outlining the approach for undertaking work and literature review for assessing work done so far.<br><br>Report giving details of the results |
| Steering Committee Meetings | ▪ MoEF | Following Project IW and subsequently at least once a year<br><br>Indicative Budget: (US$20,000) | Minutes of the meeting to be presented to the Chairman, NSC |
| Technical Advisory committee meetings | ▪ MoEF<br>▪ Technical Experts | Annually<br><br>Indicative Budget (US$40,000) | Minutes of the minute to be presented to Chairman of TAC |
| Mid-term External Evaluation | ▪ Project team<br>▪ UNDP- CO<br>▪ External Consultants (i.e. evaluation team) | At the mid-point of project implementation.<br><br>Indicative Budget: (US$5000) | The mid-term evaluation will assess whether the activities taken to achieve the targets set out in the project document are being done or not. |
| Final External Evaluation | ▪ Project team,<br>▪ UNDP-CO<br>▪ External Consultants (i.e. evaluation team) | At the end of project implementation<br><br>Indicative budget: (US$5000) | The final evaluation of the project will evaluate how<br>• the project has been used to mainstream climate change concerns in the developmental process,<br>• how it has enhanced capacity to address climate change and<br>• the lessons learnt |
| Terminal Report | ▪ PMC | At least one month before the end of the project<br><br>Indicative budget: none | The contents will be according to the 17/CP.8 guidelines |
| Audit | ▪ UNDP-CO<br>▪ PMC | Yearly<br><br>Indicative budget: (US$10,000) | As per UNDP guidelines |

**Table 2:** Impact Measurement indicators for key outputs

| Key Impact Indicator | Target (Year 4) | Means of Verification | Sampling frequency | Location |
|---|---|---|---|---|
| A consistent, comparable, comprehensive, and transparent national GHG emission inventory for the year 2000 with reduced uncertainties | • A GHG inventory for the year 2000 validated by NSC and TAC and endorsed by GOI.<br>• Validation for compliance to IPCC guidelines for national GHG inventory development and the IPCC Good Practice guidance. | Documented as a chapter on GHG inventory information in SNC document and also published on the NATCOM web site. | NA | India |
| An integrated assessment of impacts of climate change and associated vulnerabilities in the various regions of India | • To develop a range of climate change projections for India at 25 km x 25 km resolution for appropriate SRES scenarios<br>• To refine the national climate change impacts assessments w.r.t INC<br>• To develop integrated vulnerability framework for climate hotspot regions and assess adaptation options for consideration of policy makers | • Documents printed and published on the web/print media<br>• List of people / institutions that receive documents and/or attend presentations | NA | India |
| A description of the Indian national circumstances and the steps taken or envisaged to implement the Convention | • A chapter each in SNC on<br>• National circumstances;<br>• steps taken to integrate climate change;<br>• activities related to technology transfer; climate change research, research programmes;<br>• education, training and public awareness; capacity building, and networking; gaps and related financial and technical and capacity needs for implementing the convention. | • Documents printed and published<br>List of participants that attend presentations | NA | India |

**PART V: Legal Context**

180. General responsibilities of the Government, UNDP and the executing agency are:

- All phase and aspects of UNDP assistance to this sub-programme shall be governed by and carried out in accordance with the relevant and applicable resolutions and decisions of the competent United Nations organs and in accordance with UNDP policies and procedures for such

sub-programmes, and subject to the requirements under UNDP Monitoring, Evaluation and Reporting System.

- The Government shall remain responsible for this UNDP-assisted development sub-programme and the realization of its objectives as described in this Sub-programme Document.
- Assistance under this sub-programme document being provided for the benefit of the Government and the people of (the particular country or territory), the Government shall bear all risks of operations in respect of this sub-programme.
- The Government shall provide to the sub-programme the national counterpart personnel training facilities, land, buildings, equipment and other required services and facilities. It shall designate the Government Co-operating Agency named in the cover page of this document (hereinafter referred to as the "Co-operations Agency"), which shall be directly responsible for the implementation of the Government contribution to the sub-programme.
- The UNDP undertakes to complement and supplement the Government participation and will provide through the Executing Agency the required expert services, training, equipment and other services within the funds available to the sub-programme.
- Upon commencement of the sub-programme the Executing Agency shall assume the responsibility for sub-programme execution and shall have the status of an independent contractor for this purpose. However, that primary responsibility shall be exercised in consultation with UNDP and in agreement with the Co-operating Agency Arrangements to this effect shall be stipulated in the Sub-programme Document as well as for the transfer of this responsibility to the Government or to an entity designated by the Government during the execution of the sub-programme.
- Part of the Government's participation may take the form of cash contribution to UNDP. In such cases, the Executing Agency will provide the related services and facilities and will account annually to the UNDP and to the Government for expenditure incurred.

181 (a) Participation of the Government

- The Government shall provide to the sub-programme the services, equipment and facilities in the quantities and at the time specified in the Sub-programme Document. Budgetary provision, either in kind or in cash, for the Government's participation so specified shall be set forth in the Sub-programme Budgets.
- The estimated cost of items included in the Government contribution, as detailed in the Sub-programme Budget, shall be based on the best information available at the time of drafting the sub-programme proposal. It is understood that price fluctuations during the period of execution of the sub-programme may necessitate an adjustment of said contribution in monetary terms; the latter shall at all times be determined by the value of the services, equipment and facilities required for the proper execution of the sub-programme.
- Within the given number of man-months of personnel services described in the sub-programme document, minor adjustments of individual assignments of sub-programme personnel provided by the Government, may be made in consultation with the Executive Agency, if this is found to be in the best interest of the sub-programme. UNDP shall be so informed in all instances where such minor adjustments involve financial implications.
- The Government shall continue to pay the local salaries and appropriate allowances of national counterpart personnel during the period of their absence from the sub-programme while on UNDP fellowships.

- The Government shall defray any customs duties and other charges related to the clearance of sub-programme equipment, its transportation, handling, storage and related expenses within the country. It shall be responsible for its installation and maintenance, insurance and replacement, if necessary, after delivery to the sub-programme site.
- The Government shall make available to the sub-programme - subject to existing security provisions - any published and unpublished reports, maps, records and other data, which are considered necessary to the implementation of the sub-programme.
- Patent rights, copyrights and other similar rights to any discoveries or work resulting from UNDP assistance in respect of this sub-programme shall belong to the UNDP. Unless otherwise agreed by the parties in each case, however, the Government shall have the right to use any such discoveries or work within the country free of royalty and any charge of similar nature.
- The Government shall assist all sub-programme personnel in finding suitable housing accommodation at reasonable rents.
- The services and facilities specified in the Sub-programme Document which are to be provided to the sub-programme by the Government by means of a contribution in cash shall be set forth in the sub-programme Budget. Payment of this amount shall be made to the UNDP in accordance with the Schedule of Payments by the Government.
- Payment of the above mentioned contribution to the UNDP on or before the dates specified in the Schedule of Payments by the Government is a prerequisite to the commencement or continuation of sub-programme operations.

182 (b) Participation of the UNDP and the executing agency

- The UNDP shall provide to the sub-programme through the Executing Agency the services, equipment and facilities described in the Sub-programme Document. Budgetary provision for the UNDP contribution as specified shall be set forth in the Sub-programme Budget.
- The Executing Agency shall consult with the Government and UNDP on the candidature of the Sub-programme Manager* who, under the direction of the Executing Agency, will be responsible in the country for the Executing Agency's participation in the sub-programme. The Sub-programme Manager shall supervise the experts and other agency personnel assigned to the sub-programme, and the on-the-job training of national counterpart personnel. He shall be responsible for the management and efficient utilization of all UNDP-financed inputs, including equipment provided to the sub-programme.
- The Executing Agency, in consultation with the Government and UNDP, shall assign international staff and other personnel to the sub-programme6 as specified in the sub-programme Document, select candidates for fellowships and determine standards for the training of national counterpart personnel.
- Fellowships shall be administered in accordance with the fellowship regulations of the Executing Agency.
- The Executing Agency may, in agreement with the Government and UNDP, execute part or all of the sub-programme by subcontract. The selection of subcontractors shall be made, after consultation with the Government and UNDP, in accordance with the Executing Agency's procedures.
- All material, equipment and supplies which are purchased from UNDP resources will be used exclusively for the execution of the sub-programme, and will remain the property of the UNDP in

whose name it will be held by the Executing Agency. Equipment supplied by the UNDP shall be marked with the insignia of the UNDP and of the Executing Agency.

- Arrangements may be made, if necessary, for a temporary transfer of custody of equipment to local authorities during the life of the sub-programme, without prejudice to the final transfer.
- Prior to completion of UNDP assistance to the sub-programme, the Government, the UNDP and the Executing Agency shall consult as to the disposition of all sub-programme equipment provided by the UNDP. Title to such equipment shall normally be transferred to the Government, or to an entity nominated by the Government, when it is required for continued operation of the sub-programme or for activities following directly there from. The UNDP may, however, at its discretion, retain title to part or all of such equipment.
- At an agreed time after the completion of UNDP assistance to the sub-programme, the Government and the UNDP, and if necessary the Executing Agency, shall review the activities continuing from or consequent upon the sub-programme with a view to evaluating its results.
- UNDP may release information relating to any investment oriented sub-programme o potential investors, unless and until the Government has requested the UNDP in writing to restrict the release of information relating to such sub-programme.

* May also be designated Sub-programme coordinator or Chief Technical Adviser, as appropriate.

183 Rights, Facilities, Privileges and Immunities

- In accordance with the Agreement concluded by the United Nations (UNDP) and the Government concerning the provision of assistance by UNDP, the personnel of UNDP and other United Nations Organization associated with the sub-programme shall be accorded rights, facilities, privileges and immunities specified in said Agreement.
- The Government shall grant UN volunteers, if such services are requested by the Government, the same rights, facilities, privileges and immunities as are granted to the personnel of UNDP.
- The Executing Agency's contractors and their personnel (except nationals of the host country employed locally) shall:
  - (a) Be immune from legal process in respect of all acts performed by them in their official capacity in the execution of the sub-programme;
  - (b) Be immune from national service obligations;
  - (c) Be immune together with their spouses and relatives dependent on them from immigration restrictions;
  - (d) Be accorded the privileges of bringing into the country reasonable amounts of foreign currency for the purposes of the sub-programme or for personal use of such personnel, and of withdrawing any such amounts brought into the country, or in accordance with the relevant foreign exchange regulations, such amounts as may be earned therein by such personnel in the execution of the sub-programme; and
  - (e) Be accord together with their spouses and relatives dependent on them the same repatriation facilities in the event of international crisis as diplomatic envoys.
- All personnel of the Executing Agency's contractors shall enjoy inviolability for all papers a documents relating to the sub-programme.

- The Government shall either exempt from or bear the cost of any taxes, duties, fees or levies which it may impose on any firm or organization which may be retained by the Executing Agency and on the personnel of any such firm or organization, except for nationals of the host country employed locally, in respect of:

  (a) The salaries or wages earned by such personnel in the execution of the sub-programme;

  (b) Any equipment of the sub-programme or which, after having been brought into the country, may be subsequently withdrawn there from;

  (c) Any substantial quantities of equipment, materials and supplies obtained locally for the execution of the sub-programme, such as, for example, petrol and spare parts for the operation and maintenance of equipment mentioned under (b), above, with the provision that the types and approximate quantities to be exempted and relevant procedures to be followed shall be agreed upon with the Government and, as appropriate, recorded in the Sub-programme Document; and

  (d) As in the case of concessions currently granted to UNDP and Executing Agency's personnel, any property brought, including one privately owned automobile per employee, by the firm or organization or its personnel for their personal use or consumption or which after having been brought into the country, may subsequently be withdrawn there from upon departure of such personnel.

- The Government shall ensure

  (a) Prompt clearance of experts and other persons performing services in respect of this sub-programme; and

  (b) The prompt release from customs of:

    (i) Equipment, materials and supplies required in connection with this sub-programme; and

    (ii) Property belonging to and intended for the personal use or consumption of the personnel of the UNDP, its Executing Agencies, or other persons performing services on their behalf in respect of this sub-programme, except for locally recruited personnel.

- The privileges and immunities referred to in the paragraph above, to which firm or organization and its personnel may be entitled, may be waived by the Executing agency where, in its opinion or in the opinion of the UNDP, the immunity would impede the course of justice and can be waived without prejudice to the successful completion of the sub-programme or to the interest of the UNDP or the Executing Agency.
- The Executing Agency shall provide the Government through the Resident Representative with the list of the personnel to whom the privileges and immunities enumerated above shall apply.
- Nothing in this Sub-programme Document or Annex shall be construed to limit the rights, facilities, privileges or immunities conferred in any other instrument upon any person, natural or juridical, referred to hereunder.

184 Suspension or termination of assistance

- The UNDP may be written notice to the Government and to the Executing Agency concerned to suspend its assistance to any sub-programme if in the judgment of the UNDP any circumstance arises which interferes with or threatens to integration of the successful completion of the sub-

programme or the accomplishment of its purpose UNDP may, in the same or subsequent written notice, indicate the under which it is prepared to resume its assistance to the sub-programme. Any such suspension shall continue until such time as such conditions are accepted by the Government and as the UNDP shall give written notice to the Government and the Executing Agency that is prepared to resume its assistance.

- If any situation referred to in paragraph 1, above, shall continue for a period of fourteen days after notice thereof and of suspension shall have been given by the UNDP to the Government and the Executing Agency, then at any time thereafter during the continuance thereof, the UNDP may be written notice to the Government and the Executing Agency terminate the sub-programme.

*The provisions of this paragraph shall be without prejudice to any other rights or remedies the UNDP may have in the circumstances, whether under general principles of law or otherwise.*

## SECTION II: STRATEGIC RESULTS FRAMEWORK AND GEF INCREMENT

### PART I : Incremental Cost Analysis

185 Not Applicable for this project

### PART II : Logical Framework Analysis

#### 2.1 Project Document for Work Programme entry

186. Refer to Annex II of the Executive Summary

**Table 2:** Indicative Outputs, Activities and quarterly workplan (Activity wise detailed technical plan is detailed in Annex B)

| Outputs | Activities | Quarterly Workplan | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Year 1 | | | | Year 2 | | | | Year 3 | | | | Year 4 | | | |
| | | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 | Q11 | Q12 | Q13 | Q14 | Q15 | Q16 |
| | **Project Inception** | | | | | | | | | | | | | | | | |
| **Output 1.1:** GHG inventory by sources and sinks for the year 2000 | **Energy** | | | | | | | | | | | | | | | | |
| | Activity 1.1.1: Develop energy balance matrix | | | | | | | | | | | | | | | | |
| | Activity 1.1.2: Refine NCVs of coking, non coking and lignite consumed in thermal power plants | | | | | | | | | | | | | | | | |
| | Activity 1.1.3: Measure plant level -technology specific GHG emission factors for thermal power plants | | | | | | | | | | | | | | | | |
| | Activity 1.1.4: Refine the GHG emission estimates from the road transport sector by proper apportionment of the fossil fuel used in various types of road transport vehicles | | | | | | | | | | | | | | | | |
| | Activity 1.1.5: Refine emission factors for different types of gasoline and diesel driven vehicles incorporating driving cycles | | | | | | | | | | | | | | | | |
| | Activity 1.1.6: Develop methodology and generate data related to oil and natural gas venting, flaring, transmission and distribution sector. | | | | | | | | | | | | | | | | |
| | Activity 1.1.7: Estimate and compile emission inventory from all categories of the energy sector | | | | | | | | | | | | | | | | |
| | **Industrial Processes and Product Use** | | | | | | | | | | | | | | | | |
| | Activity 1.1.8: Refine GHG emissions estimates from iron and steel manufacturing | | | | | | | | | | | | | | | | |
| | Activity 1.1.9: Determine technology specific (dry, wet and semi dry) GHG emission factors through measurements for cement production | | | | | | | | | | | | | | | | |
| | Activity. 1.1.10: Determine country specific emission factors for ammonia production process | | | | | | | | | | | | | | | | |
| | Activity 1.1.11: Estimate and compile emission inventory from all categories of the IPPU sector | | | | | | | | | | | | | | | | |
| | **Agriculture, Forests and other Land Use** | | | | | | | | | | | | | | | | |

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| | Activity 1.1.12: Improve $N_2O$ emission inventory from croplands | | | | | | | | | | | | | | | | | |
| | Activity 1.1.13: Improve GHG emission estimates from rice cultivation in the emission hotspots identified in INC | | | | | | | | | | | | | | | | | |
| | Activity 1.1.14: Undertake region wise surveys of livestock feed intake, milk production etc. and estimate EF of CH4 from this source | | | | | | | | | | | | | | | | | |
| | Activity 1.1.15: Undertake region specific measurements of CH4 emission due to enteric fermentation in dairy cattle | | | | | | | | | | | | | | | | | |
| | Activity 1.1.16: Develop a matrix on land use and land use change of area under crops, forests, waste land, settlements and others through literature survey, remote sensing and onsite assessments | | | | | | | | | | | | | | | | | |
| | Activity 1.1.17: Assess biomass stocks, carbon fraction of biomass, biomass growth rate of various types of species (crops/forests) | | | | | | | | | | | | | | | | | |
| | Activity 1.1.18: Estimate and compile emission inventory from all categories of the AFOLU sector | | | | | | | | | | | | | | | | | |
| | **Waste** | | | | | | | | | | | | | | | | | |
| | Activity 1.1.19: Generating data on MSW handling practices for urban areas | | | | | | | | | | | | | | | | | |
| | Activity 1.1.20: Determine CS-EF of CH4 from landfills | | | | | | | | | | | | | | | | | |
| | Activity 1.1.21: Undertake detailed chemical analysis of wastewater in key industries | | | | | | | | | | | | | | | | | |
| | Activity 1.1.22 – Estimate and compile emission inventory from all categories under the waste sector | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| **Output 1.2:** A National Inventory Management System | Activity 1.2.1: Develop systemic tools and procedures NIMS | | | | | | | | | | | | | | | | | |
| | Activity 1.2.2: Design for dissemination of information through web based management system. | | | | | | | | | | | | | | | | | |
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| **Output 1.3:** Strengthened institutional networks and improved scientific | Activity 1.3.1: Conduct technical training programs on IPCC methodologies, IPCC good practice guidance, Measurement, standardization and calibration techniques, Development of measurement protocols; | | | | | | | | | | | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| measurement, monitoring, reporting, and learning capacities and informed decision-making | Activity 1.3.2: Conduct science-policy workshops and prepare appropriate material for information dissemination related to inventory development; | | | | | | | | | | | | | | | | |
| | Activity 1.3.3: Undertake awareness-raising activities on GHG inventory focused on promoting the importance of an institutionalized inventory process beyond the national GHG inventories to policymakers. | | | | | | | | | | | | | | | | |
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| **Output 2.1:** Development of Climate Change and socio economic Scenarios | **Climate change scenarios** | | | | | | | | | | | | | | | | |
| | 2.1.1: Generate projections of climate change scenarios for India using regional climate change models (HadRM3, PRECIS) | | | | | | | | | | | | | | | | |
| | 2.1.2: Comprehensive diagnostics of the nature of climate simulation for current climate as well as future projections under different scenarios by 15 AOGCMs | | | | | | | | | | | | | | | | |
| | 2.1.3: short-listing the models, which display reasonable skill in depicting the monsoon for further detail analysis. | | | | | | | | | | | | | | | | |
| | 2.1.4: Develop future socio economic scenarios for India | | | | | | | | | | | | | | | | |
| **Output 2.2:** Improved sectoral impact analysis and a Comprehensive assessment of impacts of climate change on key sect ors | **Water Resources** | | | | | | | | | | | | | | | | |
| | 2.2.1: Improve river runoff estimates using SWAT for all the river basins considered in INC | | | | | | | | | | | | | | | | |
| | 2.2.2: Assess river run off in the flood prone river systems of the eastern regions using HEC-HMS model and compare with drought prone river basins | | | | | | | | | | | | | | | | |
| | 2.2.3: Assess impacts of climate change in a selected snow fed river | | | | | | | | | | | | | | | | |
| | 2.2.4: Assess impacts of climate change on selected glaciers | | | | | | | | | | | | | | | | |
| | 2.2.5: Assess the impacts of climate change on water demand in the future at the national level | | | | | | | | | | | | | | | | |
| | **Agriculture** | | | | | | | | | | | | | | | | |
| | 2.2.6: Undertake an assessment of impacts of climate change on the major crops of rice and wheat | | | | | | | | | | | | | | | | |

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| | 2.2.7: Undertake an assessment of impacts of climate change on rainfed crops (sorghum and groundnut) by integrating the HadRM3 inputs | | | | | | | | | | | | | | | | |
| | 2.2.8: Undertake an assessment of impacts of climate change on livestock and fisheries | | | | | | | | | | | | | | | | |
| | **Forests and Natural Ecosystems** | | | | | | | | | | | | | | | | |
| | 2.2.9: Undertake the assessment of the impacts of projected climate change on forest ecosystems - forest boundaries and extent, biodiversity and net primary productivity at the national level, dominant natural forest types, economically important species and, protected areas | | | | | | | | | | | | | | | | |
| | 2.2.10: Study the impacts of climate change on selected vulnerable Mangroves, Wetlands, Coral reefs and grasslands | | | | | | | | | | | | | | | | |
| | **Coastal zones** | | | | | | | | | | | | | | | | |
| | 2.2.11: Assess the impacts of the present climate and climate change on the 3 most current vulnerable coastal districts in India | | | | | | | | | | | | | | | | |
| | **Energy and infrastructure** | | | | | | | | | | | | | | | | |
| | 2.2.12: Identify current and potential impacts of climate change on diverse industrial services and infrastructure sectors with reference to energy | | | | | | | | | | | | | | | | |
| | **Human health** | | | | | | | | | | | | | | | | |
| | 2.2.13: Assess the impacts of climate change on malaria and dengue in the hotspots in India as well as at national scale and assess the impacts of heat stress on human health | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| **Output 2.3:** Integrated vulnerability assessment frameworks in selected areas to provide representative sample of climate change impacts and adaptation responses by developing an adaptation framework | **Integrated V&A assessments** | | | | | | | | | | | | | | | | |
| | 2.3.1: Undertake integrated vulnerability assessment studies in identified climatically hotspot regions, establishing the linkages between climate, water resources , agriculture productivity , food security and livelihood for developing an adaptation framework | | | | | | | | | | | | | | | | |
| | 2.3.2: Undertake integrated vulnerability assessment studies in identified climatically hotspot regions, establishing the linkages between extreme events, water resources, status of human health, associated livelihoods for developing an adaptation framework | | | | | | | | | | | | | | | | |

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| | 2.3.3: Undertake integrated impact assessment studies in identified climatically hotspot regions, for establishing the linkages between climate change, forests, other natural ecosystem products and associated livelihoods for developing an adaptation framework | | | | | | | | | | | | | | | | |
| | 2.3.4: Undertake integrated impact assessment in climatic hotspot to establish linkages between climate change and energy infrastructure for developing an adaptation framework | | | | | | | | | | | | | | | | |
| **Output 2.4:** Enhanced institutional capacity for undertaking V&A assessments and informed decision making . | **Enhanced institutional capacity** | | | | | | | | | | | | | | | | |
| | 2.4.1: Conduct thematic training workshops to enhance the assessment capacities of researchers | | | | | | | | | | | | | | | | |
| | 2.4.2: Conduct inter-sectoral workshops to facilitate integration of the assessments | | | | | | | | | | | | | | | | |
| | 2.4.3: Conduct workshops to sensitise the policy makers, media, and NGOs about the outputs of the assessments | | | | | | | | | | | | | | | | |
| | 2.4.4: Develop dissemination products and web pages for dissemination of information (V&A) | | | | | | | | | | | | | | | | |
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| **3:** A description of the Indian national circumstances and the steps taken or envisaged to implement the Convention National circumstances | **3.1 National Circumstances** | | | | | | | | | | | | | | | | |
| | 3.1: Collate information on national circumstances and update information in INC | | | | | | | | | | | | | | | | |
| | **3.2: Steps taken to integrate climate change** | | | | | | | | | | | | | | | | |
| | 3.2.1: Collate information on major policies, programmes and projects that address climate change concerns | | | | | | | | | | | | | | | | |
| | 3.2.2: Review the technical papers on Methodological and Technological Issues and identify barriers to technology transfer | | | | | | | | | | | | | | | | |
| | 3.2.3: Collate information on India's research, networks, observing systems; India's contribution to national, regional and global research networks and observing systems; and on initiatives for designing new technologies for mitigating CC. | | | | | | | | | | | | | | | | |
| | 3.2.4: Collate information on initiatives to enhance education, training and awareness on CC issues in India | | | | | | | | | | | | | | | | |
| | 3.2.5: Constraints and gaps, and related financial, technical and capacity needs | | | | | | | | | | | | | | | | |
| | 3.2.6: Compile a report on national circumstances and steps taken | | | | | | | | | | | | | | | | |
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| **4. Preparation of SNC Report** | | | | | | | | | | | | | | | | | |

## SECTION III: Total Budget and Workplan

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|---|---|---|---|---|---|---|---|---|---|
| **Award ID:00045445** | | | | | | | | | |
| **Award Title: PIMS 2945 CC EA: Enabling Activities for the preparation of India' s Second National Communication to the UNFCCC** | | | | | | | | | |
| **Project ID: 00053688** | | | | | | | | | |
| **Project Title: PIMS 2945 CC EA: Enabling Activities for the preparation of India' s Second National Communication to the UNFCCC** | | | | | | | | | |
| **Execution Agency: Ministry of Environment & Forests** | | | | | | | | | |
| **Outcomes** | **Responsible Party** | **Source of Funds** | **Budget code** | **Budget Description** | **Year 1** | **Year 2** | **Year 3** | **Year 4** | **TOTAL** |
| Outcome 1: A consistent, comparable, comprehensive, and transparent national GHG emission inventory for the year 2000 with reduced uncertainties | MoEF | GEF | 71300 | National Consultants | 50000 | 50000 | 40000 | 10000 | 150000 |
| | MoEF | GEF | 71400 | Sub-contracts | 235000 | 210000 | 180000 | 120000 | 745000 |
| | MoEF | GEF | 71600 | Travel | 40000 | 40000 | 30000 | 25000 | 135000 |
| | MoEF | GEF | 74500 | Miscellaneous | 60000 | 60000 | 50000 | 30000 | 200000 |
| | MoEF | GEF | 73100 | Common services Premises | 40000 | 40000 | 40000 | 25000 | 145000 |
| **Sub Total** | | | | | **425000** | **400000** | **340000** | **210000** | **1375000** |
| Outcome 2: An integrated assessment of the impacts of climate change and associated vulnerabilities in the various regions of India. | MoEF | GEF | 71300 | Local consultant | 55000 | 40000 | 35000 | 15000 | 145000 |
| | MoEF | GEF | 71400 | Sub-contracts | 437500 | 310000 | 307500 | 40000 | 1095000 |
| | MoEF | GEF | 71600 | Travel | 40000 | 40000 | 30000 | 20000 | 130000 |
| | MoEF | GEF | 74500 | Miscellaneous | 52000 | 40000 | 40000 | 30000 | 162000 |
| | MoEF | GEF | 73100 | Common services premises | 15000 | 15000 | 15000 | 15000 | 60000 |
| **Sub Total** | | | | | **599500** | **445000** | **427500** | **120000** | **1592000** |
| Outcome 3: .A description of the Indian national circumstances and the steps taken or envisaged to implement the Convention. | MoEF | GEF | 71300 | Local consultant | 5000 | 5000 | 5000 | 5000 | 20000 |
| | MoEF | GEF | 71400 | Sub-contracts | 20000 | 20000 | 20000 | 20000 | 80000 |
| | MoEF | GEF | 71600 | Travel | 5000 | 5000 | 5000 | 5000 | 20000 |
| | MoEF | GEF | 74500 | Miscellaneous | 5000 | 5000 | 5000 | 5000 | 20000 |
| | MoEF | GEF | 73100 | Common services premises | 15000 | 15000 | 15000 | 15000 | 60000 |
| **Sub Total** | | | | | **50000** | **50000** | **50000** | **50000** | **200000** |
| Outcome 4: Preparation of Second National Communication, project management, monitoring and evaluation | MoEF | GEF | 71300 | National consultants | 54500 | 54500 | 54500 | 54500 | 218000 |
| | MoEF | GEF | 71400 | Sub Contracts | 10000 | 10000 | 22000 | 40000 | 82000 |
| | MoEF | GEF | 71600 | Travel | 6000 | 4000 | 3000 | 4000 | 17000 |
| | MoEF | GEF | 74500 | Miscellaneous | 2000 | 2000 | 2000 | 2000 | 8000 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | MoEF | GEF | 73100 | Common services premises | 2000 | 2000 | 2000 | 2000 | 8000 |
| **Sub Total** | | | | | **74500** | **72500** | **83500** | **102500** | **333000** |
| **GRAND TOTAL** | | | | | **1159500** | **978000** | **899500** | **463000** | **3500000** |

**Table 2: GEF Resources Per Outcome And Activities**

| Activities in Second National Communication | Total Budget (US$) |
|---|---|
| **1. A consistent, comparable, comprehensive and transparent national GHG emission inventory for the year 2000 with reduced uncertainties** | **1375000** |
| 1.1 GHG inventory by sources and sinks for the year 2000 | 875000 |
| 1.1.1 Energy | 290000 |
| 1.1.2 Industrial Products and Process Use | 165000 |
| 1.1.3 Agriculture, Forestry and Other Land Use | 320000 |
| 1.1.4 Waste | 100000 |
| 1.2 A national inventory management system | 320000 |
| 1.2.1 Develop systemic tools and procedures. | 250000 |
| 1.2.2 Design for dissemination of information through web based management system. | 70000 |
| 1.3 Strengthened institutional networks and improved scientific measurements, monitoring, reporting and learning capacities and informed decision making | 180000 |
| 1.3.1 Technical training programmes | 126000 |
| 1.3.2 Science policy workshops | 24000 |
| 1.3.3 Awareness raising activities (publications/workshops) | 30000 |
| **II. An integrated assessment of impacts of climate change and associated vulnerabilities in the various regions of India** | **1592000** |
| 2.1 Development of climate change and socio economic scenarios | 115000 |
| 2.2 Improved sectoral impact analysis: A comprehensive assessment | 518000 |
| 2.2.1 Water resources | 110000 |
| 2.2.2 Agriculture | 106000 |
| 2.2.3 Forest and natural ecosystem | 92000 |
| 2.2.4 Coastal zones | 85000 |
| 2.2.5 Energy and Infrastructure | 50000 |
| 2.2.6 Human health | 75000 |
| 2.3 Integrated vulnerability assessment framework in selected areas to provide representative samples of climate change impacts and adaptation responses | 537000 |
| 2.3.1 Water resources and agriculture | 162000 |
| 2.3.2 Human health and extreme events | 135000 |
| 2.3.3 Forest and natural ecosystem products and livelihoods | 140000 |
| 2.3.4 Water, energy and infrastructure | 100000 |
| 2.4 Enhanced institutional capacity for undertaking V&A assessments and informed decision making | 422000 |
| 2.4.1 Thematic training workshops | 210000 |
| 2.4.2 Inter-sectoral workshops | 127000 |
| 2.4.3 Awareness generation workshops for stakeholders | 40000 |
| 2.4.3 Develop dissemination products | 45000 |
| **III. A description of Indian National Circumstances and the steps taken or envisaged to implement the Convention** | **200000** |

| | |
|---|---|
| 3.1 National Circumstances | 50000 |
| 3.2 Steps taken to integrate climate change | 150000 |
| **IV. Preparation of Second National Communication, project management, monitoring and evaluation** | **333000** |
| 4.1 Project Management, | 248000 |
| 4.2 Monitoring and Evaluation | 50000 |
| 4.3 SNC Report Preparation | 35000 |
| **Grand Total** | **3500000** |

## SECTION IV: ADDITIONAL INFORMATION

### PART I : Other agreements

Endorsement Letter of the Government of India

FROM : FAX NO. : 911143608861 Mar. 17 2006 02:52PM P1

SUDHIR MITAL
JOINT SECRETARY
Tel: 24363958
Fax: 24369192

भारत सरकार
पर्यावरण एवं वन मंत्रालय
GOVERNMENT OF INDIA
MINISTRY OF ENVIRONMENT & FORESTS

D. O. No. 4(2)/24/2005 - IC&SD.I
Dated: 5th November 2005

Dear Dr Burra

This is with reference to the full scale project titled, 'Second National Communication developed under the PDF B enabling activity project. This is to inform you that the above proposal was considered by the Ministry. We endorse the above project to GEF for further necessary action.

Regards

Yours sincerely,

Sd/-

(SUDHIR MITAL)

Dr. Neera Burra
Assistant Resident Representative
UNDP, 55 Lodhi Estate
New Delhi 110003

Copy to
Mr. Rajeev P Singh
Deputy Secretary (FB)
DEA, Ministry of Finance
North Block, New Delhi
(Encl. Project Proposal)

(SUDHIR MITAL)

पर्यावरण भवन, सी.जी.ओ. कॉम्प्लेक्स, लोदी रोड, नई दिल्ली-110003
PARYAVARAN BHAWAN, C.G.O. COMPLEX, LODHI ROAD, NEW DELHI-110003

**PART II: Organigram**

187 Not applicable

**PART III : Terms of References for key project staff and main sub-contracts**

188. See Annex C

**PART IV: Stakeholder Involvement Plan**

189. The development of the National Communication is a multidisciplinary effort, and to prepare the NATCOM-1, a broad based participatory approach was embarked upon by involving representative stakeholders from representative ministries, research organizations, universities, non-governmental organizations, industry associations and policy makers. About 131 research groups from 90 institutions and more than 659 experts from all regions of the country.

190. The same approach has been followed during the PDF- B phase of the SNC for preparing the work programme of the core components of the full-scale proposal. An inception workshop was organized to brief the concerned stakeholders about the results of NATCOM-1, its gaps, the capacity needs for continuous national communication reporting to the UNFCCC, the final review results of the project, and the path that needs to be followed for undertaking work for preparing the full-scale project proposal for the SNC.

191. The SNC will continue to involve policy makers from the central ministries and state departments, the scientific community involved in climate change research, bodies representing the industries and non-governmental organizations which will facilitate the participation of stakeholders at the grassroots level. The project will also aim to enhance and strengthen the involvement of state governments, industries, industry associations and local level authorities.

Table 1 below summarizes the main stakeholders, which are likely to be involved in the SNC.

**Table 1: Summary of key stakeholder groups and their potential roles in the project**

| Key Stakeholder | Main activity | Role in the project | Activities Planned |
|---|---|---|---|
| MoEF/PMC | Implementation and execution of the project | - Take leadership in the overall implementation and execution of this project.<br>- Provide overall administrative guidance to the project<br>- Ensure regular monitoring and evaluation of project implementation through its PMC<br>- Provide support for mainstreaming climate change issues in policy planning<br>- Provide the required co-financing and coordinate with other Ministries<br>- Coordinate smooth release of | - Organize inception and concluding workshops<br>- Organize at least two consultative meetings for each of the activities during the project<br>- Organize thematic, training and dissemination workshops |

| Key Stakeholder | Main activity | Role in the project | Activities Planned |
|---|---|---|---|
| | | project funds from UNDP-GEF | |
| Ministries/Departments | National Steering Committee | - Provide regular guidance to the elements of the project w.r.t the area the Ministry is handling<br>- Participate actively in capacity development initiatives | - At least one National steering committee meeting planned for each year of the project |
| National Experts | Technical Advisory Committee | - Will oversee the technical soundness of the project | - At least one Technical Advisory meeting planned |
| - Individual Researchers<br>- Research Institutions<br>- Policy makers at national and state level<br>- General Public<br>- MoEF/PMC | Capacity Building | - All will participate in training programmes<br>- Will work towards for enhancing institutional capacities<br>- Experts, MoEF/PMC may be working as resource persons<br>- Will help design and develop dissemination material including brochures, workshop proceedings, papers in journals and books on climate change related issues<br>- Help develop a data base of emission factors<br>- Help strengthen the content of the website<br>- Help strengthen the NATCOM networks | - Organize training on inventory development, good practice guidance and modeling<br>- Improve the contents of website<br>- Develop data base on emission inventory and emission factors<br>- Publish at least 2 brochures, various thematic workshop proceedings, and at least two books on the various issues being dealt in the National Communication |
| - Research Institutions<br>- Departments<br>- Industry associations | Uncertainty Reduction | - These institutions will carry out activities to reduce uncertainties in inventory estimation for some of the key categories in all the above sectors.<br>- The uncertainty reduction will include analysis of activity data as well as measurements for improving the existing emission coefficients and for generating new country specific emission factors. | - Inercalibration of measurement techniques<br>- Organize at least one sectoral hands on training workshop on measurement techniques for researchers<br>- Develop data base on emission factors<br>- Prepare manuals on methodological issues of inventory development |
| - Research institution<br>- Universities<br>- Ministries | Vulnerability Assessment and | - These institutions will be involved in undertaking work for generation of climate | - Organize at least two thematic meetings on each sector |

| Key Stakeholder | Main activity | Role in the project | Activities Planned |
|---|---|---|---|
| | Adaptation | change scenarios, and V&A studies in the areas of water resources, agriculture, forestry, natural ecosystems, coastal zones, human health and energy & infrastructure<br>- Will help to develop an adaptation framework | - -Organise hands on traing for using the climate projections<br>- Organise workshop to train researchers on the modeling aspects of impact assessments<br>- Organize two workshop for developing adaptation framework |
| - Research institutions, Ministries,<br>- Departments,<br>- Industry Associations,<br>- Education institutions,<br>- Universities etc.,<br>- State departments of environment | Other steps | - This activity includes assimilation of information on national circumstances<br>- Collation of information on capacity in terms of research activities and facilities for undertaking climate change studies<br>- Collation of information on education, research and training activities related to climate change issues in India<br>- Analyze the technical and financial capacity constraints for undertaking the national communication activities on a regular basis | |

## Part V: Any Other Additional Information

### 5.1 Summary Report of Self Assessment Exercise

192. A nationwide stock-taking exercise has been undertaken through a consultative process, during the PDF-Phase B of this project to develop the work plan for the SNC. The main lessons learnt during the stock-taking exercise indicated that in spite of the substantial capacities built during the INC and other bilateral and multilateral projects that dealt with climate change issues, capacities need to be enhanced further to address India's commitment to the UNFCCC. Appropriate institutional and human capacity is presently scarce, and its development needs time and support. Broadening participation of researchers and other stakeholders enables them to take informed decisions and is a way to build capacities. Integrating climate change concerns in the development process and hence in the policies/programmes/projects, is still in its nascent stage in India. To give a boost to the process, inclusion of policy planners and implementers at national/state and local levels is essential. All this is possible only if a strong intellectual pool is added to top up the previous effort and a high level of ownership of the communication by the government and other stakeholders continues.

193. The brief for developing the activities for SNC was to assess the existing capacities that could be utilized to build upon further for reporting the requisite elements of 17/CP.8 – the guideline for reporting non-Annex 1 SNCs. For example, the stocktaking exercise for inventory, explored the additional data needs for improvements by source categories, options for new and improved GHG inventories and data managing and archiving possibilities along with the capacity enhancement requirements vis a vis the information generated during the INC on these issues. Similarly, vulnerability studies carried out under the INC were reviewed to assess the critical elements of assessments, e.g. baselines, climate and socio-economic scenarios, their coverage in terms of sectors, scale, methodology etc., and their linkages with national priorities. The consultative meetings discussed the extent to which these elements should be improved for addressing the national priorities and for integrating the climate change issues in the policy planning. Synergies with activities related to Convention on desertification, biodiversity, LDCs and NAPA were explored.

194. For prioritization of issues in GHG inventory preparation, tools like key category analysis of the INC inventory (www.natcomindia.org) was employed, consensus and technical inputs were generated for developing an inventory management system and critical capacity needs to enhance the capability for inventory preparation. Similarly, for undertaking an integrated assessment of impacts of climate change and associated vulnerabilities in various regions of India, studies carried out under other programmes like Indo-UK joint programme on 'Impacts of Climate Change in India" (www.defra.gov.uk/environment/climatechange/index.htm), The World Bank supported activity entitled 'A review of Vulnerability to Climate Change and Adaptation Strategies in India' and other available studies in India have been extensively reviewed[5,6,7,58]. The capacity building needs for this assessment have also been prioritized according to the requirement of developing this component and sustaining it beyond the SNC timeframe.

[5] MoEF, 2004a. Proceedings of the NATCOM workshop on climate change scenarios and future emissions, July 22, IIMA, MoEF, 2004

[6] MoEF, 2004b. Proceedings of the workshop on vulnerability assessment and adaptation due to climate change on Indian water resources, coastal zones and human health, 27-28 June, 2003, IIT Delhi.

[7] MoEF, 2004c. Proceedings of the workshop on uncertainty reduction in greenhouse gas inventories, 4-05th March, National Physical Laboratory, New Delhi,

[8] Shukla, P. R., Sharma Subodh, Ravindranath, N. H., Garg, Amit and Bhattacharya Sumana,( eds), 2003. Climate Change and India: Vulnerability Assessment and Adaptation, Universities press, India.

195. The whole process was kick-started with the organization of NSC meeting which approved the proposed consultation process for undertaking a stocktaking exercise through discussions for developing the work plan for the SNC. This was followed by the organization of an inception workshop on 3rd May 2005 at New Delhi to brief the concerned stakeholders about the INC, final review results of the INC project, reporting requirements of 17/CP.8 and capacity needs for continuous national communication reporting to the UNFCCC. Next, a series of consultative meetings were organized (the list is provided in Table 1). In these meetings more than 225 participants representing government, research institutions, universities, academia, industry associations, industries, NGOs, and other interest groups participated. The list of institutions involved in this consultation process and their roles in the self-assessment have been provided in summary form in Table 2.

196. The meetings identified the objectives, respective activities for achieving these objectives and the capacity needs to address the extensive reporting requirements of 17/CP.8 as compared to 10/CP.2 and prioritized them keeping in view the developmental needs like universal access to energy, potable water and reduced poverty etc. The priority areas of work that need to be pursued during SNC and for which work plans were developed emerged as (1) the additional categories, gases, methodologies and new pools identified in GPG (2000; 2003)[9] ; (2) of the need for new Efs and refinement of existing CS_EFs; (3) establishment of a National Inventory Management System to facilitate the process of inventory estimation in the future and using it as a repository of information useful for policy planning; (4) developing climate change scenarios using regional climate change models run on multiple socio-economic scenarios; (5) refining the sectoral impact assessments; and (6) identifying the vulnerabilities due to climate change and adaptation concerns in climatically hotspot areas through an integrated impact assessment approach. The activities designed to address these are detailed in the Appendix B1 of this document.

197. The proposed work programme of SNC proposal, developed on the basis of discussions and recommendations of these sectoral consultative meetings, has been endorsed by the TAC in its meeting held on 28 September 2005 at New Delhi.

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**Table 1:** List of Consultative Meetings

| Date | Title of the Meeting | Venue |
|---|---|---|
| *June 30 – July 1, 2005* | Planning meeting for reducing uncertainties in GHG estimation | National Physical Laboratory, New Delhi |
| *July 20, 2005* | Meeting for developing a framework for estimating GHG emissions from the energy sector | PMC, New Delhi |
| *July 22, 2005* | Meeting for developing a framework for vulnerability assessment and adaptation for water resources, agriculture, coastal zones & human health | Indian Institute of Technology, New Delhi |
| *July 26, 2005* | Meeting for developing a framework for | Indian Institute of |

[9] IPCC, 2000. IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories. In: Penman, J., Kruger, D., Galbally, I., Hiraishi, T., Nyenzi, B., Emmanul, S., Buendia, L., Hoppaus, R., Martinsen, T., Meijer, J., Miwa, K., and Tanabe, K., (Eds.), IPCC National Greenhouse Gas Inventories Programme. Published for the IPCC by the Institute for Global Environmental Strategies, Japan.

IPCC, 2003. Good Practice Guidance for Land Use, Land-Use Change and Forestry. In: Penman, J., Gytarsky, M., Hiraishi, T., Krug, T., Kruger, D., Pipatti, R., Buendia, L., Miwa, K., Ngara, T., Tanabe, K. and Wagner, F., (Eds.), National Greenhouse Gas Inventories Programme. Published for the IPCC by the Institute for Global Environmental Strategies, Japan.

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|---|---|---|
| | estimating GHG emissions from the forestry and other land use changes (now AFOLU) | Science, Bangalore |
| *July 26-27, 2005* | Consultative meeting on land use, land use change and forestry, natural ecosystems, energy & infrastructure | Indian Institute of Science, Bangalore |
| *July 30, 2005* | Consultative meeting for developing a framework for estimating GHG emissions from the industrial processes and product use | India Habitat Centre, New Delhi |
| *August 1, 2005* | Consultative meeting for developing a framework for estimating GHG emissions from the agriculture sector | PMC, New Delhi |
| *August 2, 2005* | Consultative meeting for developing a framework for estimating GHG emissions from the waste sector | PMC, New Delhi |
| *September24, 2005* | Meeting on other steps including national circumstances | PMC, New Delhi |

**Table 2:** Summary Table stakeholder consultation for self assessment

| S.No. | Name of the Institutions/Stakeholders consulted | Stakeholder interests, Official Position or mandate | Reason for inclusion | Role in the Self Assessment process |
|---|---|---|---|---|
| **I. Inventory Estimation** | | | | |
| **Energy** | | | | |
| 1 | Central Fuel Research Institute, Dhanbad | Research | Premier national laboratory for fuel research, participated in INC | Data Provider/ Consultation |
| 2 | Central Mining Research Institute, Dhanbad | Research | Premier national laboratory for mining research, participated in INC | Data Provider/ Consultation |
| 3 | Central Road Research Institute, New Delhi | Research | Premier national laboratory for transport sector, participated in INC | Data Provider/ Consultation |
| 4 | Indian Institute of Petroleum, Dehradun | Research | Premier national laboratory for petroleum fuel research, participated in INC | Data Provider/ Consultation |
| 5 | The Energy and Resources Institute, New Delhi | Research | Premier organization working in energy and environment, participated in INC | Data Provider/ Consultation |
| **Industrial Processes** | | | | |
| 6 | Central Glass and Ceramic Research Institute, Kolkata | Research | Premier national laboratory for glass & ceramic research, participated in INC | Data Provider/ Consultation |
| 7 | Confederation of Indian Industries, New Delhi | Industry Association | Industry Representation | Data Provider/ Consultation |

| | | | | |
|---|---|---|---|---|
| 8 | Cement Manufacturers' Association, New Delhi | Industry Association | Industry Representation, participated in INC | Data Provider/ Consultation |
| 9 | Industrial Associations | Industry Association | Industry Representation | Data Provider/ Consultation |
| 10 | National Chemical Laboratory, Pune | Research | Premier national laboratory for chemical industry research, participated in INC | Data Provider/ Consultation |
| 11 | National Environmental Engineering Research Institute, Nagpur | Research | Premier national laboratory for environment research, participated in INC | Data Provider/ Consultation |
| 12 | Dalmia Cement | Industry | Stake holder | Data Provider/ Consultation/ |
| 13 | Federation of Indian Minerals Industry | Industry | Stake holder | Data Provider/ Consultation/ |
| 14 | Indian Chemical Manufacturers' Association | Industry | Stake holder | Data Provider/ Consultation/ |
| 15 | Indian Oil Corporation Ltd. , New Delhi | Industry | Stake holder | Data Provider/ Consultation/ |
| 16 | Jubilant Organosys Ltd. | Industry | Stake holder | Data Provider/ Consultation/ |
| 17 | Louis Berger Group | Consultation Organization | Involved with industry association | Consultation |
| 19 | Samtel | Industry | Stake holder | Data Provider/ Consultation/ |
| 20 | Tata Chemicals | Industry | Stake holder | Data Provider/ Consultation/ |
| 21 | Tata Power | Industry | Stake holder | Data Provider/ Consultation/ |
| 22 | Tata Services | Industry | Stake holder | Data Provider/ Consultation/ |
| 23 | Usha Martin | Industry | Stake holder | Data Provider/ Consultation/ |
| 24 | Steel Authority of India Ltd. | Industry | Stake holder | Data Provider/ Consultation/ |
| 25 | Bharat Heavy Electricals Ltd. | Industry | Stake holder | Data Provider/ Consultation/ |
| **Agriculture** | | | | |
| 26 | Central Leather Research Institute, Chennai | Research | Premier national laboratory for animal sector, participated in INC | Data Provider/ Consultation |
| 27 | Central Rice Research Institute, Cuttack | Research | Premier national laboratory for rice research, participated in INC | Data Provider/ Consultation |
| 28 | Indian Agricultural Research Institute, New Delhi | Research | Premier national institute for agriculture research, participated in INC | Data Provider/ Consultation |

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|---|---|---|---|---|
| 29 | National Dairy Research Institute, Karnal | Research | Premier national laboratory for animal sector, participated in INC | Data Provider/ Consultation |
| 30 | National Physical Laboratory, New Delhi | Research | Premier national laboratory for environment research, participated in INC | Data Provider/ Consultation |
| 31 | Regional Research Laboratory, Bhubaneswar | Research | National laboratory for environment research, participated in INC | Data Provider/ Consultation |
| **Land Use Land-Use Change and Forestry** | | | | |
| 32 | Forest Research Institute, Dehradun | Research | National institute dealing with forest research, participated in INC | Data Provider/ Consultation |
| 33 | Forest Survey of India, Dehradun | Research | National agency for forests, participated in INC | Data Provider/ Consultation |
| 34 | Indian Council for Forest Research and Education, Dehradun | Research | National organization dealing with forest research | Data Provider/ Consultation |
| 35 | Indian Institute of Science, Bangalore | Research | Premier National institute for environment research, participated in INC | Data Provider/ Consultation |
| 36 | National Remote Sensing Agency, Hyderabad | Research | National agency for space data | Data Provider/ Consultation |
| **Waste** | | | | |
| 37 | National Environmental Engineering Research Institute, Nagpur | Research | Premier national laboratory for environment research, participated in INC | Data Provider/ Consultation |
| 38 | National Solid Waste Association, Mumbai | Industry Association | Industry Representation | Data Provider/ Consultation |
| **II. Uncertainty Reduction** | | | | |
| **Energy** | | | | |
| 39 | Central Fuel Research Institute, Dhanbad | Research | Premier national laboratory for fuel research, participated in INC | Data Provider/ Consultation |
| 40 | Cement Manufacturers' Association, New Delhi | Industry Association | Industry Representation, participated in INC | Data Provider/ Consultation |
| 41 | Central Mining Research Institute, Dhanbad | Research | Premier national laboratory for mining research, participated in INC | Data Provider/ Consultation |
| 42 | Indian Institute of Petroleum, Dehradun | Research | Premier national laboratory for petroleum fuel research, participated in INC | Data Provider/ Consultation |
| 43 | National Thermal Power Corporation, Noida | Power generator | Major power generation agency | Data Provider/ Consultation |

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|---|---|---|---|---|
| **Industrial Processes** | | | | |
| 44 | National Chemical Laboratory, Pune | Research | Premier national laboratory for chemical industry research, participated in INC | Data Provider/ Consultation |
| 45 | National Environmental Engineering Research Institute, Nagpur | Research | Premier national laboratory for environment research, participated in INC | Data Provider/ Consultation |
| **Agriculture** | | | | |
| 46 | Assam Agriculture University, Jorhat | Academic Institute | Research in Agriculture Sector, participated in INC | data Provider |
| 47 | Anna University, Chennai | Academic Institute | Research in Agriculture Sector | data Provider |
| 48 | Bidhan Chandra Krishi Vishva Vidhyalaya, Nadia, West Bengal | Academic Institution | Research in Agriculture Sector | data Provider |
| 49 | Central Leather Research Institute, Chennai | Research | Premier national laboratory for animal sector, participated in INC | Data Provider/ Consultation |
| 50 | Central Research Institute for Dryland Agriculture, Hyderabad | Research | National institute for agriculture research | Data Provider/ Consultation |
| 51 | Central Rice Research Institute, Cuttack | Research | Premier national laboratory for rice research, participated in INC | Data Provider/ Consultation |
| 52 | GB Pant University of Agriculture and Technology, Pantnagar | Academic Institute | Research in Agriculture Sector | data Provider |
| 53 | Indian Agriculture Research Institute, New Delhi | Research | Premier national institute for agriculture research, participated in INC | Data Provider/ Consultation |
| 54 | ICAR Research Centre for Eastern Region, Patna | Research | National institute for agriculture research | Data Provider/ Consultation |
| 55 | Indian Grassland Fodder Research Institute, Jhansi | Research | National institute for agriculture research | Data Provider/ Consultation |
| 56 | Indian Institute of Soil Science, Bhopal | Research | National institute for agriculture research | Data Provider/ Consultation |
| 57 | Institute of Radio Physics and Electronics, Kolkata | Academic Institution | Research in Agriculture Sector, participated in INC | data Provider |
| 58 | Institute of Science & Technology for Advance Studies and Research (ISTAR), Vallabh Vidyanagar, Anand (Gujarat) | Research | National institute for agriculture research | Data Provider/ Consultation |

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|---|---|---|---|---|
| 59 | Indian Veterinary Institute, Barreily | Research | National laboratory for animal sector research | Data Provider/ Consultation |
| 60 | Madras Veterinary College, Chennai | Research | National laboratory for animal sector research | Data Provider/ Consultation |
| 61 | National Dairy Research Institute, Karnal | Research | Premier national laboratory for animal sector, participated in INC | Data Provider/ Consultation |
| 62 | National Physical Laboratory, New Delhi | Research | Premier national laboratory for environment research, participated in INC | Data Provider/ Consultation |
| 63 | National Remote Sensing Agency, Hyderabad | Research | National agency for space data | Data Provider/ Consultation |
| 64 | Punjab Agriculture University, Ludhiana | Academic Institute | Research in Agriculture Sector | data Provider |
| 65 | Regional Research Laboratory, Bhubaneswar | Research | National laboratory for environment research, participated in INC | Data Provider/ Consultation |
| 66 | Regional Research Laboratory, Trivandrum | Research | National laboratory for environment research, participated in INC | Data Provider/ Consultation |
| 67 | Tamil Nadu Agriculture University, Coimbatore | Academic Institute | Research in Agriculture Sector | data Provider |
| **Land Use Land-Use Change and Forestry** | | | | |
| 68 | Forest Research Institute, Dehradun | Research | National institute dealing with forest research, participated in INC | Data Provider/ Consultation |
| 69 | Forest Survey of India, Dehradun | Research | National agency for forests, participated in INC | Data Provider/ Consultation |
| 70 | Indian Council for Forest Research and Education, Dehradun | Research | National organization dealing with forest research | Data Provider/ Consultation |
| 71 | Indian Institute of Science, Bangalore | Research | Premier National institute for environment research, participated in INC | Data Provider/ Consultation |
| 72 | National Bureau of Soil Survey and Land Use Planning, Bangalore | Data Holder | Land use and soil survey | Data Provider/ Consultation |
| **Waste** | | | | |
| 73 | Anna University, Chennai | Academic Institute | Research in waste Sector | Data Provider/ Consultation |
| 74 | National Environmental Engineering Research Institute, Nagpur | Research | Premier national laboratory for environment research, participated in INC | Data Provider/ Consultation |
| 75 | National Physical Laboratory, New Delhi | Research | Premier national laboratory for environment research, participated in INC | Data Provider/ Consultation |
| **III. Vulnerability Assessment and Adaptation** | | | | |

| | | | | |
|---|---|---|---|---|
| **Climate scenario** | | | | |
| 76 | Indian Institute of Tropical Meteorology, Pune | Climate research/ modelling | Premier institute for climate odeling, participated in INC | Climate odeling, data products provider, consultation |
| **Water Resources** | | | | |
| 77 | Central Water Commission, New Delhi | Water resources research | Data Holding agency | Data provider/ consultation |
| 78 | Indian Institute of Technology, New Delhi | Water resources research | Premier institute for water resource odeling, participated in INC | Data provider/ consultation |
| 79 | Jadavpur University, Kolkata | Water resources research | University, participated in INC | Data provider/consultation |
| 80 | National Institute of Hydrology, Roorkee | Water resources research | Premier institute for water resource related research | Data provider/consultation |
| **Agriculture** | | | | |
| 81 | Indian Agricultural Research Institute, New Delhi | Research | Premier national institute for agriculture research, participated in INC | Data Provider/ Consultation |
| 82 | International Crops Research Institute for the Semi-Arid Tropics | Research | Institute for agriculture research | Data Provider/ Consultation |
| 83 | Indian Institute of Tropical Meteorology, Pune | Research | Institute for agriculture odeling, participated in INC | Data Provider/ Consultation |
| 84 | M S Swaminathan Research Foundation, Chennai | NGO | Active in areas like agriculture, impacts and adaptation | Data Provider/ Consultation |
| 85 | The Energy and Resources Institute, New Delhi | Research | Premier organization working in energy and environment, participated in INC | Data Provider/ Consultation |
| **Forestry** | | | | |
| 86 | Forest Survey of India, Dehradun | Research | National agency for forests, participated in INC | Data Provider/ Consultation |
| 87 | Indian Council for Forest Research and Education, Dehradun | Research | National organization dealing with forest research | Data Provider/ Consultation |
| 88 | Indian Institute of Remote Sensing, Dehradun | Research | Institute for remote sensing | Data Provider/ Consultation |
| 89 | Indian Institute of Science, Bangalore | Research | Premier National institute for environment research, participated in INC | Data Provider/ Consultation |

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|---|---|---|---|---|
| 90 | Indian Space Research Organization, Bangalore | National Agency | National agency for space data and research | Data Provider/ Consultation |
| 91 | National Remote Sensing Agency, Hyderabad | Research | National agency for space data | Data Provider/ Consultation |
| **Natural Ecosystem** | | | | |
| 92 | Anna University, Chennai | Academic Institute | Expertise for natural ecosystem studies | Data Provider/ Consultation |
| 93 | Indian Institute of Science, Bangalore | Research | Premier National institute for environment research, participated in INC | Data Provider/ Consultation |
| 94 | Jawaharlal Nehru University, New Delhi | Academic Institute | Expertise for natural ecosystem studies, participated in INC | Data provider |
| 95 | M S Swaminathan Research Foundation, Chennai | NGO | Active in areas like agriculture, impacts and adaptation | Data Provider/ Consultation |
| **Coastal Zones** | | | | |
| 96 | Indian Institute of Technology, Mumbai | Research | Expertise for natural coastal zones studies, participated in INC | Data Provider/ Consultation |
| 97 | National Institute of Oceanography, Goa | Research | Expertise for natural coastal zones studies, participated in INC | Data Provider/ Consultation |
| **Energy and Infrastructure** | | | | |
| 98 | Indian Institute of Management, Ahmedabad | Research | Expertise in energy and infrastructure studies, participated in INC | Data Provider/ Consultation |
| 99 | Maulana Azad National Institute of Technology, Bhopal | Research | Expertise in energy and infrastructure studies, participated in INC | Data Provider/ Consultation |
| **Human Health** | | | | |
| 100 | Indian Council of Medical Research, New Delhi | Research | National Agency for medical research | Data Provider/ Consultation |
| 101 | Indian Institute of Technology, New Delhi | Research | Expertise in odeling for health studies | Data Provider/ Consultation |
| 102 | Malaria Research Centre, Delhi | Research | National institute for malaria research, participated in INC | Data Provider/ Consultation |
| 103 | Technology Information, Forecasting & Assessment Council, New Delhi | Research/data holder | Expertise in health studies | Data Provider/ Consultation |
| **IV. National Circumstances** | | | | |
| 104 | Institute of Economic Growth | Research/data holder | Availability of relevant expertise, participated in INC | Data Provider/ Consultation |
| 105 | Indian Institute of Management, Ahmedabad | Research/data holder | Availability of relevant expertise, participated in INC | Data Provider/ Consultation |
| 106 | Institute for Social and Economic Change, Bangalore | Research/data holder | Availability of relevant expertise | Data Provider/ Consultation |

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| 107 | National Council of Agriculture and Economic Research, New Delhi | Research/data holder | Availability of relevant expertise | Data Provider/ Consultation |
| 108 | Planning Commission | Research/data holder | Availability of relevant expertise | Data Provider/ Consultation |
| 109 | The Energy and Resources Institute, New Delhi | Research/data holder | Availability of relevant expertise, participated in INC | Data Provider/ Consultation |
| **Programmes for Sustainable Development** | | | | |
| 110 | Central Water Commission, New Delhi | Data Holder | Availability of relevant expertise | Data Provider/ Consultation |
| 111 | Department of Agricultural Research and Education | Data Holder | Availability of relevant expertise | Data Provider/ Consultation |
| 112 | Department of Economic Affairs | Data Holder | Availability of relevant expertise | Data Provider/ Consultation |
| 113 | Indian Institute of Management, Ahmedabad | Data Holder | Availability of relevant expertise, participated in INC | Data Provider/ Consultation |
| 114 | Ministry of Heavy Industries & Public Enterprises | Data Holder | Policy maker | Data Provider/ Consultation |
| 115 | Ministry of Non-Conventional Energy Sources | Data Holder | Policy maker | Data Provider/ Consultation |
| 116 | Ministry of Coal | Data Holder | Policy maker | Data Provider/ Consultation |
| 117 | Ministry of Environment and Forests | Data Holder | Policy maker | Data Provider/ Consultation |
| 118 | Ministry of Health | Data Holder | Policy maker | Data Provider/ Consultation |
| 119 | Ministry of Power | Data Holder | Policy maker | Data Provider/ Consultation |
| 120 | Ministry of Petroleum and Natural Gas | Data Holder | Policy maker | Data Provider/ Consultation |
| 121 | Ministry of Shipping, Road Transport and Highways | Data Holder | Policy maker | Data Provider/ Consultation |
| 122 | Ministry of Science and Technology | Data Holder | Policy maker | Data Provider/ Consultation |
| 123 | National Disaster Management Cell | Data Holder | Policy maker | Data Provider/ Consultation |
| 124 | Planning Commission | Data Holder | Policy maker | Data Provider/ Consultation |
| **Education Research and Training** | | | | |
| 125 | Centre for Environment Education, Ahmedabad | NGO | Availability of relevant expertise | Data Provider/ Consultation |
| 126 | Department of Science and Technology, New Delhi | Data Holder | Policy maker/ funding agency for S&T projects | Data Provider/ Consultation |
| 127 | Ministry of Non-Conventional Energy Sources | Data Holder | Policy maker | Data Provider/ Consultation |
| 128 | Ministry of Environment and Forests | Data Holder | Policy maker, nodal ministry for environment | Data Provider/ Consultation |

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|---|---|---|---|---|
| 129 | Ministry of Petroleum and Natural Gas | Data Holder | Policy maker | Data Provider/ Consultation |
| **Research and Systematic Observation** | | | | |
| 130 | Council of Scientific and Industrial Research | Research | National research agency with large network of research institutions | Data Provider/ Consultation |
| 131 | Department of Space | Research/ data holder | National agency | Data Provider/ Consultation |
| 132 | Department of Science and Technology, New Delhi | Research | National agency | Data Provider/ Consultation |
| 133 | India Meteorological Department, New Delhi | Data holder | National agency for meteorological observations | Data Provider/ Consultation |
| 134 | Ministry of Non-Conventional Energy Sources | Data holder | National agency | Data Provider/ Consultation |
| 135 | Ministry of Environment and Forests | Data holder | National agency | Data Provider/ Consultation |
| 136 | Ministry of Petroleum and Natural Gas | Data holder | National agency | Data Provider/ Consultation |
| 137 | National Disaster Management Cell | Data holder | National body dealing with disasters | Data Provider/ Consultation |
| 138 | Technology Information, Forecasting & Assessment Council | Data holder | Availability of relevant expertise | Data Provider/ Consultation |

# Annex A

**Table 1:** Key source analysis of the 1994 GHG inventory (NATCOM, 2004). Here CS: is Country Specific Emission Factors, D: IPCC default emission factors.

| Sources of emission | $CO_2$ equivalent (Gg) | Percentage of total emissions | Cumulative emission (Gg) | Cumulative emission vs. total emission (%) | Tier used | EF used | Status of EF envisaged in SNC |
|---|---|---|---|---|---|---|---|
| Energy and transformation industries | 355037 | 28.9 | 355037 | 28.9 | Tier I | CS | R |
| Enteric Fermentation | 188412 | 15.3 | 543449 | 44.2 | Tier II | CS | R |
| Industry | 150674 | 12.3 | 694123 | 56.5 | Tier I | D | D |
| Rice Cultivation | 85890 | 7.0 | 780013 | 63.5 | Tier II | CS | R |
| Transport | 80286 | 6.5 | 860299 | 70.0 | Tier I | CS | R |
| Emission from Soils | 45260 | 3.7 | 905559 | 73.7 | Tier I | D | CS |
| Iron and steel production | 44445 | 3.6 | 950004 | 77.3 | Tier I | D | CS |
| Energy use in Residential sector | 43918 | 3.6 | 993922 | 80.9 | Tier I | D | D |
| Biomass burnt for energy | 34976 | 2.8 | 1028898 | 83.7 | Tier I | D | D |
| All other energy sectors | 32087 | 2.6 | 1060985 | 86.4 | Tier I | D | D |
| Cement production | 30767 | 2.5 | 1091752 | 88.9 | Tier I | CS | R |
| Energy consumed in Commercial/institutional | 20571 | 1.7 | 1112323 | 90.5 | Tier I | D | D |
| Manure Management | 20176 | 1.6 | 1132499 | 92.2 | Tier I | D | D |
| Ammonia production | 14395 | 1.2 | 1146894 | 93.4 | Tier I | D | CS |
| Land-use, Land-use change & Forestry | 14292 | 1.2 | 1161186 | 94.5 | Tier I | D | CS |
| Coal mining | 13650 | 1.1 | 1174836 | 95.6 | Tier III | CS | CS |
| Oil and natural gas system | 12621 | 1.0 | 1187457 | 96.7 | Tier I | D | D |
| Municipal Solid Waste Disposal | 12222 | 1.0 | 1199679 | 97.7 | Tier I | D | CS |
| Domestic Waste water | 7539 | 0.6 | 1207218 | 98.3 | Tier I | D | D |
| Lime stone and dolomite use | 5751 | 0.5 | 1212969 | 98.7 | Tier I | D | D |
| Agricultural crop residue | 4747 | 0.4 | 1217716 | 99.1 | Tier I | D | D |
| Nitric acid production | 2790 | 0.2 | 1220506 | 99.3 | Tier II | CS | CS |
| Human Sewage | 2170 | 0.2 | 1222676 | 99.5 | Tier I | D | D |
| Lime production | 1901 | 0.2 | 1224577 | 99.7 | Tier I | D | D |
| Industrial Waste Water | 1302 | 0.1 | 1225879 | 99.8 | Tier I | D | CS |
| Ferro alloys production | 1295 | 0.1 | 1227174 | 99.9 | Tier I | D | D |
| Aluminium production | 749 | 0.1 | 1227923 | 99.9 | Tier I | D | D |
| Carbide production | 302 | 0.0 | 1228225 | 100.0 | Tier I | D | D |
| Soda ash use | 273 | 0.0 | 1228498 | 100.0 | Tier I | D | D |
| Black carbon and styrene prod. | 42 | 0.0 | 1228540 | 100.0 | Tier I | D | D |

**Table 2:** Activities proposed in SNC for reducing uncertainties in inventory estimation (here CS: is Country Specific Emission Factors, D: IPCC default emission factors; R : Revision envisaged)

| Sources of emission | EF used in INC | Status of EF envisaged in SNC | Activities proposed in SNC | Rationale | Tier used in INC | Proposed in SNC |
|---|---|---|---|---|---|---|
| Energy and transformation industries | CS | R | o Refinement of NCV of different types of coal<br>o Determine technology specific point source level EFs of $CO_2$, CO and $NO_X$ for thermal power plants | o Inadequate sample size taken in INC<br>o Thermal power plants is the key category within the energy and transformation sector | Tier I | Tier II |
| Enteric Fermentation | CS | R | o Sample survey of age wise domestic livestock population, feed type, milk production in various climate regions of India<br>o Develop $CH_4$ EF for enteric fermentation through estimation and measurement | o It is a key category in the agriculture sector.<br>o In INC, appropriate activity data was not available to make a correct assessment<br>o The sample size for which measurements were taken was small, and could not be validated through estimates because lack of activity data | Tier II | Tier III |
| Industry (fuel combustion) | D | D | -not targeting- | -not targeting- | Tier I | Tier I |
| Rice Cultivation | CS | R | Undertake $CH_4$ flux measurements in hotspot areas | This is the second largest GHG emitting category amongst all the agriculture categories. As the emission from this source is dominated by emissions from hotspots, therefore it is proposed to investigate the EFs from these regions. | Tier II | No change |
| Transport | CS | R | o Conduct survey to apportion the fossil fuel used in various types of road vehicles<br>o Refine EFs from different kinds of gasoline and diesel driven vehicles by incorporating driving cycles | These two approaches will be used to reconcile the top down and bottom up emission estimates from this source | Tier I | Tier II |
| Emission from Soils | D | CS | o Development of $N_2O$ EFs from different soils | This is a major source of $N_2O$ emission amongst all the categories. | Tier I | Tier II |

| | | | | | | |
|---|---|---|---|---|---|---|
| Iron and steel production | D | CS | o Plant level assessment of $CO_2$ EFs (resulting from combustion of fuel & production process) | It is a fast growing sector of the economy in addition to being a major source of CO2 emission | Tier I | Tier II |
| Energy use in Residential sector | D | D | -not to be targeted- | -not to be targeted- | Tier I | No change |
| Biomass burnt for energy | D | D | -not to be targeted- | Data available | Tier I | No change |
| All other energy sectors | D | D | -not to be targeted- | Individually not in key category | Tier I | No change |
| Cement production | CS | R | Plant level assessment of $CO_2$ EFs due to production process | It is a fast growing sector of the economy in addition to being a major source of CO2 emission | Tier I | Tier II |
| Energy consumed in Commercial-institutional | D | D | -not to be targeted- | -not to be targeted- As source category too diverse, and enough resources not available. | Tier I | No change |
| Manure Management | D | D | -not to be targeted- | Manure management not done in a systematic manner in India | Tier I | No change |
| Ammonia production | D | CS | Determine plant level $CO_2$ EF | Key category – not targeted in INC. | Tier I | Tier II |
| Land use, Land-use change and Forestry | D | CS | o Develop land use change matrix<br>o Assess biomass stock, carbon fraction of biomass, biomass growth rates of various types of species (crops/forests) to be considered under this category | A key category, and targeted in SNC to bring in the GPG LULUCF (2003) guidance in the inventory estimation process. | Tier I | Tier II |
| Coal mining | CS | CS | -not targeted- | -not targeted- | Tier III | Tier III |
| Oil and natural gas system | D | D | Develop methodology for assessing data on a regular basis on oil and natural gas transport, storage, venting and flaring. | Though not a key category, but the consumption of oil and natural gas shows the highest growth rate w.r.t other fossil fuel, so efforts will be made to stream line assessment of activity data | Tier I | Tier I |

| | | | | | | |
|---|---|---|---|---|---|---|
| Municipal Solid Waste Disposal | | | o Assess per capita MSW generation, composition and handling process<br>o Generate EFs for managed and unmanaged landfill areas | Rapid urbanization resulting in increased generation of waste and changed composition | Tier I | Tier II |
| Domestic Waste water | D | D | -not targeted- | -not a key category- | Tier I | No change |
| Lime stone and dolomite use | D | D | -not targeted- | not a key category- | Tier I | No change |
| Agricultural crop residue | D | D | -not targeted- | not a key category- | Tier I | No change |
| Nitric acid production | CS | CS | -not targeted- | not a key category- | Tier II | No change |
| Human Sewage | D | D | -not targeted- | not a key category- | Tier I | No change |
| Lime production | D | D | -not targeted- | not a key category- | Tier I | No change |
| Industrial Waste Water | D | CS | Chemical analysis of waste water in selected key industries | Rapid growth of certain industries like paper, pulp, beverage etc. | Tier I | Tier II |
| Ferro alloys production | D | D | -not targeted- | not a key category | Tier I | No change |
| Aluminium production | D | D | -not targeted- | not a key category | Tier I | No change |
| Carbide production | D | D | -not targeted- | not a key category | Tier I | No change |
| Soda ash use | D | D | -not targeted- | not a key category | Tier I | No change |
| Black carbon and styrene production | D | D | -not targeted- | not a key category | Tier I | No change |

# Annex B

## Approach of the activities Proposed and budget

Activity 1.1.1 Develop energy balance matrix to ascertain energy flow across sectors

Rationale: Reduce uncertainties in GHG inventory estimation from energy sector

Objective: Development of energy balance matrix

Approach/Methodology: Energy sector is a dominant sector in the overall contribution of GHG emissions in national total GHG emissions, it is proposed to develop a energy balance matrix to track all important sub-sectors in the GHG emission inventory estimation for the year 2000.

Though India does generate an energy balance matrix but this activity proposed in SNC will create linkage between top-down energy balance and bottoms-up inventory estimation. The proposed matrix will include both the energy producers as well as energy consumers which will help in tracking the energy flows across the sectors for better accountability of their contributions in the GHG emission estimates..

Resource requirement: US $ 45000

Activity 1.1.2:. Refine NCV of coking coals, non-coking coal & lignite consumed in thermal power plants

Rationale: Reduce uncertainties in GHG inventory estimation from energy sector

Objective: Refinement of CO2 emission estimates from thermal power sector by collecting plant specific coal consumption data, refining NCV of coking, non coking and lignite consumed in thermal power plants

Approach/Methodology: In NATCOM-1, CFRI suggested new NCV and CEF values based on data from its archive and production pattern of the year 1994 of different grades of coals. The data were rigorously analyzed to yield the Nation specific values and those were considered to be good enough in respect of estimating GHG emissions for the base year 1994. In the present context it is being felt that there is scope of further refinement NCV and CEF values particularly when we come forward with an objective of preparing the GHG emission inventories for the year 2000 in NATCOM-2.

Refinement of NCV and CEF values with due consideration to Coals which are being currently marketed; Current production pattern of different grades of coals; Region wise coal data (variation of NCV and CEF of the coals of different regions will be taken into the consideration to get the National values).

In order to achieve the above objective, following approach will be adopted:

- Collection of data on presently available coals and their inclusion in coal database.
- Exclusion of some data for the coals, which are currently not in production and thereby, further modifying the coal database.
- Apart from CFRI- data, the data generated at the other sources will be taken into account for enrichment of coal database.
- Such coal database will be prepared for each categories of coal, viz., coking coal, non-coking coals and lignite.

- Database for each major sources may be utilized to obtain the region specific NCV and CEF values. For arriving at the said estimates the coal grades and their respective production will be taken into the consideration
- Region wise estimated values for NCV and CEF and production pattern in the subsidiaries will be taken help of to derive the National values for the emission coefficients.
- Preparation and submission of report

Output to be produced:
- Adopting the strategy mentioned above it is possible to arrive at improved estimates of NCV and CEF
- Uncertainties in the GHG inventory from solid fossil fuels to be undertaken under NATCOM-2 may further be reduced as compared NATCOM-1.

Resource requirement: US $ 30000

Activity 1.1.3: Measure plant-level technology-specific GHG emission factors for thermal power plants

Rationale: Reduce uncertainties in GHG inventory estimation from energy sector

Objective: Refinement of GHG emission estimates from thermal power sector by determining plant level GHG emission factors by taking into account the combustion technology, capacity, vintage, efficiency, and fuel variability

Approach/Methodology: In order to further refine the GHG emission estimates from thermal power plants, it is essential to carry some direct measurements particularly at the key sectors. Such direct measurements when linked with representative consumption data can help to reduce the uncertainties in GHG estimates, thereby improving the quality of the national inventory.

In order to achieve the above objective, following approach will be adopted:

- Identification of the power plants for direct measurement: The number of plants to be selected for the study has to be identified on the basis of their vintage, fuel variability, capacity, location and ownership. The selection matrix will be suitably designed so that it provides representative data encompassing the variability of the identified parameters.
  Initial estimate on the number of plants to be studied is in the range of 6-8 spread across the country.

| Selection parameters | Variability |
|---|---|
| ▪ Vintage | 10,20,30 yrs |
| ▪ Fuel | Lignite, coal type, washed coal, blend |
| ▪ Unit Capacity | 60/210/500 MW |
| ▪ Ownership | Private/Public sector/SEBs |

  Supercritical unit, if commissioned, will also be incorporated.

- Direct Measurement: Sampling and characterization of input fuel, Fly ash, bottom ash and soot for a period of time; Collection and analysis of gas from the individual units during same time interval; Measurement of the flow rate of flue gas; Collection of relevant plant data, fuel flow rate, PLF, etc.; Estimation of $CO_2$ from mass balance; Comparison with direct measurement value and with CEMS, if installed; Identification of the cause & source of variation
  - Data analysis: Data compilation in a structured format/Data base; Statistical analysis of the data
  - Report preparation

Output to be produced:
The case studies at the power plants will provide a more reliable basis for estimating GHG emission from the power plants. The study can be used to analyze the effect on economic activity of policy instruments designed to limit greenhouse gas emissions. The study will provide

- Refined emission factor and fraction of un-oxidised carbon data for preparation of national inventories from the coal based utilities
- Identify the most suitable option for estimating the $CO_2$ emission from the power plants as a routine procedure
- Provides a baseline to measure progress, evaluate cost-effective greenhouse gas reduction opportunities

Resource requirement: US $ 50000

Activity 1.1.4: Refine the GHG emission estimates from the road transport sector by proper apportionment of fossil fuel used in various types of road transport vehicles

Rationale: Reduce uncertainties in GHG inventory estimation from energy sector

Objective: Reduction in uncertainty associated with activity data and generation of GHG emission inventory from transport sector

Approach/Methodology: Transport sector contributes approximately 10 per cent to national greenhouse gas emissions and road transport accounts for 90 per cent of transport sector emissions. Road transportation accounts for majority of the mobile-source fuel consumption (motor gasoline and diesel fuel). The pre-eminent prospect of energy saving and thus in emissions lies in this sector. The sector possesses the principal contributing potential of greenhouse gas emissions than other modes of transport.

For generation of GHG ($CO_2$, $CH_4$, $N_2O$, CO, $NO_x$, and NMVOC) emissions inventory for the reporting year 2000 it is intended to use IPCC 1996 methodology and IPCC default emission coefficients (or revised methodology and emission coefficients, if available) especially for rail transport, aviation and navigation/shipping. For road transportation, IPCC default emission coefficients as well as country specific emission coefficients (if available) will be used respectively for top town and bottom up (for city specific case studies) methodology approaches.

The mail elements to be targeted for reduction in uncertainty associated will be:

(i) Incorporation of all the fuel used in transport sector
(ii) Estimation of the consumption of fuel-types to different transport categories.

Output to be produced: Report on the fossil fuel consumption by different vehicles in road transport sector

Resource requirement: US $ 30000

Activity 1.1.5: Refine emission factors for different types of gasoline and diesel driven vehicles incorporating driving cycles

Rationale: Reduce uncertainties in GHG inventory estimation from energy sector

Objective: Development of refined emission factors of GHGs and other emissions from road transport vehicles

Approach/Methodology: The road transport vehicle population and consequently the fuel consumption of this sector is increasing at a rapid rate in India. As compared to other developed countries of North America, Europe or Japan, the Indian situation with respect to the mix of vehicle population and the consumption pattern of diesel and gasoline fuel are unique. The diesel consumption is about 6-7 times that of gasoline. The two and three wheeler vehicles consume about 65 per cent of total gasoline. The conventional fuels; gasoline & diesel are continuously been upgraded for their qualities to meet future emission norms and vehicle technology requirements. The mix of vehicle types and longer use of vehicles also make the Indian traffic composition of vehicles very different. The existing road structure and its varied use (other than vehicles) also affect traffic movement, which is also different in cities, towns and on highway.

The NATCOM-I estimated $CO_2$, $CH_4$, $N_2O$ for the year 1994 for the 3 and 2 wheelers, passenger cars and commercial vehicles. The $CO_2$ was based on measurements with NDIR analyzer and limited measurement of $CH_4$ were undertaken with available gas chromatography technique. $N_2O$ could be estimated with the available UK Emission Factor data base. The sample size was also very limited.

In order to develop inventory of GHG emissions from road transport sector, it is obvious that the uncertainty in automotive emission factors should be reduced significantly by carrying out actual measurements. For quantification of contribution to GHG emission from different categories of vehicles, data on emission factors suited to Indian conditions of fuel quality, engine / vehicle technology, emission control system, lubricants, type of vehicle population mix with different ages, etc., along with the environment in which vehicles operate (e.g., traffic flow conditions) are not available in realistic manner.

Development of Vehicle Emission Factor applicable to India would involve calculation of emission rates from vehicles representing traffic movements in metropolitan cities, towns and highways; generation of fuel consumption data of in-use vehicle types in actual traffic movement conditions for apportionment of fuel to each type of vehicle; study of fuel, vehicle technology and traffic movement effects on emissions for emission rate data generation of vehicles; development of methodologies / techniques for measurement of mass emission of species and adaptation of analyzers, sample handling, on-board data acquisition systems, etc; and data generation & its statistical analysis for development of emission factors.

Output to be produced:
This would provide average in-use fleet emission factors for species like $CO_2$, $CH_4$, $N_2O$, CO, $NO_x$, NMVOC, $SO_x$ and particulate matter for relevant categories of Vehicles.

Resource requirement: US $ 60000

Activity 1.1.6: Develop methodology and generate data related to oil and natural gas venting, flaring, transmission and distribution sector

Rationale: Reduce uncertainties in GHG inventory estimation from energy sector. During INC, only Tier I methodology was used to generate emission estimates from this sector. Though contribution of the oil & natural gas sector to the national GHG emission is not very significant as yet, it has been considered as a major activity in the inventory development because it is one of the more rapidly growing sectors of the economy. The INC only used the Tier-I approach to estimate the emissions from this source and the SNC envisages a bottoms-up approach, which is more appropriate for a rapidly growing sector.

Objective: Develop methodology and generate data related to oil and natural gas venting, flaring, transmission and distribution.

Approach/Methodology: In association with DGMS, ONGC and few refineries. Methodology will be developed to generate/collect quality controlled data related to oil and natural gas venting, flaring, transmission and distribution which is required for preparation of GHG emission inventory from this sector. The emission inventory will then be generated using the IPCC default emission factors or other available appropriate emission factor.

Output to be produced: A report on the data generated or collected.

Resource requirement: US $ 35000

Activity 1.1.7: Estimate and compile emission inventory from all categories of the energy sector

Rationale: Fulfillment of SNC requirement

Objective: Develop GHG inventory from energy sector for the year 2000

Approach/Methodology: The GHG emission inventory for energy sector for the year 2000 will be developed as per the applicable IPCC methodologies using appropriate activity data and available or generated country specific or IPCC default emission factors following the guidance provided by GPG 2000.

Output to be produced: An inventory report of GHG emissions for energy sector for the year 2000.

Resource requirement: US $ 40000

Activity 1.1.8: Refinement of the GHG emission coefficients from iron and steel making process

Rationale: Reduce uncertainties in GHG inventory estimation from Industrial Processes and Product Use (IPPU) sector

Objective: Refine GHG emissions estimates from iron and steel manufacturing process by monitoring the stack emissions at representative integrated steel plants (the most common mode of production of iron and steel in India) and by developing correction factors for emissions related to electrode consumption and emissions from the combustion of fuels such as coke oven gas.

Approach/Methodology: While attempting to refine the emission coefficients from this key category one need to have an assessment of the uncertainties associated in the estimation process. Most of the steel plants are using both indigenous and imported coals from multiple sources. Assumption of a single EF factor of the fuels that are being used in different plants is likely to introduce errors in the estimation. The result of the previous study shows that the EF estimated from the actual measurement on coal and coke samples are 2.6 and 2.8 respectively in contrast to the default Emission Factor for of 2.5 and 3.1 t $CO_2$/t reducing agent. The plant specific data of the EF of fuels and the emission coefficient cannot be extrapolated to have the representative value for the production of hot metal from all the integrated steel plants. Besides the use of different quality of cokes prepared from blends of indigenous and imported coals some of the plants also use inferior coals as coal dust injections, the quality of which also vary from plant to plant. Moreover, depending on the vintage and blast furnace efficiency the fuel consumption rate per ton of hot metal also varies which consequently changes the emission.

To account for the variability of the said parameters and for better understanding of the emission data from the steel plants, sampling and measurements from major steel plants needs to be targeted. Such measurements also provide a scope for estimating the amount of stored carbon during transformation of coal to coke, the default value of which is 6 per cent.

Emission from this key sector is to grow significantly in the future. Reduction of uncertainties from this sector will improve the quality of national GHG estimate. A comprehensive study at the plant level of major utilities will not only help in reducing the uncertainties but will also provide valuable inputs in identifying the reliable option for inventorying CO2 emissions from coal/lignite based power plants.

*The approach will include following steps-*

*Collection of relevant information from the major steel plants:* This involves the date of commissioning of the individual units, types of fuels being used and their sources, historical data on fuel quality and emission.

*Identification of the steel plants for direct measurement:* The number of plants to be selected for the study has to be identified on the basis of their vintage, fuel variability, capacity, location and ownership. The selection matrix will be suitably designed so that it provides representative data encompassing the variability of the identified parameters. Initial estimate on the number of plants to be studied is in the range of 3-4 spread across the country.

| Selection parameters | Variability |
|---|---|
| ▪ Vintage | 10,20,30 yrs |
| ▪ Fuel | Indian & Imported coals and their blend |
| ▪ Unit Capacity | 1-5 mtpa |
| ▪ Ownership | Private/Public sector |

*Direct Measurement:* This involves Sampling and characterization of input fuel for a period of time, collection and analysis of coke oven gas during same time interval, measurement of the flow rate of gas, collection of relevant plant data, flow rate etc., estimation of emission factor, and uncertainty assessment.

Output to be produced: Refined emission factor for preparation of national inventories from the Steel production units; identification of the most suitable option for estimating the $CO_2$ emission from the steel plants as a routine procedure.

Resource requirement: US $ 45000

Activity 1.1.9: Determine technology specific (dry, wet and semi dry) emission factors through measurements for cement production

Rationale: Reduce uncertainties in GHG inventory estimation from Industrial Processes and Product Use (IPPU) sector

Objective: Refinement of the GHG emission coefficients for cement production process

Approach/Methodology: A cement plant's principle raw material is generally limestone but the plant likely will also burn a proportion of clay, shale etc. and other raw materials to decrease the clinkering temperature, which may contain a component of carbonate minerals. IPCC considered an average CaO (Calcium Oxide) content of 65 per cent (range 60 – 67 per cent) in clinker for calculating the emission factor. CaO content in Indian clinkers normally varies from 62 to 66 per cent. The CaO content from each

plant varies because the raw material sources are different. The emission factor will be dependent upon CaO content of the clinker.

Magnesium carbonate present in limestone also liberates CO2 during calcinations which is not accounted for in default EF. MgO (Magnesium Oxide) content, in Indian clinkers, varies from 0.5 to 6.0 per cent. The other carbonates present are collectively less than 3.0 per cent and individually less than 1.0 per cent. The composition of these carbonates varies widely based on the raw material source. Carbon dioxide emission from all the carbonates is to be accounted to reduce the uncertainty in CO2 emission coefficient. EFDB (Emission Factor Data Base) default emission factor is 0.5010 based on 64.6 per cent CaO in clinker. EFDB default emission factors for MgCO3 (Magnesium Carbonate) and other carbonates are not available.

To reduce GHG emission coefficient it is proposed to generate country specific EF by accounting the GHG emission due to variation in raw material composition from the plant level data. One cement plant from each raw material source will be selected and the analysis of raw materials will be carried out. For measurement of carbon dioxide, flue gas from the stack will be analyzed continuously by gas monitors. After the analysis, $CO_2$ emission due to calcination process and combustion process will be apportioned to generate country specific EF.

Output to be produced: Refined emission factor for preparation of national inventories from the cement production units

Resource requirement: US $ 45000

Activity 1.1.10: Determine country specific emission factors for ammonia production process

Rationale: Reduce uncertainties in GHG inventory estimation from Industrial Processes and Product Use (IPPU) sector

Objective: Refinement of the GHG emission coefficients for ammonia production process

Approach/Methodology: At present, there are 64 large size fertilizer units in the country, manufacturing a wide range of nitrogenous and phosphatic/complex fertilizers. Of these, 39 units produce urea, 18 units produce DAP and complex fertilizers, 7 units produce low analysis straight nitrogenous fertilizers and 9 of the above units produce ammonium sulphate as a by-product. Besides, there are about 79 small and medium scale units producing single super phosphate. The total installed capacity of fertilizer production in the country which was 104.98 lakh tonnes of nitrogen and 29.51 lakh tones of phosphate as on 1.4.98 has risen to 110.71 lakh tonnes of nitrogen and 36.48 lakh tonnes of phosphate as on 29.2.2000.

Most of the fertilizers utilize ammonia as raw material. The requirement of ammonia is as low as 0.1 kg/kg for nitro phosphate and as high as 0.6 kg/kg for urea. The production of ammonia represents a significant non-energy industrial source of $CO_2$ emissions. The processes that affect the $CO_2$ emissions are

- Catalytic shift reaction of CO to $CO_2$
- $CO_2$ absorption in scrubbing solution
- Methanation of residual to methane

The emissions of $CO_2$ from a ammonia production unit thus largely depends upon the conversion efficiencies of the reactions involved, operational practices, and the tail gas clean up systems. Therefore the realistic estimate of emission factors warrants an in-depth study of the process and plant activity data.

Output to be produced: Refined emission factor for preparation of national inventories from the ammonia production

Resource requirement: US $ 30000

Activity 1.1.11: Estimate and compile emission inventory for all categories of the IPPU sector

Rationale: Fulfilment of SNC requirement

Objective: Develop GHG inventory from IPPU sector for the year 2000

Approach/Methodology: The GHG emission inventory for IPPU sector for the year 2000 will be developed as per the applicable IPCC methodologies using appropriate activity data and available or generated country specific or IPCC default emission factors following the guidance provided by GPG 2000.

Output to be produced: An inventory report of GHG emissions for IPPU sector for the year 2000.

Resource requirement: US $ 45000

Activity 1.1.12: Improve $N_2O$ emission inventory from croplands

Rationale: Reduce uncertainties in GHG inventory estimation from Agriculture, Forestry and Other Land Use (AFOLU) sector

Objective: Improve $N_2O$ emission inventory from croplands by making campaign mode measurements to cover all croplands under different agro climatic regions having different fertilizer management practices

Approach/Methodology:

Due to the diverse soil, climate and land-use types in India, there are uncertainties associated with the $N_2O$ emissions from agricultural sector. The uncertainties arise due to non-availability of reliable state-specific emission coefficients. There is a need to measure the $N_2O$ emission coefficients from major soil types in India for updating our national greenhouse gas inventories according to the good practice guidelines given by the IPCC. The proposed study will focus on-

- To measure emission of $N_2O$ from different agro-climatic regions of the country.
- To derive the country specific emission coefficients of $N_2O$ emission from Indian agriculture
- To calibrate and validate InfoCrop and DNDC models for estimation of $N_2O$ emission from agricultural soils of India.
- Up-scaling $N_2O$ emission from different agro-climatic regions of the country using modelling and geographical information systems.

*The approach will include -*

- Measurements from major soil types, dominant cropping systems and major agro-ecological regions in India are needed. This will involve establishment of network stations for taking year-long measurements of nitrous oxide for representative regions.
- One representative site will be selected in each agro-climatic regions of the country.
- Field experiments will be conducted in kharif and rabi seasons in the most predominant soil type and cropping system of the region with commonly followed agri-management practices. The fertilizer and irrigation management will be as per the standard farmers' practice of the region.
- For estimating the emissions of $N_2O$ weekly gas sampling from the field experiments will be carried out throughout the year (cropping as well as fallow periods) using the closed-chamber technique.
- Samples will be stored in steel vaccutainers and sent to the coordinating centre for analysis by Gas Chromatograph using the ECD detector.
- Along with nitrous oxide emission samples, soil, climate and management data also will be collected from each field experiment.

Output to be produced: Country specific EF for $N_2O$ emissions from croplands.

Resource requirement: US $ 55000

Activity 1.1.13: Improve GHG emission estimates from rice cultivation in the emission hotspots identified in INC

Rationale: Reduce uncertainties in GHG inventory estimation from Agriculture, Forestry and Other Land Use (AFOLU) sector

Objective: Improve GHG emission estimates from rice cultivation by ascertaining the role of the factors such as soil types, genotypes, water management, manure management practices etc. in the emission hotspot areas identified in INC

Approach/Methodology: In agriculture sector, rice paddy fields have been identified as one of the important anthropogenic source of methane, apart from other sub-sectors like agricultural soils, livestock and burning of crop residues. The studies so far have revealed that there is a great deal of uncertainty in the rice paddy harvest area under different water management practices, which can be reduced by extensive ground survey and remote sensing (RS) techniques coupled with extensive GHG measurements. However, it has been found that the conditions which are conducive for the reductions or sinks of methane emission from agriculture fields are, to some extent, enhances the emission of nitrous oxide from these fields. The role of soil types, genotypes, manure management practices etc. in influencing the GHG EF from rice fields have also not been properly understood which introduce uncertainties in the EF developed so far.

At one hand, it is, therefore, important to undertake a holistic study of agriculture soils to quantify its sink potentials of atmospheric methane, (which need further understanding of various involved parameters and soils processes responsible for emission of methane and nitrous oxide under different crops) and at the other to reduce uncertainty in the rice cropping area under different water management practices using ground survey and RS techniques; in order to arrive at improved GHG budget estimates. Therefore, it is proposed to mount a measurement campaign for generation of the country specific EF from rice fields in the emission hotspot areas identified in INC which would capture the influence of parameters like soil types, genotypes, water management, manure management being practiced in those areas on the EFs for better representative-ness and reduction in uncertainties in inventory estimation.

A multi-institutional network will carry out this study by making $CH_4$ measurements in identified rice cultivation areas in hot covering both major crops seasons namely Rabi and Kharif using static box techniques and GC analysis.

Output to be produced: Refined GHG emission factors for rice paddy fields

Resource requirement: US $ 35000

Activity 1.1.14: Undertake region-wise surveys of livestock feed intake, milk production etc. and estimate EF of $CH_4$ from this source

Rationale: Reduce uncertainties in GHG inventory estimation from Agriculture, Forestry and Other Land Use (AFOLU) sector

Objective: Improve $CH_4$ emission inventory from enteric fermentation

Approach/Methodology:

Livestock management results in emission of greenhouse gases in the form of methane and nitrous oxide. Livestock sector is the largest source of methane and contribute around 55per cent of total emissions of the country and account for about 10,000Gg/ year (NATCOM 2004). There are two types of emissions. Emission from enteric fermentation and emission from manure management. Enteric fermentation produces only methane while manure management produces methane and nitrous oxide depending upon anaerobic or aerobic condition. Methane production is the highest whereas nitrous oxide is negligible. As regards methane emission, enteric fermentation accounts for major quantum of methane emission and ruminants play a prominent role and bovines (cattle and buffalo) in particular contribute around 90per cent of all emissions from livestock. Small ruminants' (goat and sheep) contribute around 8 per cent. The studies relating to manure management are non-existent in India. The uncertainties in animal performance data, body weights, digestibility of the feed, feed value and GE (Gross Energy) estimations are still exist and need to be addressed to reduce the uncertainties in the inventory estimation. The country specific data related to animal waste management system with special reference to emission of methane and nitrous oxide from manure management also need to be collected.

In order to address the above constraints identified during INC, following activities have been planned to be carried out during SNC:

- National Survey on animal body weights of bovine population.
- Uncertainty reduction in GHG emissions from livestock management by developing appropriate EFs.

In the proposed study it is planned to collect body weight data through sample survey and relate that with feed and dung. The proposed study will include following elements-

- To identify the prominent breeds and their geographical distribution
- To collect the body weight data through sample field survey
- To analyze the trends in Cattle and buffalo population
- To relate the body weight with feed and dung
- To estimate the methane gas production form bovine stock of India

Output to be produced:

National Survey on animal body weights of bovine population and reduction in uncertainties in emission factors from bovine stock

Resource requirement: US $ 25000

Activity 1.1.15: Undertake region specific measurements of $CH_4$ emissions due to enteric fermentation in dairy cattle

Rationale: Reduce uncertainties in GHG inventory estimation from Agriculture, Forestry and Other Land Use (AFOLU) sector

Objective: Improve $CH_4$ emission inventory from enteric fermentation

Approach/Methodology:

Livestock is one of the most important key-source categories and contributes about 61 per cent of GHG emissions from Agriculture sector, which accounts for 78 per cent $CH_4$ and 84 per cent $N_2O$ emissions among all sectors. The proposed study for livestock under Agriculture sector is in continuation of NATCOM-I GHG measurements and inventory compilation exercise and intend to fill gap areas and further reduce uncertainties in a well coordinated, standardized and network mode. The elements of the proposed project include -

- Standardization and inter-comparison of various methane measurement methods
- Study of methane production potentials of Indian feeds/fodders via in-vitro method
- Study of methane and nitrous oxide emission from manure management practices in cool, temperate and warm climatic regions in different seasons.
- Survey of animal husbandry and manure management practices, bodyweight of animals and performance of animals

In the proposed study it is planned to establish all facilities (SF6, Calorimeter, Hood/ Face mask, Indirect technique) at one or two Institutions in India. This will enable to generate transfer functions among techniques. Further simpler technique like Hood/ Face mask will be applied in the field condition to get desired database for the country regarding in-vivo methane conversion of different feeds. These techniques will be used to generate data which will be calibrated/ standardized in a coordinated manner and QA/QC will be maintained by using reference gas standards having national and international traceability in measurements. Animal feeds will be characterized by several simpler chemical/ instrumental approaches already in practice by various network institutions. These methods, which analyze organic carbon, nitrogen, carbohydrate, etc., will be standardized against reference measurement facility at NPL by using CHN/O/S analyzer.

Output to be produced:
Generation of country specific methane emission factors for dairy cattle.

Resource requirement: US $ 45000

Activity 1.1.16: Develop a matrix on land use and land use change of area under crops, forests, wasteland, settlements and others through literature survey, remote sensing and on-site assessments

Rationale: Reduce uncertainties in GHG inventory estimation from Agriculture, Forestry and Other Land Use (AFOLU) sector

Objective: Develop a land use change matrix for the year 2000 with respect to 1990 showing changes in the aerial extent of forest, grassland, cropland, wetlands, settlements and other lands

Approach/Methodology:

India is bestowed with valuable natural resources consisting of forests, mineral deposits, wetlands, rivers, surface water bodies and vast areas of agriculture serving the needs of around a billion population and varied ecological functions. Due to increase in population, industrialization and with large variations in climate and natural disasters, the natural resources management and inventory has become very complex.

Studies so far conducted in our country are limited in scope, as they cater for base line data towards regional planning and evaluation. The national spatial databases enabling the monitoring of temporal dynamics of agricultural ecosystems, forest conversions, and surface water bodies etc. are lacking. The realization that these kinds of databases are very important for national accounting of natural resources and planning at regular intervals, led to the concept of the natural resources census.

This project is being proposed to develop the LULUCF (Land Use, Land Use Change & Forestry) matrix for the period 2000 with respect to 1990 through analysis of satellite data and existing databases. LANDSAT TM1 satellite data for 1990, published by the USGS available from the GLCF2 will be used to generate a spatial database of LULCF. Suitable classification methods will be used to generate LULUCF information with 6 classes for 1990. The analysis will involve the classification of approximately 220 LANDSAT TM data sets. About 25per cent of the total area will be supplemented with IRS LISS-II satellite data of 1990 to account for seasonal variations. The spatial dataset generated by the DOS (Department of Space) National Land use and Land cover mapping project which provides LULUCF information in 13 classes generated from multi-temporal IRS AWiFS satellite data of 2004 will be used. Normalization factors will be applied to the 2004 area estimates to provide data for the reporting year i.e. 2000.
Adopting the available 2004 national LULUCF database and available satellite datasets, ground truth etc. will result in significant optimization of cost and time. The change matrix will be prepared at a district, state and country showing the transitions between 6 classes for the time periods 1990 and the 2004 (normalized to 2000) LULUCF area estimates. The change analysis will be compatible to 1:100,000 scale i.e., the minimum unit for change detection.

The change matrix will be compared with published data (Agricultural statistics, forest change estimates etc.). Field verification for the 2004 LULC data set by DOS is in progress. Therefore only limited field verification is proposed to be taken up in the creating the LULUCF change matrix. Satellite images/ ground truth information already available with NRSA will be used for validation, accuracy assessment etc. Detailed method manuals and quality standards have been prepared for execution of the LULC-AWiFS project. These will be adopted in the creation of the 1990 LULUCF database and change analysis.

Output to be produced:

- Change matrix detailing area transitions for 6 land use land cover classes, for the time period 1990 and 2000, at the district level.
- Maps highlighting areas of significant change
- Detailed report on land use change matrix

Resource requirement: US $ 80000

Activity 1.1.17: Assess biomass stocks, carbon fraction of biomass, biomass growth rates of various types of species (crops/forests)

Rationale: Reduce uncertainties in GHG inventory estimation from Agriculture, Forestry and Other Land Use (AFOLU) sector

Objective: Generate information on biomass stock and carbon fraction biomass as well as soil carbon

Approach/Methodology: Reducing the uncertainties in the assessment of carbon stocks and fluxes across different LULC is a critical issue. Uncertainties, in estimating forest carbon stocks/ fluxes arise from the sampling design and intensity, expansion factors, assumptions on increment, extrapolating inventory parameters from plots etc. In order to reduce uncertainties in the emission inventories from AFOLU sectors, following activities have been planned which would specifically focus on the following aspects:

- Assessment of biomass stock in forest, croplands and grasslands
- Estimation of soil carbon stock in forest soils of different species and forest types of India and its changes due to key management and disturbance factors
- Assessment of soil organic carbon dynamics due to land use changes (i) from forest to non-forest and (ii) from non-forest to forests in key forest types
- Review and compilation of different forest related emission and sequestration factors for each species and forest types in terms of their growth stock, growth rate, litter, and dead wood accumulation.

Output to be produced: Report containing data on biomass stock in forests, croplands and grasslands as well as carbon fraction in biomass and soils

Resource requirement: US $ 30,000

Activity 1.1.18: Estimate and compile emission inventory from all categories of the AFOLU sector

Rationale: Fulfilment of SNC requirement

Objective: Develop GHG inventory for the Agriculture, Forestry and Other Land Use (AFOLU) sector

Approach/Methodology: The GHG emission inventory for the Agriculture, Forestry and Other Land Use (AFOLU) sector for the year 2000 will be developed as per the applicable IPCC methodologies using appropriate activity data and available or generated country specific or IPCC default emission factors following the guidance provided by GPG 2000 and GPG2003.

Output to be produced:
An inventory report of GHG emissions for the Agriculture, Forestry and Other Land Use (AFOLU) sector

Resource requirement: US $ 50000

Activity 1.1.19: Generating data on MSW handling practices for urban areas

Rationale: Reduce uncertainties in GHG inventory estimation from waste sector

Objective: Refine $CH_4$ emission estimates from the MSW handling process by generating data on MSW handling practices for urban areas, by undertaking detailed composition analysis of MSW and develop country specific $CH_4$ emission factors

Approach/Methodology: The rapid urbanization in India is not only resulting in the increasing amount of waste generation but the composition of waste is also changing with change in life-style. Simultaneously, the waste handling system is gradually becoming more systematic although large uncertainties still exist about the disposal of the MSW. Hence, it is proposed to develop a data base about the waste generation rates in urban areas, its composition and handling practices to reduce uncertainties in the $CH_4$ emission estimates from MSW.

For the study at the national level, cities and towns (approximately 10-12) would be selected, representing different categories of demographic status and their composition, characteristics, quantity and MSW handling practice will be determined to arrive at the quantity of MSW reaching landfill sites. The degradable organic carbon content would be estimated for each of the component of MSW.

Output to be produced: Assessment report on MSW generation, constitution and disposal practices.

Resource requirement: US $ 20000

Activity 1.1.20: Determine CS-EF of CH4 emission from landfills

Rationale: Reduce uncertainties in GHG inventory estimation from waste sector

Objective: Undertaking all year round flux measurements in representative managed and unmanaged landfill areas to develop $CH_4$ emission factors

Approach/Methodology: It is proposed to generate country specific CH4 emission factor from representative managed and unmanaged landfill sites in India by undertaking CH4 emissions measurements from the landfills of selected cities and towns using flux box technique.

Output to be produced: Country specific emission factor for CH4 emissions from landfill sites

Resource requirement: US $ 35000

Activity 4.1.1.21: Undertake detailed chemical analysis of waste water in key industries

Rationale: Reduce uncertainties in GHG inventory estimation from waste sector

Objective: Improve GHG emission estimate from wastewater generation by undertaking detailed chemical analysis of wastewater in key industries and by developing country-specific emission factors.

Approach/Methodology: Methane emission is expected to be generated when wastewaters attain anaerobic condition. Anaerobic treatment of wastewater is employed in certain industries to recover energy and to reduce organic component in the wastewater. Waste sector in India has been reported to contribute about 6per cent methane emissions compared to the national methane emission in the year 1994. The country's methane emission estimates for the year 1994 under domestic sewage and industrial wastewater were 0.56 Tg/ year and 1.34 Tg/year respectively. Some of the major factors that influence methane generation from wastewater are Wastewater Characteristics; Handling Systems; Temperature and the surface area of wastewater holding unit. It is proposed to assess the methane emitted from the

wastewater management systems to identify the key methane emitting industries and estimation of emission factors. This will include following steps-

- Identification of Industries: In the present proposal, it is proposed to investigate methane emissions from the wastewater handling in the following industries: pulp& paper, dairy, sugar-integrated distillery, tannery, fertiliser and a sewage treatment plant.
- Assessment of methane emitted from the wastewater management systems (WMS) to identify the key methane emitting industries and estimation of emission factors
- Determination of the amount of degradable organic materials in the chosen wastewaters
- Measurement of $CH_4$ emission from waste water handling in key representative industries
- Estimation of emission factors for the wastewater handled, by determination of methane conversion factors and methane producing capacity, fraction of wastewater and ETP sludges handled through aerobic or anaerobic routes
- Country estimates of total methane emission from specified industries' waste water handling.

Output to be produced: Country specific $CH_4$ emission factor for waste water handling, amount of degradable organic materials in chosen wastewaters, and methane emissions from industrial wastewater.

Resource requirement: US $ 30000

Activity 1.1.22: Estimate and compile emission inventory from all categories under waste sector

Rationale: Fulfilment of SNC requirement

Objective: Develop GHG inventory for the waste sector

Approach/Methodology: The GHG emission inventory for the waste sector for the year 2000 will be developed as per the applicable IPCC methodologies using appropriate activity data available or generated country specific or IPCC default emission factors following the guidance provided by GPG 2000.

Output to be produced: An inventory report of GHG emissions for the waste sector

Resource requirement: US $ 15000

Activity 1.2.1: Develop systematic tools and procedures for National Inventory Management System (NIMS )

Rationale: Mainstreaming of climate change into policy planning

Objective: Establishment of a National Inventory Management System

Approach/Methodology:

Within the framework of the SNC, India will focus on the development of a National Inventory Management System (NIMS) to ensure the sustainability of the inventory process. It will address institutional arrangements, database management and methodological issues, among others. The development of the inventory management system will be based on the experience gained in the preparation of the 1994 and 2000 national GHG inventories and include activities such as developing procedures for documenting methodologies, creating a data base of emissions factors, activity data and

assumptions; data management and collection; strategies for data generation and improvement; systems for data archiving and record keeping; mechanisms for synchronization and cross-feeding between emission inventories, national energy balances and relevant sector surveys; guidance for technical peer reviews, procedures for QA/QC and uncertainty management.

Under the overall supervision of the Ministry of Environment and Forests and supported by the Steering group, the NIMS will assume the responsibility of planning and strategizing the various components of inventory management. This include identification of sources, recalculation and/or inventory estimation from new sources, key sources analysis, ensuring QA/QC procedures, uncertainty analysis, submission of inventories to NIMS, archiving, and evaluation.

Output to be produced: Establishment of NIMS

Resource requirement: US $ 250000

Activity 1.2.2: Design for dissemination of information through web based management system

Rationale: Mainstreaming of climate change into policy planning

Objective: Establishment of a National Inventory Management System

Approach/Methodology: The NIMS will undertake dissemination and awareness raising activities by using various available tools like electronic and print media ,organization of relevant workshops etc. One of the most effective tool will be a web-based interactive media for this purpose.

Output to be produced: Establishment of dissemination and awareness raising mediums

Resource requirement: US $ 70000

Activity 1.3.1: Conduct technical training programmes on IPCC methodologies, IPCC good practice guidance, measurement, standardization and calibration techniques, development of measurement protocols

Rationale: Develop national capacity building

Objective: Develop national capacity for developing the GHG emission inventories

Approach/Methodology: In order to develop capacity at national, institutional and individual levels about IPCC methodologies, Good Practice Guidance, measurement protocols and quality assurance of measurements, at least three thematic workshops will be carried out involving inventory developers, researchers and resource persons. In addition, institutional strengthening for monitoring/measurement facilities will also be addressed.

Output to be produced: Workshop proceedings, technical manuals on measurement protocols

Resource requirement: US $ 126000

Activity 1.3.2: Conduct science-policy workshops and prepare appropriate material for information dissemination related to inventory development

Rationale: Develop national capacity building

Objective: To develop science-policy interface about elements of Convention

Approach/Methodology: In order to disseminate knowledge products of SNC among the relevant policy makers, it is proposed to organize two science-policy workshops involving participants of inventory development as well as V&A assessments and policy makers at national and state level.

Output to be produced: Workshop proceedings, knowledge products of SNC in the form of CDs/printed documents

Resource requirement: US $ 24000

Activity 1.3.3: Undertake awareness-raising activities on GHG inventory focused on promoting the importance of an institutionalized inventory process beyond the national GHG inventories to policymakers

Rationale: Develop national capacity building

Objective: Develop national capacity for developing the GHG emission inventories

Approach/Methodology: The Stakeholder Involvement Committee (SIC) will provide necessary interface between the various stakeholders (including general public, media, educationists, NGOs and others) and NPD for effective dissemination of SNC outputs for awareness raising. Various medium like web, print, workshops etc. will be used for effective dissemination of acquired knowledge.

Output to be produced: various documents like brochures, posters, CDs etc.

Resource requirement: US $ 30000

Activity: 2.1.1: Generate projections of climate change scenarios for India using regional climate change models (HadRM3, PRECIS)

Rationale: During the INC, only one realization of the regional model HadRM2, for one future time slice (2041-60) for one scenario IS92a was achieved. As impact studies need to give a multiple projections, the following activities are proposed.

Objective of the project:

- To update and document the analyses of observed changes in rainfall, surface air temperature and other climatic parameters of relevance to the major socio-economic sectors;
- Analysis of IPCC AR4 (Intergovernmental Panel on Climate Change Fourth Assessment Report) model simulations to evaluate the global coupled atmosphere-ocean general circulation model (AOGCM) skills in representing the regional climatic characteristics
- To quantify future climate change scenarios for India under different SRES emission scenarios as well as "committed climate change" scenarios, during the 21$^{st}$ century including various intermediate time slices;
- Develop high-resolution climate change scenarios using the latest regional climate model PRECIS simulations for A2 and B2 scenarios;
- To examine the nature of possible changes in the frequency and intensity of extreme weather and climate events associated with the expected climate change over India;
- To interact with various impact assessment groups and design specific climate change data products for use in their models, and organize training workshops to help sectoral groups to use and interpret climate change scenario data products;

Approach/Methodology:

- Evaluation of Climate Model Simulation of the Climate over India with AOGCMs and RCMs
- Future projections for India based on IPCC AR4 simulations
- Develop High-resolution regional climate change scenarios
- Assess the Changes in Severe Weather/Climate Events
- Develop Specialized Climate Change Data Products for Impact Assessment

Output to be produced:

Development of future climate change scenarios for India and establishment of a regional climate change data mining and distribution system for impact assessment

Resource requirement: US $ 45000

Activity: 2.1.2: Comprehensive diagnostics of the nature of climate simulation for current climate as well as future projections under different scenarios by 15 AOGCMs

Rationale: During the INC, only one realization of the regional model HadRM2, for one future time slice (2041-60) for one scenario IS92a was achieved. As impact studies need to give a multiple projections, the following activities are proposed.

Objective : Analysis of IPCC AR4 (Intergovernmental Panel on Climate Change Fourth Assessment Report) model simulations to evaluate the global coupled atmosphere-ocean general circulation model (AOGCM) skills in representing the regional climatic characteristics.

Approach/Methodology: During the ongoing process of IPCC assessment report preparation, simulations results of AOGCM have now been compiled which would be analysed to generate information on future climate change in India.

Output to be produced: Report on analysis of AOGCM model simulation for future climate change in India.

Resource requirement: US $ 15000

Activity: 2.1.3: short-listing the models, which display reasonable skill in depicting the monsoon for further detailed analysis.

Rationale: For better understanding of models for providing information for impact assessments

Objective of the project: Generate information about available models which display reasonable skill in depicting the monsoon for further detail analysis.

Approach/Methodology: Various available models will be investigated to shortlist models which have reasonable capacity to depict the monsoon which is characteristic feature of this region. The short listed model will be used to generate information related to impact on monsoon system due to climate change.

Output to be produced: Report on short listed models

Resource requirement: US $ 10000

Activity 2.1.4 Develop future socio economic scenarios for India

Rationale: The socio economic factors such as population growth and economic development and technological changes will alter the impacts of and adaptation to climate change. Because India has the Worlds largest populations, and is experiencing rapid changes and pressures, it is essential to understand the socio economic factors that will drive the development in the future and hence the adaptive capacities to combat the adverse impacts of climate change.

Objective of the project: Develop projections of socio economic scenarios in conjunction with the time line for the climate change projection scenarios and aligned with the requirement of the integrated impact assessments.

Approach/Methodology: Develop a broad socio economic scnerio for India in line with the national plans for development and associated projections for population and economic growth. The socio economic scenarios will be consistent with the national growth plans in the short and medium term. Data on population density (national, state, coastal districts etc.)., level of urbalnization, national and sectoral GDP etc. will form the basis of these scenarios. The socio economic scenarios would integrate the effects of climate variability and change on society and economy; explore the several coherent directions for the future (i.e., different storylines) which will be in line with the IPCC SRES scenarios (SRES, 2000)[10]; and input from stakeholders to ensure usefulness of the scenarios.

Output to be produced: Report on future socio economic scenarios

Resource requirement: US $ 45000

Activity 2.2.1 Improve river runoff estimates using SWAT for all the river basins considered in INC

Rationale: During the INC, a distributed hydrological model (SWAT) was used to assess the impacts of climate change on water resources in India on major river basins using HadRM2 daily weather data. A total of 40 years of simulation over 12 river basins of the country had been conducted. However, prediction of the impact of climate change on the water resources was projected with the assumption that the land use shall not change over time. The study determined the present water availability in space and time without incorporating any man-made changes like dams, diversions, etc.

Objective of the project:

- Improve the climate scenario using the additional SRES scenarios of HadRM3
- Incorporate the major man made interventions on the river basins in the modelling
- Use this additional and updated input to rerun the simulation of the river basins using the SWAT model
- Identify the hotspots with respect to floods and droughts
- Demonstrate flood plain zoning using hydraulic modelling and extreme events from model output on pilot sub-basins of a selected flood prone river

Approach/Methodology:

The project shall carry out the hydrologic modelling of the river basins of the country using the SWAT hydrologic model.

1. Data acquisition and processing:

[10] SRES, 2000. IPCC special Report on Emission Scenarios, Cambridge University Press, Cambridge.

- *Digitized Topography:* Digital Elevation Model for India created from 1:250,000 scale topographic map will be used.
- *Land Use:* data from NRSA shall be used for the current study.
- *Soils:* data from NBSSLUP at the available scale shall be used for the study.
- *Weather Data:* the HadRM3 weather data for the sites provided by the IITM will be used. Generated data shall be used only for creating future scenario for assessing the impact of climate change. All the SRES scenarios identified by IITM for Impact studies will be used.

2. Hydrological modelling of river basins using the SWAT hydrological model
3. Incorporation of baseline interventions
4. Pilot level flood plain zoning
5. Impact assessment and identification of vulnerable areas
6. Report writing

Expected output:

- Improved climate scenarios using the additional SRES scenario of HadRM3
- Identification of hotspots with respect to floods and droughts
- Flood plain zoning of selected flood prone river using hydraulic modelling will generate maps and tables for flood plain zones
- Report on impacts of climate change on water resources

Resource requirement: US $ 30000

Activity 2.2.2 Assess river runoff in the flood prone river systems of the eastern region using HEC-HMS model and compare with drought prone river basins.

Rationale: These river basins lie in the flood-prone eastern areas of the country and would provide opportunities of comparison of output results of different hydrological models. This region was chosen, as the outputs of the HadRM2 indicate increase in the projected precipitation intensity and annual number of rainy days with respect to the current climate.

Objectives:

- To collect for the entire basins data and information relevant to water use and to water pollution.
- To analyze the data for possible interrelationships between various human activities and other aspects with regard to the availability and quality of water in the basins.
- To use distributed model through hydraulic routing instead of lumped system through hydrologic routing for better simulation of the study area using the historical hydro-meteorological (hourly/daily) data, soil map and land use map at the micro-watershed level.
- To predict the water availability under changed climate scenario in the basins based on the hydrological model provided time slice for future projection data supplied from IITM, Pune.
- To analyze extreme hydrological events for future prediction, if any.
- To develop an integrated water quality management and monitoring programmes, combining the designated best use (DBU) requirements with the existing water quality and the present and predicted pollution load.
- To asses the water availability on the land use and crop pattern at the micro watershed level under changed climate in the basins based on the socio-economic survey.
- To compare the output of the hydrological model with that of the other hydrological model for the same study area.

Approach/Methodology: The hydrologic simulation model will be used for the evaluation of the hydrologic impact of climatic variability on water resources of some of the eastern and north-eastern river basins in India. The hydrologic model simulates precipitation and routing processes, both natural and

controlled. The use of model requires input of daily/hourly rainfall, soil condition at the micro-watershed level and hydro-meteorological data. The historical data for the basins will be used for the calibration and validation.

Hydrologic Modelling system will be utilized for the prediction of the water availability of river basins in India under changed climate scenario and hydrological extremities for the prediction using the projected daily precipitation and temperature data as supplied by IITM, Pune. However, an attempt will also be made to generate the output by other model on the same study area.
Information on human and economic activities, land use, water use, disposal of pollutants etc., pertaining to the subject under state jurisdiction and is not available in the required compiled and consolidated form. In each state there are a multitude of departments and agencies each having only a part of the information and that too in an unprocessed form. For same specific data one has to go to the district or even to the municipality level. An attempt will be made to consolidate these relevant data on the basins where the proposed work would be taken up.

Field survey would also have to stretch over several years to get meaningful information on factors that vary from hour to hour, day to day, month to month and year on year.

Expected output:
Water Resources assessed for some Important Eastern and North Eastern River Basins under Changed Climate Scenario

Resource requirement: US $ 20000

Activity 2.2.3: Assess impacts of climate change in a selected snow fed river

Rationale: The extent of snow covered and glacierized area has been strongly affected by climatic changes over the last century. Keeping in view the influence of projected climate change of the melting rate and timings of snow and glaciers melt, it is expected that Himalayan rivers which receive substantial contribution from snow and glaciers are vulnerable to climate change. In spite of high vulnerability, studies related to climate change impact on the hydrological response of the Himalayan rivers are lacking. In the present study, the impact of climate change on the melt runoff, rainfall runoff and total stream flow of the Sutlej River basin up to Bhakra (Indian part) has been proposed. It is to be pointed out that no such study was carried out for the snow and glacier fed river basins under INC, therefore this pilot study for the snow fed river is being proposed under SNC.

Objective of the project: It is proposed to carry out impact assessment study for the Sutlej River, which has a substantial contribution from snow and glaciers. The runoff of snow and glacier fed rivers is expected to be highly vulnerable under global warming conditions.

(i) To study the effect of climate change on the different components of runoff (rainfall runoff and snow and glacier melt runoff)
(ii) To investigate the changes in the total runoff and its distribution due to expected climate change on the seasonal and annual basins.
(iii) To study the impact of changed hydrological response on the planning, development in the basin and reservoir operation policy of the Bhakra reservoir.

Approach/Methodology:

1. Processing of hydro meteorological data of the study basin.
2. Calibration of a hydrological model using observed climatic inputs and streamflow

3. Selection of projected future climate change scenarios for the study area
4. Simulation of hydrological characteristics of the catchment under changed climatic scenarios using the calibrated hydrological model; and
5. Comparison and interpretations of the model simulations for the possible future hydrological characteristics in relation to the current situation.

Expected Output:

- Impact assessment of climate change on the melt runoff, rainfall runoff and total streamflow of the Sutlej river basin upto the Bhakra dam, on the seasonal and annual scales
- Formulation of adaptation strategies depending upon the hydrological response of the study basin under projected climate scenarios for the future.

Resource requirement: US $ 15000

Activity 2.2.4: Assess the impacts of climate change on selected glaciers

Rationale: As global climate warms, recession and wasting of glaciers are perhaps more significant in the Karakoram and Himalaya than elsewhere and expected to continue this century. Dramatic retreat of Himalayan glaciers is linked to extreme variability in precipitation and rise in summer air temperature on these summer nourished glaciers. This causes an especially negative impact on the mass balance. The proportion of rain is increased by the temperature rise and snow accumulation decreases, surface albedo has decreased due to snowfall decrease and ablation increases.

The wastage of the total Himalayan glacier ice reserve could contribute 16 per cent to the total meltwater volume released from all world glaciers (Haeberli, 1998). However, the consequences of loss of regional glacier freshwater supplies to the downstream areas of Himalayan basins will bring about profound changes to the environment, social and economic life, particularly of heavily populated areas as flow regimes became radically altered. Some Himalayan glaciers are now known to be receding rapidly, but knowledge on the regional reaction of Himalayan glaciers to climate change is not well understood. Year-to year changes are notable and measurable with field and satellite based observing system. An overview of glacier studies done in India will be presented under this project. Case studies of two important glaciers namely Dokraini and Gangotri in the Ganga headwater will be presented in details as these glaciers have been scientifically studied since 1994. Mass changes in the Gangotri glacier will also be presented by using DEMs model which will be developed by using the latest multi-spectral and stereographic images provided by Aster, IRS and Landsat 7. Snow and glaciers in the Ganga headwater are perhaps the most vulnerable hotspot in the Indian Himalaya as over 80 per cent of flows in the Bhagirathi and Alaknanda rivers are derived from glaciers melt, hence the agro-based socio-economy of the region is vulnerable to any unfavourable climatic change over the Himalaya.

Objectives:

1. The purpose of the project is to assess the seasonal and long term water resources in snow and glacier fed rivers originating in the Himalayan region, and to determine strategies for coping with impacts of climate change induced de-glaciation on the livelihood of people in the region.
2. The project will seek to develop a regional perspective of ice reserve in the Indian part of the Himalaya, incorporating the effects of de-glaciation on water resources availability across the Himalayan region, particularly in the Ganga-headwater, Garhwal-Himalya.

Approach Methodology:

Satellite remote sensing data will be used to provide information on the mass balance of the glaciers in the Ganga-headwater. In view of the extreme nature of the terrain, it is practically impossible to use conventional mass-balance techniques employed to measure the permanent (glacier ice) cover. Another impediment in accurately assessing the ice reserve is the presence of thick debris - cover on the entire ablation region of glaciers. In this project we intend to examine:

- DEM and geomorphometric analysis to determine the glacier extent
- Spatial analysis to characterize glaciers with geomorphic features
- Pattern recognition approach will be employed to determine supra-glacial characteristics
- The existing information on the impact of climate change on glaciers will be reviewed.

Expected Output: An understanding of the glacier-climate interactions in the Indian Himalayas and a general scenario of the climate change impacts that have taken place.

Resource requirement: US $ 30000

Activity 2.2.5: Assess the impacts of climate change on water demand in the future at the national level

Rationale:

Potential future climate change would affect temperature and precipitation. Changes with respect to historical values of these parameters would have impacts on water availability and use. It is important for water managers to know now if responses to climate change need to be anticipated and implemented well in advance of actual impacts.

Water use is often expressed by sector, e.g., urban (municipal and industrial/commercial), agricultural, and hydroelectric power generation. Climate variability and climate change could affect water use and resource availability. Demand management can play a significant role in reducing water use under potential future changes in climate. If water use and availability are affected, there is every likelihood that water resource management will change in an attempt to satisfy demand. The satisfaction of demands can be accomplished by resource expansion, changes in resource management, and/or demand management.

Approach/Methodology:

This work will evaluate the range of climate change scenarios on water availability and use, and discusses the effectiveness of demand management measures, with specific results drawn from similar studies carried out in other regions. The method of analysis would be to develop a water use projection from 1990 (or 2000) to the year 2050 assuming the perpetuation of historical climate and a range of climate change scenarios. The climate change scenarios would be based on predictions of the regional climate change model used in this project, run for the entire Indian region.

Water conservation measures used in the base case (1990/2000) will be used to draw conclusions with respect to the effectiveness of demand management including policies which incorporate successively restrictive measures. These will be extended in the future scenarios, with projected population and the projected increase in the activities for various sectors.

Output:
Projected water demand under the climate change scenario in India for policy planning

Resource requirement: US $ 15000

Activity 2.2.6: Undertake an assessment of impacts of climate change on the major crops of rice and wheat

Rationale:

During the INC, the impacts of climate change on agricultural productivity of main crops such as wheat and rice was evaluated. Integration of the climate outputs of the regional models with the crop assessment models (WT Wheat Grows, CERES, and INFOCROP) could not be done during INC. The sensitivity of different components of the agricultural sector to climatic variability could not be carried out due to constraint of time and resources.

The effects of climate change is expected to be small on kharif crops but overall kharif agriculture may become more risky due to increased climatic variability. Production of rabi crops is more seriously threatened due to projections of large increase in temperatures and higher uncertainties in rainfall. Central and southern Indian regions, which are already warm at present, may be more seriously affected than north India.

Objective:

To assess the impacts of climate change on the major crop production in India and hence evaluate food security.

Approach/Methodology:

In the SNC, it is proposed to undertake an assessment of impacts of climate change on the major crops rice .The assessments will be carried out using crop-simulation models (APSIM – a cropping system modelling framework having a suit of crop modules, DSSAT, INFO-CROP, WTGROWS etc.) and using field experimentation. Though most of the models were used in the INC assessments, in SNC the focus will be on integrating the HadRM3 inputs with these models. For the major crops, in addition to the changing climate scenarios, socio-economic projections will also be integrated to assess the impacts.

Output:

Quantified cereal production projections for 2050s and the location of areas which will generate revenue through cultivation of these crops in the climate change regime.

Resource requirement: US $ 36000

Activity 2.2.7: Undertake an assessment of impacts of climate change on rainfed crops (sorghum and groundnut) by integrating the HadRM3 inputs.

Rationale:

Experiences in many countries have shown the importance of emerging capacity to assess the vulnerability and adaptation of the production systems to climate change. The rainfall and temperature distributions can be substantially altered by the global climate change. Agricultural productivity and farmer livelihood in the semi-arid India are underpinned by more appropriate natural resource

management under changing climatic conditions. Initiation of an vulnerability and adaptation assessment framework for climate change can eventually be used to deliver a well-recognized methodology for effective delivery o policy options in agricultural production systems of the Semi Arid Tropics (SAT) of India. The components of this activity have been designed to first understand the extent of impacts of climate change on the rainfed agriculture systems and hence its vulnerability, which is a step towards developing an integrated framework for managing such agriculture systems under climate change conditions.

Objective:

The general objective of the study is to conduct an assessment of the impact and vulnerability of cropping systems to climate change. Specifically, the study aims to:

- Development Climate change scenario to evaluate agricultural production system responses to future climate in the study region
- Identify, develop, and validate appropriate crop production systems (of shorghum and ground nut) and tools to address the impact of climate change
- Conduct an assessment of the impact and vulnerability of selected groundnut/shorghum based systems to climate change using well developed system analysis and modelling tools

Methodology:

1. Identification of potential crops and cropping systems:
2. Development of climate change scenarios:
3. Cropping system scenario (Soil, crop and management inputs):
4. Cropping system model calibration and Agricultural crop impact analysis:
5. Identification of sensitive regions with high vulnerability

Outputs: An improved understanding of the Climate Change Impacts on Rainfed Crop Production Systems

Resource requirement: US $ 30000

Activity 2.2.8: Undertake an assessment of impacts of climate change on livestock and fisheries

Rationale: Climate change can be expected to have a significant impact on fisheries in India, affecting both the productivity of fish populations and how they are distributed throughout lakes, streams, and oceans. Changes to water temperature, currents, water quality, food supply, and predators could all have effects on fish populations. In India such a study is yet not available. An attempt will be made to assess how these changes will affect the dominant fish types in the oceans, streams and rivers.

Livestock, ranks among the most important economic activities in the dry regions of the country such as Gujarat and Rajasthan. Dairy, is one of the most important, agricultural commodity group in these regions. Also India is now a net exporter of dairy products, therefore, it is envisaged that in SNC, the likely impacts of climate change on dairy cattle will be studies.

Objective:

1. To understand the parameters governing fish breeding and the likely effects due to climate change
2. To understand the parameters governing livestock survival and breeding and the likely effects due to climate change

Approach and methodology:

Fisheries:

1. The breeding habitats of the major fish types will be identified
2. The climatic and water quality parameters that affect fish breeding will be identified in each of these regions
3. The observed changes over a period of time in these regions in atmospheric and sea surface temperatures will be studied
4. The climate change scenarios on changes in temperature, freshwater availability, sea surface temperature etc. will be applied to understand the likely effects of such changes on fish breeding

Livestock:

1. Assess the growth rates of dairy cattle in the last 20 years
2. Assess the growth rates of dairy products within the same period
3. Assess the feed stock needs of the dairy cattle
4. The distribution of feed stock growing in the current climate
5. Make projections of the dairy population
6. Look at the projections of feed stock availability in the climate change scenario
7. Do an Integrated study to understand the impacts of climate change on dairy population and dairy products

Outputs: Reports on impact assessment of climate change on livestock and fisheries

Resource requirement: US $ 40000

Activity 2.2.9: Undertake the assessment of the impacts of projected climate change on forest ecosystems, forest boundaries and extent, biodiversity and net primary productivity at the national level, dominant natural forest types, economically important species and, protected areas

Rationale: Preliminary assessments using BIOME-3 vegetation response model, based on regional climate model projections (HadRM2) for India show shifts in forest boundary, changes in species-assemblage or forest types, changes in net primary productivity, possible forest die-back in the transient phase, and potential loss or change in biodiversity. Some of the limitations of the V&A assessment under Natcom-1 are as follows:

- Analysis based on single GCM-RCM climate outputs
- Impact assessment based on single vegetation response model (BIOME3)
- Only equilibrium model (BIOME3) used and transient vegetation responses to climate change not assessed
- Implications for biodiversity not assessed and species-level assessment not carried out
- Socio-economic impacts of climate change on forest ecosystems not evaluated
- Socio-economic scenarios not considered and implications for forests not assessed
- Non-availability of soil and water data for different forest types

Objectives:

1. Assess the impact of climate change on forest ecosystems at national and regional level;
   - Shifts in boundary of forest ecosystems or plantation types
   - Ecosystem change matrix; forest types, plantations, grasslands etc.
   - Changes in species mix and species vulnerability
   - Identification/ranking of vulnerable ecosystems, regions, and hot spots
2. Assess implications of climate change impacts on biodiversity
3. Assess the impacts of climate change on Net Primary Productivity and biomass production

Approach/ Methodology

- Identify ecosystems, scale and regions / locations for V&A studies
- Select climate and socio-economic scenarios
- Select and develop climate impact vegetation response models
- Use latest versions of equilibrium models such as BIOME4 and a dynamic models such as HYBRID would also be used for predicting transient responses.
- Further, for regional impact assessment and for incorporating socio-economic factors neural network model would be developed to suit Indian conditions.
- A India-relevant Plant Functional Types (PFTs) will be developed:
- Database for modelling, will be generated - Climate parameters, Geo-referenced forest type map, Plant physiological parameters for developing PFTs:, Soil organic carbon, Tree crown and density, Soil water availability, Biodiversity status in different forest types
- Assessment of vulnerability and impacts

Expected Outcomes:

- Shifts in forest boundary; altitudinal and latitudinal
- Extent of area under each forest/plantation type
- Spatial distribution of forests and plantations
- Biodiversity; dominance of species, distribution of C3 and C4 and species assemblage
- Development of vulnerability index to rank different regions/forest types and identified hotspots
- Net primary productivity (NPP)

Outputs: Assessment report

Resource requirement: US $ 52000

Activity 2.2.10: Study the impacts of climate change on selected vulnerable Mangroves, Wetlands, Coral reefs and grasslands

Rationale:
The natural ecosystems of India have been subject to exploitation and alterations by humans for several hundred years, and thus only a small fraction remains in a pristine state. Some of these ecosystems such as the grasslands, coral reefs and mangroves support the livelihoods of forest-dependent communities and the national economy. Preliminary studies during Natcom-1 as well as the global level assessments have shown the likely adverse impacts of climate change on these ecosystems. Thus, it is necessary to conduct studies that would help predicting changes due to climate impacts, and develop and implement adaptation strategies. It is proposed in this phase to overcome the limitations stated above and make reliable assessment of impacts and develop adaptation strategies to reduce vulnerability of natural ecosystems.

*Natural Ecosystems:* It is proposed to select Mangroves, Wetlands, Coral reefs and grasslands for research under Natcom-II. Among the several locations for each type of natural ecosystems, a few locations would be selected based on the projected extent of climate change in those grids.

*Assessment scale:* The assessment of natural ecosystems will focus on the implications of climate change on identified natural ecosystems at the level of each natural ecosystem, for example; Wetland or Mangrove. Among the wetlands and mangroves, a few would be selected for the study.

*Impacts to be assessed:* Impact to be assessed include survival, extent, geographic spread, biodiversity, regeneration and productivity.

Objective
The objectives of the proposed study are as follows:

1. Assess the status and socio-economic pressures on the selected natural ecosystems in India
2. Assess the current and future climate and its impact on natural ecosystems
3. Identify vulnerable natural ecosystems and hotspots

Approach / methodology

The approach and methodology to be followed and activities to be carried out during Natcom-2 are presented in the following sections. The approach would broadly involve;

1. Selection of Natural Ecosystems
2. Assessment of status of natural ecosystems; assessment of level of disturbance of natural ecosystems and causes
    - Extent of fragmentation
    - Chemical and physical conditions of natural ecosystems
    - Condition of plant and animal communities
    - Number of species at risk
    - Trends of plant growth in natural ecosystems
3. Modelling to assess the impacts of climate change on selected natural ecosystems (In the proposed study attempts will be made to develop preliminary models to assess the impacts if climate change on different natural ecosystems.)
4. Assessment of the current and future climate and its impact on natural ecosystems
    - Assess the current climate in the grids with the natural ecosystems
    - Project the climate change for these identified grids with natural ecosystems
    - Evaluate the likely impacts of temperature rise, rise in water level, increased precipitation etc.
5. Identification of vulnerable natural ecosystems and hot spots
6. Socio-economic and livelihood implications
7. Identification of adaptation measures

Resource requirement: US $ 40000

<u>Activity 2.2.11: Assess the impacts of the present climate and climate change on the 3 most current vulnerable coastal districts in India</u>

The coastal zone is an important and critical region for India, which has a low lying densely populated coastline of over 7500 km with Arabian Sea on the West and Bay of Bengal on the East. It is inhabited by more than 10 million people in nine coastal states [West Bengal, Orissa, Andhra Pradesh and Tamil Nadu on the East coast, and Kerala, Karnataka, Goa, Maharashtra and Gujarat on the West coast], two union territories [Pondicherry and Daman & Diu] and two groups of islands (Andaman & Nicobar and Lakshdweep). According to the census of 2001, there were about 65 coastal districts in these 9 states. The total area occupied by coastal districts is around 3,79,610 km, with an average population density of 455 persons per km; which is 1.5 times the national average of 324 (Census, 2001).

During the INC, a preliminary assessment of the sea level rise, derived from tide gauge observations, made over the last hundred years across the Indian Ocean was presented. Also, a study was undertaken to identify the coastal districts most vulnerable to cyclones that have occurred in the last 100 years. The

vulnerability was measured in terms of loss of life, damage to assets, and livelihood systems and loss of employment.

The SNC envisages to take this work further by including assessments of loss of dry land without protection, loss of wetlands without protection, an assessment of damage to existing infrastructure (ports, bridges), human settlements, damage to commercial fisheries production, saline intrusion that adversely affect freshwater resources and agriculture in the 3 most vulnerable districts, namely, Kendrapara in Orissa, Nellore in Andhra Pradesh and Nagapattinam in Tamil Nadu out of the 5 most vulnerable districts identified in INC. The approach would include the development of vulnerability profiles, sensitivity analysis, indicator mapping, Monte Carlo analysis, strategic environmental impact assessments and expert judgments.

Objective:
The objective of this study is to carry out vulnerability assessment that will focus on the hazards and the exposure. In this project, we will also perform an assessment of adaptive capacity

Approach/methodology

- Analyse the impacts and vulnerability of households and the poor to current and future hazards
- Estimating the risk due to impacts of natural disasters and catastrophes on poverty, crop production, water availability, livelihoods etc.
- Focus on coastal ecosystem
- Mapping and resource identification of the coastal zones (including inland and marine ecosystem)
- Inventory of livelihood in the coastal ecosystem including agriculture, fisheries, aquaculture, mangroves, and salt pan lands as climate change will have primary impact on livelihood which will in turn determine the vulnerability of the coastal populations.
- Assessment of trends in poverty in the selected areas

Expected outputs:

Identification of the extent of impacts on the coastal zones due to current climate and climate change

Resource requirement: US $ 85000

<u>Activity 2.2.12: Identify current and potential impacts of climate change on diverse industrial services and infrastructure sectors with reference to energy</u>

Rationale: In the present era of economic growth in India, huge investments are being committed in the infrastructure projects. However, the expected climate change and increased frequency and intensity of extreme events in the future can affect the infrastructure adversely if care is not taken in the design of the structure itself. Similarly, Climate warming would result in increased demand for cooling and decreased demand for heating energy, with the overall net effect varying with geographic region.

During INC, a case study of climate change impacts for the Konkan Railway had been carried out by developing an impact matrix and potential climate change parameters having bearing on this kind of infrastructure project. However, INC effort was limited to only one case study using one climate change scenario. Similarly, energy demand at national level was estimated.

Objective:
It is proposed to

- Assess the current knowledge about the cost of such impacts
- Identify current and potential impacts of climate change on diverse industrial services and infrastructure sectors with reference to energy,

Approach
- Develop a framework for impact analysis
- Integrate the framework with the storylines of socio-economic scenarios and identification of key drivers.
- Identify forcing variables and their threshold limits for different sectors based on case studies.
- Develop a database for regional assessment of impacts.
- Providing assessment of current literature and state of the art tools as inputs to SNC for identification of future actions and adaptation policies for impacts related to energy and infrastructure

Expected output
- A report describing the likely vulnerabilities and impacts related to energy and infrastructure
- Comprehensive reference list along with assessment of knowledgebase and data related to impacts.

Resource requirement: US $ 50000

Activity 2.2.13: Assess the impacts of climate change on malaria and dengue in hotspots as well as at national scale and assess the impacts of heat stress on human health

Rationale:

In INC, the focus of the studies was limited only to the vector borne disease such as malaria. The study identified windows of transmission in terms of temperature, relative humidity and for the current climate and made projections of the impacts of future climate change on these windows in the various regions of the country. As a result the hotspots of malaria in the current climate and future climate have been identified.

It is proposed to assess the impacts of climate change on malaria in these hotspots by incorporating the socio-economic and land use change considerations along with climate parameters based on the outputs of the HadRM3 in the assessment at this micro level. Further, it is proposed to expand the scope of coverage to other diseases like dengue and assess impacts of heat stress.

Objective:
- To study the impacts of climate change on malarial hotspots identified in INC
- To study the impacts of climate change on dengue in India
- To study the impacts due to heat stress

Approach/Methodology:

For all the above health impact studies the MIASMA model (a Windows-based modelling application) will be used. The model is driven by both population and climate/atmospheric scenarios, applied across baseline data on disease incidence, prevalence and climate conditions. MIASMA will be linked with the HadRM3 outputs of climate change scenarios. Climate input in this model is disease specific. For thermal stress, maximum and minimum temperatures are required. For vector-borne diseases maximum, minimum temperature and rainfall data is required. Additionally, other baseline data such as the data on partial

immunity in the human population and the extent of drug resistant malaria in the region also go as inputs in this model.

Expected Output:

- An understanding of the conditions driving malaria at local level
- Transmission windows of malaria and dengue defined in terms of climate and socio-economic parameters for such small units
- GIS based out puts indicating the extent of disease spread (malaria/dengue/heat stress) under climate change conditions versus current climate

Resource Requirement: US $ 75000

Activity 2.3.1: Undertake integrated vulnerability assessment studies in identified climatically hotspot regions, establishing the linkages between climate, water resources, agriculture productivity, food security and livelihood for developing an adaptation framework

Rationale:
Integrated assessment of climate change impact on different sectors of regional economy is very important to determine future strategies for sustainable development, adaptation and other policy decisions. Conventional assessment of impacts on agriculture and, therefore, policy response to manage climate change impacts was incomplete in INC since the approach to study the various critical sectors was not available. Global integrated impact assessment models provide such a framework, but are inadequate for regional (country and lower) policy planning because these are not calibrated and validated at that scale and due to their inherent inter- and intra-sectoral conflicts.

The task becomes extremely complicated and vast if attempted at a national scale. Therefore, climatically hotspot areas will be identified for carrying out the study.

Objective

- To assess the vulnerability of agriculture productivity due to water stress and the resulting imbalace in food security and hence threat to livelihood under current climate
- To assess productivity at the chosen micro-scale due to climate change
- To identify the adaptation concerns and present adaptation option
- To develop a framework for adaptation at this micro scale for climate change

Approach/Methodology

- Extensive literature reviews will be commissioned to document the evidence of trends in climatic variables and their associations with agricultural performance in different regions and sectors
- Identify indigenous coping capacity of farmers in times of distress due to failure in crop production
- Using simulation models to quantify the impacts on food crops: InfoCrop, an indigenous model will be calibrated and validated for major agro-ecological regions. The validated models will be used to understand the impact of climate change on crop production in different socio-economic scenarios. GIS will be used for spatial data management. Simple models for livestock and fish will also be developed to quantify the probable impact of climate change. A simple spatial DSS will be developed to allow other scientists to quantify the impacts in their regions.

- Simulation analysis of adaptation options at the field level: Simulation models will be employed to analyze the potential effects of the autonomous as well as planned adaptation strategies on alleviating stress by climate change. Adaptive capacity of different regions will be calculated.
- Conceptual design of the Decision Support System: A theoretical study will be commissioned to develop a framework for adaptation. This will list all important variables, their relationships and feedbacks in the form of flow charts.
- Vulnerability assessment: The spatial and temporal differences in the socio-economic and climate change scenarios will be used as inputs in the DSS software for quantifying the overall vulnerability of the agricultural sector. The potential role of various adaptation strategies at the regional scale will also be quantified.
- Assess the current policies, institutional framework, the technologies and risk sharing mechanisms that help cope with current climate.

Expected Output:
An integrated vulnerability framework for assessing climate change impacts on water resources, agriculture productivity, livelihoods.
An integrated framework for assessing related adaptation concerns under climate change scenario.

Resource requirement: US $ 162000

Activity 2.3.2: Undertake integrated vulnerability assessment studies in identified climatically hotspot regions, establishing the linkages between extreme events, water resources, status of human health, and associated livelihoods for developing an adaptation framework

Rationale:

In INC, an integrated approach was missing for assessing the impacts of climate change on human health were missing. In SNC, it is proposed that an integrated approach will be applied to assess the adaptation needs and concerns for Cholera in India, specially focusing on the impacts of extreme events. It is well known that cholera is most prevalent after flooding takes place every year in the low lying areas of the various river basins or after flooding to incessant rains.

Objective:
- It is propose to study the two most recent events of flooding and their effect on cholera generation in India, in Mumbai and Bihar and make projections of future impacts on health in the climate change regime

- It is proposed to study the impacts of climate change on nutrition levels in identified drought prone regions

Approach/Methodology:

Cholera
- Assess the damages in terms of people affected by cholera (DALYs)
- The present infrastructure needs for meeting the excessive drainage requirements
- Assess the present accessibility of health facilities of public living in peri-urban areas
- The climate projections for these areas in 2050s
- Use modelling (MIASMA?) to assess the likely impacts of climate change on cholera incidence in these areas

- The capacity needs to cope with climate change impacts
- Develop a framework for vulnerability assessment and adaptation for these two cities

Malnutrition
- Assess the nutrition levels under current climate scenarios
- The present individual and institutional capacities for supporting malnutrition during drought periods
- Assess the requirements for coping with climate change – institutional, policy, technological and risk sharing mechanism
- Develop a frame work giving alternate adaptation options

Expected Output:
A vulnerability and adaptation frame work for cholera and malnutrition

Resource requirement: US $ 135,000

Activity 2.3.3: Undertake integrated impact assessment studies in identified climatically hotspot regions, for establishing the linkages between climate change, forests, other natural ecosystem products and associated livelihoods for developing an adaptation framework

Rationale: Preliminary assessments for India show shifts in forest boundary, changes in species-assemblage or forest types, changes in net primary productivity, possible forest die-back in the transient phase, and potential loss or change in biodiversity. Enhanced levels of $CO_2$ are projected to result in an increase in the net primary productivity (NPP) of forest ecosystems over more than 75 per cent of the forest area. Even in a relatively short span of about 50 years, most of the forest ecosystems in India seem to be highly vulnerable to the projected changes in climate. About 70 per cent of the vegetation in India is likely to find itself less than optimally adapted to its existing location, making it more vulnerable to the adverse climatic conditions as well as to the increased biotic stresses.

Biodiversity is also likely to be adversely impacted. These impacts on forests will have adverse socio-economic implications for forest dependent communities and the national economy. The impacts of climate change on forest ecosystems are likely to be long-term and irreversible. Thus, the study highlighted the need for developing and implementing adaptation strategies to minimize possible adverse impacts. Further, the study also emphasized the need to identify forest policies, programmes and silvi-cultural practices that contribute to vulnerability of forest ecosystems to climate change.

In NATCOM_1 inter-sectoral linkages of forest productivity was not explored. Policy and institutional issues, relevant to vulnerability were not addressed. Also adaptation capacity, needs, techniques, strategies not addressed and adaptation projects not developed.

In India, nearly 200,000 villages are in and around forests and over 200 million people depend on forests for their biomass requirements, biodiversity and livelihoods. The likely impacts of climate change on forest ecosystems will directly impact the forest dependent-communities and economy. Several industries also depend on forests and tree plantations for round wood and non-timber products. Thus, an assessment of likely socio-economic impacts of climate change on local communities and forest dependent industry is necessary to develop the adaptation framework under a climate change scenario.

Forest and plantation ecosystems are highly critical for biodiversity, livelihoods of local communities and industrial production. The Third Assessment Report of IPCC (2001) and Ravindranath and Sathaye (2002) have highlighted the need for developing and implementing adaptation technologies and policies.

Adaptation depends on the extent of impacts, adaptive capacity of forest ecosystems, communities and industries depending on forest resources. Thus, adaptation needs and technologies and policies need to be assessed.

Objective:

- To assess the vulnerability of forest productivity due to climate change and the resulting imbalace in livelihood security at the chosen micro-scale due to climate change
- To identify the adaptation concerns and present adaptation options

Approach and methodology

- Assess the impact of climate change on forest ecosystems at regional level;
  - Shifts in boundary of forest ecosystems or plantation types
  - Ecosystem change matrix; forest types, plantations, grasslands etc.
  - Changes in species mix and species vulnerability
  - Identification/ranking of vulnerable ecosystems, regions, and hot spots
- Assess implications of climate change impacts on biodiversity at the selected project site
- Assess the impacts of climate change on Net Primary Productivity and biomass production of that site
- Evaluate socio-economic implications of impacts of climate change on forest ecosystems of that site
- Assess adaptive capacity and develop adaptation strategies
- Evaluate current forest management practices and policies for adaptation
- Develop conservation, sustainable management, Protected Area, afforestation practices and policies to reduce vulnerability
- Identify institutional and capacity needs to plan and implement adaptation strategies
- Develop potential adaptation projects

Expected output:

- Vulnerable forest ecosystems/plantations and locations identified and ranked
- Changes in forest area and geographic distribution under climate impacted scenario estimated for selected project site
- Implications for biodiversity for different forest types assessed
- Changes in NPP and biomass (timber and fuelwood) production estimated
- Impacts on livelihoods and timber imports and exports assessed
- Adaptive capacity of forest management institutions evaluated
- Adaptation techniques and policies developed
- Institutional and capacity development needs for adaptation identified
- Adaptation projects developed

Resource requirement: US $ 140000

<u>Activity 2.3.4: Undertake integrated impact assessment studies in identified climatically hotspot regions to establish the linkages between climate change, and energy & infrastructure for developing an adaptation framework</u>

Rationale:

Energy infrastructure is designed to tolerate a reasonable level of variability within a climate regime that existed when infrastructure was designed and built. Some recent initiatives of large-scale infrastructure development in India include the development of refineries and dams for hydropower etc. It becomes necessary to point out here that such huge investments in infrastructure, having long life span, are

presently being planned without any conscious analysis of climate change related impacts on them. All over the world, extreme weather events are a major cause of damage to such infrastructure. An inevitable result of the increased damages to such energy related infrastructure from climate change will be a dramatic increase in resources needed to restore supplies. A developing economy like India has to take these issues into consideration while formulating appropriate policies.

Objective:

The study shall assess the broad impacts of climate change on the select energy-infrastructure sectors through case studies at identified at climatically hotspot regions.

The primary objectives of the study include:

- Developing a framework for impact analysis
- Integrating the framework with the storylines of socio-economic scenarios and identification of key drivers.
- Identification of forcing variables and their threshold limits for different sectors based on case studies.
- Developing a database for regional assessment of impacts.
- Applying the analysis framework for impact assessment and identification of case specific adaptation measures
- Providing assessment of current literature and state of the art as inputs to the NATCOM-II for identification of future actions and adaptation policies for impacts related to energy and infrastructure
- To help in capacity building amongst experts and researchers by dissemination the information related to research on climate change impacts, vulnerability and adaptation with focus on energy and infrastructure.

Expected output:

- Framework development for Impact assessment
- Comprehensive reference list along with assessment of knowledgebase and data related to impacts.
- A report describing the likely vulnerabilities and impacts related to energy and infrastructure in India.
- Assessment of risk mitigation and risk coverage through insurance

Resource requirement: US $ 100000

Activity 2.4.1: Conduct focused thematic training workshops for enhancing the assessment capacities of researchers

Rationale: Develop national capacity building

Objective: Develop national capacity for V&A

Approach/Methodology: In order to develop capacity at national, institutional and individual levels about climate change impact assessments, at least three thematic workshops will be carried out involving researchers and resource persons. In addition, institutional strengthening for monitoring/measurement facilities will also be addressed.

Output to be produced: Workshop proceedings/reports

Resource requirement: US $ 210000

Activity 2.4.2: Conduct inter-sectoral workshops to facilitate integration of the assessments

Rationale: Develop national capacity building

Objective: Develop national capacity for V&A

Approach/Methodology: In order to develop capacity at national, institutional and individual levels about climate change impact assessments, four focused workshops on inter-sectoral issues to be targeted in the SNC will be organized for concerned participants, resource persons and other stakeholders. In addition, institutional strengthening for monitoring/measurement facilities will also be addressed.

Output to be produced: Workshop proceedings/reports

Resource requirement: US $ 127000

Activity 2.4.3: Conduct workshops to sensitize the policy makers, media, and NGOs about the outputs of the assessments

Objective: To develop science-policy interface about V&A

Rationale: Develop national capacity building

Approach/Methodology: In order to disseminate knowledge products of SNC among the relevant policymakers, it is proposed to organize two science-policy workshops involving participants of V&A activity of SNC and policymakers at national and state level.

Output to be produced: Workshop proceedings/reports

Resource requirement: US $ 40000

Activity 2.4.4: Develop dissemination products and web pages for dissemination of information related to V&A

Objective: To develop science-policy interface about V&A

Rationale: Develop national capacity building

Approach/Methodology: In order to disseminate knowledge products of SNC among all the stakeholders, appropriate dissemination products about V&A assessments using different media will be prepared.

Output to be produced: Dissemination material in the form of CDs/posters/brochures/leaf-lets/web-site etc.

Resource requirement: US $ 45000

Activity 3.1: Collate information on national circumstances and update the same with respect to the information provided in INC

Background

National circumstance is a mandatory requirement of all national communications. It is the circumstances under which each country addresses its climate change concerns and its commitment to the UNFCCC. India submitted its INC in 2004, and that was for the base year 1994, since then the economy is developing fast and the sectoral mixes of the economy are also changing. Therefore it is important to update the information under this chapter in SNC with respect to INC. This section will include national and regional development priorities, objectives and circumstances, based on which India will address climate change and its adverse impacts as contained in Article 4, paragraph 8, and, as appropriate, in Article 4, paragraphs 9 and 10, of the Convention.

Objective
To develop a chapter in the SNC on National circumstances

Approach/Methodology
Will be done through a consultant
The information thus generated by the NSC, that is the ministries, TAC and other eminent experts will be collated and synthesised.

Expected output
A description of current national circumstances

Resource requirement : US $ 50000

Activity 3.2.1: Collate information on major policies/programmes and projects that address climate change concerns

Background
Will collate information on major policies/programmes and projects that address climate change concerns directly or indirectly keeping the sustainable development concerns in view.

Objective
To collate information on major policies/programmes that address climate change issues

Approach/Methodology
The various Ministry publications will be consulted for doing this activity. All so multilateral and bilateral programmes will be examined to assess their impacts in this area of work.

Expected output
A chapter in SNC containing information on major policies/programmes and projects that address climate change concerns.

Resource requirement: US $ 25000

Activity 3.2.2: Review the technical papers on Methodological and Technological Issues in Technology Transfers and identify barriers to technology transfer

Objective
Will collate information on barriers to technology transfer

Approach/Methodology

Review of the UNFCCC technical paper on the enabling environments for technology transfer and the IPCC special report on "Methodological and Technological Issues in Technology Transfers" will be carried out and the activities will be identified relating to the transfer of access to environmentally sound technologies and the barriers to such transfers in the light of the decision 4/CP.7, its annex, and the implementation of Article 4, paragraph 5, of the Convention.

Expected output

Report on information about barriers to technology transfer.

Resource requirement: US $ 25000

Activity 3.2.3: Collate information on India's research initiatives, research networks, observing systems; India's contribution to activities and programmes, in national, regional and global research networks and observing systems; and on initiatives for designing new technologies for mitigating climate change

Background

India's INC documented the information on India's research initiatives, research networks, observing systems; India's contribution to activities and programmes, in national, regional and global research networks and observing systems; and on initiatives for designing new technologies for mitigating climate change.

Objective

Update of information provided in INC document

Approach/Methodology

All the available information will be collated and synthesized for the preparation of report on India's research initiatives, research networks, observing systems; India's contribution to activities and programmes, in national, regional and global research networks and observing systems; and on initiatives for designing new technologies for mitigating climate change.

Expected output: Report

Resource requirement: US $ 30000

Activity 3.2.4: Collate information on initiatives to enhance education, training and awareness on Climate Change issues in India

Background
India's INC documented the information on initiatives to enhance education, training and awareness on climate change issues in India.

Objective
Update of information provided in INC document.

Approach/Methodology
All the available information will be collated and synthesized for the preparation of report on initiatives to enhance education, training and awareness on climate change issues in India.

Expected output: Report

Resource requirement: US $ 20000

Activity 3.2.5: Constraints and gaps, and related financial, technical and capacity needs

Background

India's INC documented the information on constraints and gaps, and related financial, technical and capacity needs.

Objective

Update of information provided in INC document.

Approach/Methodology
All the available information will be collated and synthesized for the preparation of report on constraints and gaps, and related financial, technical and capacity needs in India.

Expected output: Report

Resource requirement: US $ 20000

Activity 3.2.6: Compile a report on national circumstances and steps taken

Objective
Update of information provided in INC document

Approach/Methodology
All the information/reports based on collection and collation of information about national circumstances and steps taken to implement the Convention in India will be used to prepare a consolidated report on national circumstances and steps taken.

Expected output: Report

Resource requirement: US $ 30000

Activity 4.4: Preparation of SNC report

Objective
Prepare India's SNC report

Approach/Methodology
All the information generated will be collected/collated/synthesized for various sub-activities of SNC proposal to prepare India's SNC report.

This activity will also include project monitoring and evaluation.

Further the PMC staff (project manager, 2 national expert consultants, a project associate and one finance assistant) will be supported from this budget head

Expected output: India's SNC Report

Resource requirement: US $ 333000

## Annex C

## Terms of Reference

1. The National Steering Committee

The MoEF will establish the Steering committee with members drawn from other government ministries, departments.

*Composition*
The steering committee will comprise of (but not limited to) representatives from the Planning Commission, central ministries, departments.

- Set general guidelines for the formulation process of the national communication
- Ensure that the national communication is integrated fully with sectoral plans, policies and the current Plan document.
- Ensure UNFCCC obligations are met and guidance from the COP is considered during the implementation of the project.
- Ensure that all necessary steps are taken so that the National Communication eventually becomes a part of the National Policy.
- Monitor the performance of the project by evaluating periodic reports.
- Supervise hiring decisions made under this project, and review arrangements and subcontracts periodically.
- Provide access to data/archives or any other information required by the participating institutions and organizations
- Seek inputs from the Project Advisory Committee.
- Participate in national workshops, consultations and state workshops as appropriate.
- Liaison with the corresponding state departments and catalyze their participation in the planning process.
- Facilitate the inter-sectoral consultations and enhance inter-ministerial collaboration.
- Make their respective organizations aware of the importance of climate change, its impacts and promote commitment at all levels.
- Finalize and approve the draft national communication document.

2. National Project Director (NPD)

The NPD will be critical in catalyzing inter-ministerial and broader stakeholder support towards the objectives of this project and liaising with counterparts in other ministries, state governments and ministries. The NPD will liaison between the steering committee, Project Advisory Committee and the PMC who will carry out the actual work of this project. The National Project Director will be responsible for communicating to the Steering Committee, the overall management and implementation of the project.

The Advisor of the Climate Change Unit within MoEF will be appointed the NPD of the project. The NPD's administrative role will consist of regularly monitoring the progress of the project appraising the performance of national consultants in collaboration with the Project Manager, preparing recommendations to the steering committee, organizing workshops and consultations.

*Specific Duties of the NPD*
- Preparing progress and completion reports as required by GoI and UNDP procedures

- Organizing and convening steering committee meetings
- Leading the organization of national workshops and consultations
- Assist the consultants in carrying out their assignments by facilitating interaction and contacts with other ministries, organizations and institutions.
- Ensure that a transparent and participatory approach is followed, stakeholders are consulted and involved in the project.
- Co-ordinating with line ministries, state governments and institutions (such as the private sector, NGOs, CBOs) involved in the project execution.
- Overall management of the project team (project manager and national consultants) and conveying the official position of the steering committees.
- Reviewing project budget revisions and all other administrative arrangements required under GOI and UNDP procedures.
- Provide administrative inputs to the project and monitoring arrangements as per GOI/UNDP procedures.
- Preparing reports and recommendations to the project steering committee.
- Take all the steps necessary to ensure GOI's commitment and support to the approval of the national communication.
- Involve departments and experts in the project
- Attend national workshops, consultations and state workshops as appropriate.

3. Indicative TORs for the members of the Technical Advisory Committee (TAC)

The members of the TAC will comprise of eminent scientists, experts, activists and private sector representatives having extensive work and research experience. The experts will be responsible for gathering information about their respective sectors, assessing gaps, identifying priorities, options and developing strategies and action plans. They will provide technical inputs and be responsible for synthesizing all technical papers, studies, and reports in their respective areas.

Each TAC member will initially decide upon the course of action, studies to be conducted and then formulate details for respective sub-contracts and national consultants who will do much of the actual data gathering. The experts will facilitate access to the data by the national consultants. They will hold periodic brainstorming sessions to debate and decide upon courses of action and will attend expert meetings and national workshops.

*Lines of Authority*

NPD and NPM, who will seek advice and concurrence of the Steering Committee and selection committee, will co-ordinate TAC establishment. TAC experts will directly submit reports to the NPM. Any problems encountered will be brought to the attention of the NPD.

*Activities*

- Gather preliminary information on the thematic area, identify areas in which studies need to be undertaken, main sources of information and draw up details for respective sub-contracts.
- Guide the selection committee, NPD and NPM is selecting institutions and national consultants for various sub-contracts.
- Review work of national consultants to make sure satisfactory progress is being made, obtain regular status reports.
- Provide technical inputs to consultants in written form.
- Debate studies to identify gaps, develop criteria to ascertain and rank priorities, facilitate application of priorities in national workshops, and consultations.
- Ascertain training needs and national capacity in the thematic area.

- Attend national workshops and expert meetings as appropriate.
- Provide inputs to PMC as and when requested and review studies, reports and action plans developed by them.
- Assist in compiling the reports from consultants, assess the same and help in the planning process.
- Develop participatory methodologies for defining strategy objectives, identifying and analyzing strategies and action plans for their respective sectors.
- Hold consultations with nodal agencies, participating institutions, and stakeholders to seek their views and input into planning.

*Outputs*

Reports stocktaking and summarizing the present status of country level inventory development, available abatement scenarios and response strategies to combat the adverse effects of climate change, studies on vulnerability assessment of key areas of national importance and programmes on sustainable development. The reports should include the institutional and human capacity in the respective areas. Assessment of sustainability of use, sharing of benefits, cross-sector practices, legal and institutional factors concerning the area. Criteria for setting priorities and identifying gaps, methodology for developing preliminary strategies and spatially referenced action plans.

4. Indicative TOR of the SIC

A central theme of the project is the strong commitment to ensuring the development and implementation of a truly broad-based participatory approach involving the central ministries, the scientific community in India engaged in climate change research, and the civil society. To ensure greater participation, a Stakeholder Interaction Committee (SIC) comprising of the Project Monitoring Cell, Industry Associations, NGOs, Media Representatives and Educationists will be established.

This committee will interact with the National Steering Committee, comprising of representatives the Ministry of Environment and Forests and other line ministries, various departments of Government of India, the Technical Advisory Committee, and the UNDP local representative. It will provide vital inputs about the situation as it exists on the ground and help devise communication strategies for information dissemination.

The proposed target groups would include the researchers for enhancing their monitoring and assessment capabilities; the policymakers at the national and state level for enabling them to take informed decisions on climate related policy, legislation, strategies and programmes and the local stakeholders; NGOs, media and the general republic to make them aware of the likely consequence of climate change and the adaptation measures.

5. Project Staff

### *5a. National Project Manager*

The NPM will carry out day to day working of the project. A full time consultant hired for the duration of the project will fill be position of NPM. It is critical that a highly qualified and motivated person be found and selected for this position, and the person is able to devote all of his or her time to the duties described in the TORs. The Steering Committee should approve the candidate selected.

The NPM will be fully responsible for the day to day implementation of this project. The NPM will administer all technical project inputs and coordinate the execution of all project activities. The NPM will report directly to the NPD and steering committee and liaison with all individual and organizations involved in the planning process.

The NPM will prepare monthly work plans and activity reports for circulation to the NPD, steering committee, DEA and UNDP. The NPM will propose budget revisions as needed and prepare requests for disbursements in a timely fashion to ensure that funds are available when needed for project activities.

The NPM will supervise the work of all national consultants and other working groups, including national workshops and consultations. He will also provide guidance and assistance to state planning teams as appropriate and upon request. The NPM will be responsible for the preparation of outlines of key project documents and will assign responsibilities for write up to the other national consultants.

The NPM will be responsible for the final compilation of all documents. He will ensure that all activities are conducted in accordance with the methodologies outlined in the project document. He will be responsible for assessing training needs and arranging training. Among others, he will be familiar with the UNFCCC, all IPCC reports including guidelines and recent COP guidance and emerging issues in the field of climate change and ensure these are incorporated in the project and that it conforms to objectives of the project.

*Lines of authority for reporting requirements:*
The NPM will report to the NPD.

*Principal Activities of the NPM :*

- Prepare detailed monthly plans and cost estimates for accounting and timely disbursement of funds as needed
- Maintain detailed records of all expenditures incurred in accordance with GoI and UNDP procedures.
- Co-ordinate the implementation of project activities as set out in the project document.
- Co-ordination between the steering committee, thematic working groups, consultants, NPD and UNDP.
- Co-ordinate all logistical arrangements for steering committee meetings, national workshops, consultations and meetings.
- Maintain regular contacts as needed with all government, non-government, community-based and international organizations that are concerned in the planning process and ensure smooth functioning of the project.
- Maintain regular contact with state officials involved in preparing state BSAPs, co-ordinate provision of technical and administrative assistance, provision of resources and materials.
- Supervise the work of national consultants and thematic working groups.
- In conjunction with the national consultants, thematic groups, prepare detailed contents of activities.
- For all project documents, assign writing responsibilities to national consultants.
- Hold periodic brainstorming sessions with the national consultants, thematic groups and NPD, to better define options, priorities and plan course of action.
- Maintain regular contact with state planning teams, obtain regular status reports and provide assistance and guidance to states as appropriate.
- Supervise the consultative process with stakeholders including state governments, nodal agencies and co-operating partners.

Technical Inputs and Participation

- Assess training needs of national consultants, and make arrangements for providing the same.
- Ensure the project is in conformity with objectives of the UNFCCC.
- Ensure that a participatory methodology is followed and effective stakeholder participation is achieved.
- Obtain technical inputs (material and human resources) to assess and include measures for recent issues in the field of climate change, particularly those emerging from recent COP (such as issues related to sustainable development, response strategies for impacts, abatement and adaptation etc.)
- Circulate reports, studies and documents prepared to prominent experts for technical reviews.

- Take overall responsibility for preparing the draft and final national communication

Qualifications
The NPM should be a senior level professional, with an advanced degree and research experience in climate change. The NPM should have expertise in policy analysis, management and implementation, and experience with government working and research activities. He/she should have prior experience in organisation, co-ordination and management of national and international projects. The NPM should have experience of initiating and organizing theme specific workshops and be familiar with participatory methodologies. The NPM should be well versed with the UNFCCC planning manuals and guides. He/she will need to have excellent managerial, inter-disciplinary, writing and communication skills. He/she should be bi-lingual in Hindi and English and be proficient in use of computers

5b. National Consultants

Two Expert consultants will be hired to assist the NPM in carrying out his/her duties. The consultants will assist in preparing progress reports, financial statements, and liaising with the NPD, thematic working groups and state planning groups. The expert consultants will assist in providing technical input to the state planning groups, disseminate materials and information, organize and co-ordinate workshops, meetings and consultations under the project. The expert consultants will keep in regular contact with the thematic working groups and will facilitate their work as necessary.

It is currently envisaged that the expert consultants will have experience in working in at least one of the areas to be dealt with in the project (inventory development and projections, vulnerability assessment studies, development of abatement and adaptation strategies) and have experience in participatory methods and institutional arrangements. The consultants should have excellent inter-disciplinary, writing and communication skills. Both the consultants should be bi-lingual in Hindi and English and be proficient in use of computers.

The expert consultants will report to the NPM directly. They will assist the NPM in all his/her activities and smooth discharge of responsibilities.

*Principal Activities of the National Consultant*

- Assist NPM in preparing detailed monthly plans and cost estimates for accounting and timely disbursement of funds as needed
- The NPM will distribute work between the two consultants for co-ordinating the following activities, such that no overlap occurs.
- Co-ordinate the implementation of project activities as set out in the project document.
- Assist NPM in co-ordination between the steering committee, thematic working groups, consultants, NPD and UNDP.
- Co-ordinate all logistical arrangements for steering committee meetings, national workshops, consultations and meetings.
- Maintain regular contacts as needed with all government, non-government, community-based and international organizations that are concerned in the planning process and ensure smooth functioning of the project.
- Maintain regular contact with state officials involved in preparing state BSAPs, co-ordinate provision of technical and administrative assistance, provision of resources and materials.
- Assist NPM to prepare detailed content of activities in conjunction with the thematic groups.
- Writing responsibilities for all project documents as assigned by the NPM.

- Participate and contribute qualitatively to periodic brainstorming sessions with the NPD, NPM and thematic groups, to better define options, priorities and course of action.
- Maintain regular contact with state planning teams, obtain regular status reports and provide assistance and guidance to states as appropriate.
- Assist NPM in supervising the consultative process with stakeholders including state governments, nodal agencies and co-operating partners.

Technical Inputs and Participation
- Ensure the project is in conformity with objectives of the UNFCCC.
- Ensure that a participatory methodology is followed and effective stakeholder participation is achieved.
- Obtain technical inputs (material and human resources) to assess and include measures for recent issues in the field of climate change, particularly those emerging from recent COP (such as issues related to sustainable development, response strategies for impacts, abatement and adaptation etc.)
- Circulate reports, studies and documents prepared to prominent experts for technical reviews.
- Assist NPM in preparing the draft and final national communication

Qualifications
The expert consultants should have an advanced degree and research experience in climate change. The consultants should have experience in undertaking projects related to inventory development and vulnerability assessment and adaptation. The Consultants should be well versed with the UNFCCC, UNDP and UNEP guides and IPCC scientific reports. They should have prior experience in organisation, co-ordination and management of international and national workshops and be familiar with participatory methodologies. He/she will need to have excellent inter-disciplinary, writing and communication skills. He/she should be bi-lingual in Hindi and English and be proficient in use of computers.

5c. Project Associate

A Project Associate will be hired to assist the PMC in carrying out the day to day activities. The Project Associate will assist in preparing progress reports and financial statements. The Project Associate will assist in preparation of dissemination materials and information, assist in coordination of workshops, meetings and consultations under the project.

The Project Associate will distribute work between the Project director, Project Manager and Consultant for assisting in the following:

- Co-ordinate the implementation of project activities as set out in the project document.
- Assist in organizing the workshops all logistical arrangements for steering committee meetings, working group meetings, national workshops, consultations and meetings.
- Maintain the contracts of each sub contract and update as required
- Assist in preparing the financial statements and maintaining the financial records
- Assist in ensuring timely delivery of each of the deliverables to the PMC by liaising with the project proponents
- Assist in preparing progress reports
- Assist in preparing dissemination material

4. Indicative TORs for lead consultants for undertaking work for the respective activities

The main activities of this project are inventory assessment for 2000, reducing uncertainties in emissions, and assessing the vulnerability of various sectors due to climate change and assessing the adaptation requirements. Further sub-activities under each of these main activities encompass diverse sectors like

energy and transformation sectors, agriculture, land use, forestry, industrial processes, waste, water resources, human health, natural ecosystems etc. These are specialized areas of knowledge and therefore related project activities have to be conducted under expert guidance. It is therefore proposed to formulate a working group for each element of reporting for the second NATCOM, and these will be coordinated by a lead consultant of repute. The indicative responsibility of these lead consultants will be as follows:

Responsibilities
These national consultants will be directly responsible for the following:

- Identify and prioritize areas of work for the Second NATCOM
- Assess the level of existing information
- Identify methods to bridge the gaps and constraints reflected in the Initial NATCOM
- Identify expertise and institutional arrangements required to undertake work in each element of reporting
- Devise methods for ensuring participation of the field-level planners and implementers for example that of the state governments, the NGOs, the private sector and the industry
- Prepare the scope of work, the methodological framework and analytical formats as per the decision 17/CP.8 of the Conference of Parties to UNFCCC for each element of reporting
- Ensure adequate time planning, given the limited time available for second NATCOM, for completing an in-depth study for each activity
- Devise methods for a unified integrated assessment of vulnerability and adaptation for all sectors

The above indicative terms of reference for the lead will be modified, if necessary after the inception workshop.

**SIGNATURE PAGE**

Country: India

UNDAF Outcome(s)/Indicator(s): N/A
*(Link to UNDAF outcome., If no UNDAF, leave blank)*

Expected Outcome(s)/Indicator (s): G3: Energy and environment for sustainable development
*(CP outcomes linked t the SRF/MYFF goal and service line)*

Expected Output(s)/Indicator(s): N/A
*(CP outcomes linked t the SRF/MYFF goal and service line)*

Implementing partner: Ministry of Environment and Forests
*(designated institution/Executing agency)*

Other Partners: N/A
*(formerly implementing agencies )*

Programme Period: 2007-2010
Programme Component: G3: Environment
Project Title: Enabling Activities for the Preparation of India's Second National Communication to the UNFCCC
Project ID: 00053688
Project Duration: 4 years
Management Arrangement: NEX

Budget US$ 3,500,000
General Management Support Fee 382,000
Total budget: US$ 3,500,000
Allocated resources:

- Government
- Regular N/A
- Other:
  - GEF : US$ 3,500,000
  - Donor; N/A
  - Donor; N/A
- In kind contributions :US$ 3,000,000
- Unfunded budget: N/A

**Agreed by (Government): _____**
**Agreed by (Implementing partner/Executing agency):_____**
**Agreed by (UNDP):_____**