

**UNITED NATIONS DEVELOPMENT PROGRAMME
GLOBAL ENVIRONMENT FACILITY
PROJECT OF THE GOVERNMENT OF INDIA**

Project Document

Project Number : IND/99/G33/A/1G/99
 Project Title : Enabling Activities for the preparation of India's Initial National Communication to the UNFCCC
 Duration : Twenty-four months
 Project Site: : New Delhi
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 and sub-sector : Climate Change
 Government Counterpart : Department of Economic Affairs, Ministry of Finance
 Executing Agency : Ministry of Environment and Forests
 Implementing Agency : Ministry of Environment and Forests

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Brief Description: The project will assist India in undertaking the enabling activities to prepare initial national communication to the Conference of Parties in accordance with UN Framework Convention on Climate Change (UNFCCC) and to build capacity to fulfil its commitments to the Convention on a continuing basis.

On behalf of	Signature	Date	Name & Title
The Government (Department of Economic Affairs)	_____	_____	Rita Acharya Deputy Secretary (FB)
Executing Agency (Min. of Environment & Forests)	_____	_____	U K Choudhary Director (IC)
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A. BACKGROUND AND CONTEXT

A.1 An Overview

The Indian government attaches great importance to climate change issues, and signed the United Nations Framework Convention on Climate Change (UNFCCC or Convention) in 1993. As one of the Non-Annex I Parties to the Convention, the Indian government endorses the principle of “common but differentiated responsibilities” put forward by the Convention as a basic prerequisite. India makes great effort to comply with the relevant obligations under the UNFCCC, including the submission of an initial national communication within two years after financial resources are provided. This proposal requests funding for the preparation of the initial national communication to the UNFCCC.

India has a large territory represented by complex geography and climate patterns. The high regional and sector variability in levels of social and economic development leads to similar patterns in vulnerability and adaptation measures due to climate change impacts. This necessitates in-depth regional and sector studies to estimate greenhouse gas (GHG) emissions as well as to assess vulnerability and adaptation measures across the country. In order to fulfill the requirements of the UNFCCC, the Indian government, through its various institutions and resources, has strengthened its researches on the (1) science of climate system and climatic change, (2) impact on social and economic development and (3) response strategies. However, due to the complexity of climate change issues, lack of research tools and basic data, and extremely limited financial support, the results of these researches are far from complete, and therefore further in-depth research and assessment in a wide range of areas and uncertain issues is required. This work would not be accomplished in the short term in the absence of adequate financial support from GEF.

India has already made its share of contribution to modifying the longer-term trends of climate change, by such national measures as (1) population control, (2) pursuing energy conservation and (3) persistent large-scale afforestation. India is willing to contribute further to addressing climate change, but as a developing country with a population which has crossed a billion on 13 May 2000, and a per capita GDP of less than \$US 370 (1994), India is faced with tremendous practical difficulties.

India is largely dependent on fossil fuels for its energy requirements. At present, coal accounts for about 60% of fossil fuel use in calorific terms followed by petroleum products (30%) and the remaining by natural gas. The relative emission of carbon dioxide (CO₂) for 1989-90 from coal, petroleum products and natural gas were estimated at 328.4 Tg/yr (65%), 162.7 (32%) and 17.5 (3%) respectively (*ALGAS, India, 1998*). Electricity generation in India accounts for the largest share of coal consumption as out of the total installed electricity generation capacity 70% is coal-based.

Though the major energy requirements of the country are met by fossil fuel sources, 72% of the Indian population lives in rural areas dependent on agricultural and related activities, use biomass resources like wood, agricultural crop residues, dung-cakes etc. for energy. In India, the amount of biomass burnt annually is estimated to be about 426 Tg or about 6.3% of the global level of 6800 Tg/yr. India also has a large cattle population that contributes around 40% to total methane emissions from the country (*ALGAS, India, 1998*).

Industrial growth and increasing urbanization in India have led to associated environmental changes. The vehicular population has grown at around 13% per year during the last decade. The growth of two-wheelers has been very high (16.6%) followed by cars (6.9%) and buses (5.7%). Motor vehicles are estimated to contribute 8% of the total fossil fuel related CO₂ emissions in India against the world average of approximately 15% (ALGAS, India, 1998). A variety of industrial processes, which transform materials by physical or chemical processes, are responsible for emissions of various greenhouse gases like CO₂, CH₄ and N₂O.

A.2 Climate Change Impact Assessment

Climate models have projected enhanced evaporation from global warming, which results in increased mean precipitation, seasonal shifts in precipitation, changes in soil moisture and changes or enhanced occurrence of extreme climatic events. This is expected to have significant impacts on natural ecosystems (forests, grasslands, wetlands, etc.), agricultural production, aquatic ecosystems, and human health.

India is the seventh largest country in the world with total geographical area of 329 Mha, land frontier of about 15,200 km and a coastline of 7,516 km. Table 1 gives the national circumstances for the base year 1994. Agriculture accounts for almost 30% of India's GDP and direct dependence of this sector on natural factors like monsoons indicates high vulnerability of national economy to climate change. Sea-level rise threatens all the coastal areas of the country especially the low-lying coral atoll of the Lakshadweep archipelago. Given India's regional and sectoral diversity, there is a need for in-depth assessment of potential impacts due to climate change and identify the needed adaptation strategies. Since the earlier efforts have largely focused on estimating GHG inventory and projects for GHG stabilization options, there is a need to assess sector vulnerability (forestry, agriculture and coastal zones etc.) to climate change impacts and the required adaptation measures.

Table 1: National Circumstances

Criteria	1994
Population (million)	929.4
Land area (million square kilometres)	328.7
GDP (1994 US billion \$)	342.9
GDP per capita (1994 US\$)	369.0
Land area used for agricultural purposes (million square kilometres)	50.5
Urban population as percentage of total population	27.0
Livestock population in million (disaggregated as appropriate)	387.2 (1986-87 figures)
Forest area (square kilometres)	20.7
Population below poverty line in millions (annual earnings less than US\$ 500)	168.2
Life expectancy at birth (years)	
Male	60.0
Female	61.7
Literacy rate (aged five years and above)	52

Source: 9th Five Year Plan Document, Planning Commission, India, 1997-98

A.3 India's Initiatives

In recognition of the great importance of climate change to the future of the country and the rest of the world, India has undertaken additional significant actions. At the national level, environmental protection and sustainable development have emerged as key national priorities in the approach paper to the Ninth Five-Year Plan (1997-2001). Several Indian institutions are already working in various sectors with the help of funds made available primarily by the Government of India and other agencies.

These institutions have conducted many studies over the last several years, which provide an inventory of greenhouse gas emissions and identify potential options for GHG stabilization that may be pursued. These inventories have steadily improved the estimates of carbon dioxide, methane and other GHG's from a variety of sources. Despite these improvements, the confidence level for carbon dioxide and methane emission estimates is not high, and is also low for nitrous oxide primarily due to substantial variability in emission coefficients across the country. For example, ash contents of Indian coal vary between 35 to 45% affecting the amount of carbon released upon combustion. Bottom up and top down estimates of carbon dioxide from fossil fuel combustion vary by 52 Tg or 10% and are much below the values estimated by the IEA (1997). The absolute magnitude of emissions is lower in the agriculture, landuse change and waste sectors but the emission estimates are more uncertain. The uncertainties also remain, because, for estimating the inventories "Good practices" as suggested by IPCC have not been followed. The "Good Practices" will enable India to manage the uncertainties in the GHG estimates in such a way so that they are neither over nor under estimated, are unbiased and are minimum. Accomplishing this goal necessitates quality assurance (QA) and quality control (QC) procedures which were also lacking earlier. A QA/QC program contributes to the objectives of good practice guidance, namely, to improve transparency, consistency, comparability, completeness, and reliability in national inventories (FCCC/SBSTA/1999/Add.1).

The Department of Space in India had mapped the entire country in 1992 on a 1:1 million scale to identify various landuse categories. This study of 1992 has revealed that the total wasteland area is around 53.3 million hectares or 16.2% of the total geographical area of the country. The remote sensing forestry data can be used to estimate GHG emissions due to landuse change and forestry, GHG sink development, impact assessment etc.

A.4 Prior and On-going Activities Supported by UNDP/GEF

There are a few ongoing or recently completed GEF projects that relate to the activities proposed in this project. Development of coal-bed methane resources and landfill methane recovery will yield some data that will be of use to the proposed project. The bio-diversity project will also provide some data and information on vulnerability assessment. Other projects will provide limited information. While these may not be directly useful to the proposed project, the capacity built for analysis, and data collection will be utilized since many of the same institutions will be engaged in the proposed project.

UNDP-GEF had sponsored the recently completed Asian Development Bank's regional project entitled "Asia Least Cost Greenhouse Gas Abatement Strategy (ALGAS)". This project identified and analysed mitigation options, developed least-cost strategies for mitigation/abatement of GHGs; and developed portfolios of bankable least cost GHG abatement strategies. Vulnerability and adaptation strategies were not analysed. Moreover, the primary focus of this project and other studies has been on the energy sector, with marginal treatment of land-use

change, forestry and other sectors. The proposed activity will develop information and database on climate change impact and adaptation options in these sectors, while updating the options and least-cost strategy for the energy sector.

A.5 Present Institutional Framework

The Ministry of Environment & Forests (MoEF) is the designated nodal ministry responsible for national environmental policies, programmes and priorities for implementation, and for overall coordination of projects related to environment. Other line ministries such as the Ministries of Power, Non-conventional Energy Sources, Agriculture, Science and Technology, Ocean Development provide necessary inputs to MoEF. The Ministry of Finance is consulted if implementation of environmental policies has an impact on the nation's finances as well as any fiscal incentives or penalties that may be proposed for enabling implementation of the environmental policies. The MoEF is also the focal point for all GEF-related matters and multi/bilateral donor funded environment programmes in India.

Appropriate executing agencies and departments in the state government carry out implementation of environmental policies and programmes formulated by the MoEF. MoEF's role consists of coordinating funds, providing guidance and technical expertise, and undertaking monitoring and evaluation. MoEF is assisted by a number of national as well as state level development institutions, non-governmental organizations, industry associations, and private consultancy firms, etc. Several international organizations, research laboratories, and other such agencies also provide the inputs, as may be required, for facilitating the decision-making process of the Government of India.

A.6 Project Objectives

The project objectives are to generate, analyze and communicate information relevant to the preparation and submission of India's Initial National Communication (particularly in accordance with Art. 4.1 and Art. 12 of the UNFCCC), including completion of a national greenhouse gas inventory, vulnerability assessment, an adaptation option analysis, and any other information considered relevant for the National Communication itself.

B. PROJECT JUSTIFICATION

B.1 Present Situation

The first GHG emission estimates for India were made in 1991 and an update was prepared in 1992. Table 3 below gives a picture of the development of inventory over the years. The confidence level of emission estimates of the various gases is given in Table 4, which are ranging from low to medium.

Table 3: Previous Experience of GHG Inventory Development in India

Year	Inventory Details	Source and Sector Coverage
1991	First inventory, [<i>Global Change Report No. 1, 1991, edited by A. P. Mitra</i>]	Fossil fuel combustion, rice cultivation and Enteric fermentation
1992	Update [<i>Global Change Report No. 4, 1992, edited by A. P. Mitra</i>]	Additions of Emissions from transport, coal-mines, and 1991 methane campaign results included. IPCC Tier-II approach followed for livestock related emissions, Land use change and Forestry.
1996	Update [<i>Unpublished Report, 1998, edited by A. P. Mitra and Sumana Bhattacharya</i>]	Animal manure, agriculture crop residue, and waste included. Revised IPCC approach to methane emissions from rice paddy related and new approach in forestry and landuse change emissions.
1998	India ALGAS Report [<i>ADB, June 1999</i>]	GHG inventory for 1990 using IPCC 1995 and 1996 methodology and included industrial emissions.
1999	District level inventory paper submitted to Atmospheric Environment, February 2000 [<i>Amit Garg, P. R. Shukla, S. Bhattacharya and Dadhwal</i>]	Regional and sectoral analysis of GHG emissions for 1990 and 1995 covering all the Indian districts and all emission categories.

Table 4: Confidence Rating in GHG Inventories

GHG	Confidence Level
CO ₂	<u>Medium</u> . The top-down and bottom-up emission estimates are different for fuel combustion, mainly for coal where the CO ₂ emissions values vary considerably (top-down: 329 Tg, bottom-up: 385 Tg) due to uncertainty in emission coefficient.
CH ₄	<u>Medium</u> . Methane emissions from rice paddy fields measured covering all types of water management practices in India. Major uncertainties remains in methane emission due to the addition of organic supplements to soil, various types of cultivars and diverse environmental conditions prevailing over the various rice growing regions in India. Derived emission factors have been used for methane emissions from enteric fermentation in animals applying IPCC default values to Indian livestock profile (age, weight etc.). However actual measurements have to be performed. IPCC default emission factors have been used for all other sources. These have to be measured to increase the confidence level of Indian inventory estimates.
N ₂ O	<u>Low</u> . Estimates are based on IPCC default emission coefficients. Measuring Indian coefficients will increase the confidence level.

The estimates made so far in the earlier studies are indicated in Table 5. It may be noted that no inventory has been prepared for India for 1994. Table 6 compares India's CO₂ emission due to fuel combustion from two approaches (viz., top-down and bottom-up methods) and with respect to the figures suggested in the International

Energy Agency document [*CO₂ Emission from Fuel Combustion*, 1997 edition]. There is a distinct difference between top-down and bottom-up approaches.

Table 5: Greenhouse Gas Inventories (Gg) of Anthropogenic Emissions by Sources and Removals by Sinks for 1990

Greenhouse Gas Source and Sink Categories	CO ₂	CH ₄	N ₂ O
1. All Energy		X	X
Fuel Combustion	565,900	X	X
Energy and Transformation Industries	508,600		
Industry	X		
Transport	57 300		
Commercial- Institutional	X		
Residential	X		
Other (please specify)	X		
Biomass Burned for Energy	300,460	1579	11
Fugitive Fuel Emission		X	
Oil and Natural Gas Systems		628	
Solid fuels		330	
2. Industrial Processes	24,200	X	
3. Agriculture	X		1
Enteric Fermentation		6,807	X
Rice Cultivation		4,070	
Savanna Burning		X	
Others (please specify)		X	X
Agricultural soils			240
Field burning of agricultural residues		116	3
4. Land Use Change and Forestry	X		
Changes in Forest and other woody biomass stock	X		
Forest and Grassland Conversion	52,066		
Abandonment of Managed Lands	X		
5. Other Sources as appropriate and to the extent possible (please specify)	X	X	X
Solid waste disposal on land		334	
Domestic and commercial waste water		49	
Industrial waste water		2905	

Source: ALGAS Report, 1998.

Table 6: Comparing top-down and bottom-up inventory estimates

Fuel type	Top down* (Tg CO ₂)	Bottom up* (Tg CO ₂)	IEA** (Tg CO ₂)
Coal	328.5	384.8	-
Petroleum	162.7	151.8	-
Natural gas	17.5	23.9	-
Total	508.7	560.5	602

*Mitra, A. P. (editor), “Greenhouse Gas Emissions in India in the *Global Change Report* No. 10, 1998;

**’CO₂ Emission from Fossil Fuel Combustion in the *IEA Report*, 1997.

If future climate change regimes are going to build effectively upon the 1994 base-year inventory developed for India, it will be essential that there is coherence in the inventory numbers from the two theoretically equivalent methodologies. So long as these GHG emission estimates continue to be substantially different, a reliable and accurate baseline can not be estimated. The present project will reduce the prevailing variability in national GHG emission estimates.

B.2 Expected Situation at the End of the Project

The project duration is two years. At the end of the project, the Government of India (GoI) would be in a position to compile an initial national communication to the UNFCCC. The project will result in:

- Strengthened human and institutional capacity in India for the preparation of initial national communication.
- Preparation of a comprehensive national inventory of GHGs with lower uncertainties to which quality control and quality assurance procedures will be applied to make it transparent, consistent and complete.
- Reduced variability and uncertainty of emission estimates by modifying the IPCC default emission factors to country-specific values.
- Dissemination of information about the significance of climate change issues to the Indian public and preparation of India’s initial national communication.

B.3 Target Beneficiaries

The main beneficiaries are the international society, especially the convention parties, convention secretary and all country governments. In the absence of the UNFCCC, there would be no requirement for India to prepare a National Communication to the UNFCCC. International academia, private sector, NGOs and other institutions would also benefit from increased information. The main stakeholders in this project are all the national and state agencies who have responsibility for economic and other sectors that will be impacted adversely by climate change, and who may be able to play a key role in implementing the objectives of the UNFCCC.

B.4 Project Strategy The initial national communication will be developed through a broad-based participatory planning process. The project will have two major components (i) to prepare Initial National Communication of India to the UNFCCC, and (ii) to build capacity to fulfil its commitments to the Convention. In order to prepare the initial national communication as required by the FCCC (A/AC.237/55), the following aspects would be addressed.

- a) Development of comprehensive inventory for 1994 and improvement of its reliability vis-a-vis earlier estimates (ALGAS for 1990), which would involve reducing uncertainties of GHG emission coefficients in key source categories
- b) Identification of the key steps to implement the convention
- c) Presentation of information on specific needs and concerns arising from the adverse impacts of climate change.
- d) Generation of a reliable and comprehensive database accessible through the Internet for all of the outputs produced.

The project will use the standard IPCC guidelines and methodologies proposed in the Good Practice Report, 2000 for estimating the GHG emissions from different sectors. However, the country-specific emission factors, wherever available or measured during this project will be applied for improving the reliability of the estimates as against the default IPCC emission factors.

The project will provide the initial thrust for addressing areas of national concerns likely to arise due to climate change such as food security, water resources and coastal zone management for vulnerability assessment and adaptation measures.

Capacity building and networking of national institutions and agencies would be undertaken through consultative meetings, planning and training workshops. This project will expose policy-makers, planners and researchers to participatory approaches for developing linkages between climate change issues and developmental/economic processes.

The overall project strategy is presented at **Figure 1**. While the main purpose of the project is to generate the initial national communication, this exercise will also result in the preparation of a related project on 'Targeted Research'. The Targeted Research project will involve more detailed development of local emission factors, and would focus on the methodological issues, that cannot be covered in this project. The Targeted Research project will be incrementally funded, and will seek to strengthen the scientific capacity of the country to respond to the climate change challenge as well as lay the foundation for further national communications and implementation of the convention. The estimated starting date for the targeted research project is January 2002 with an expected duration of three years. In order to maximize the impact of international support and develop possible synergies between the present initiative and the proposed research project, major findings and technical outputs generated by this project would be shared with the project experts and the management team of the targeted research project. It is expected that the targeted research project will carry forward the work initiated by the present project, and will strengthen the capacities for subsequent national communications, climate change impact assessment and adaptation related activities in India.

The following activities are expected to be included in the targeted research proposal:

- Regular monitoring and measurement of emissions resulting out of anthropogenic activities in the energy, transport, industry, agriculture, forestry and waste sectors.

- Clearing house for climate change related database management and processing
- Strengthening and building of human and institutional capacity in India for energy and environment sector modelling
- Institutional and human capacity building for climate change impact assessment on various sectors and adaptation policy formulation in India. This will include detailed studies across the country to assess regional and sector vulnerability to climate change impacts as well as to integrate adaptation measures into national planning process.
- Consolidation of indigenous efforts for climate change mitigation, including energy efficiency improvement efforts in various sectors, transfer of cleaner technology, promoting use of renewable technologies etc.

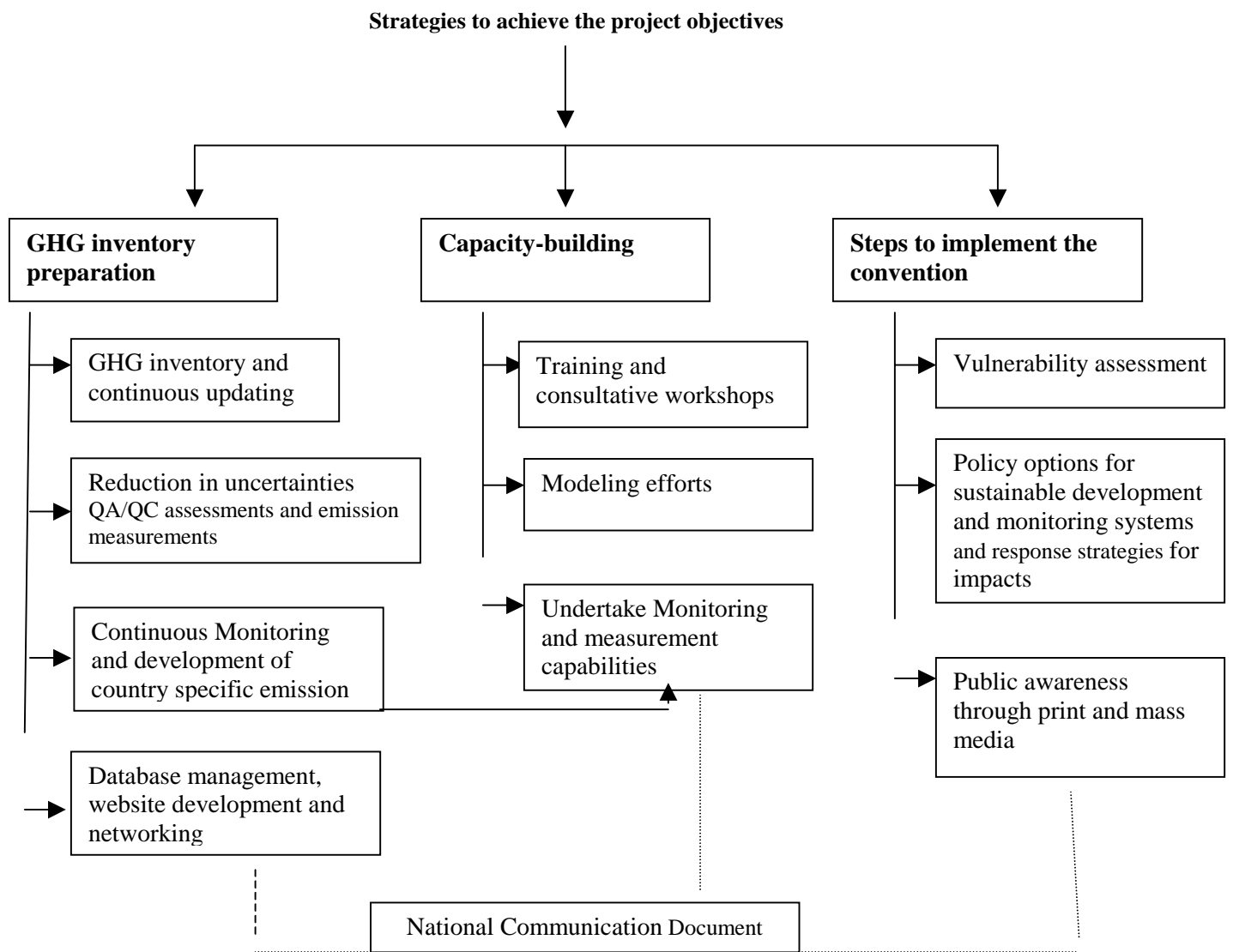


Figure 1: Schematic Diagram of the Project Strategy

B.5 Rationale for UNDP/GEF Support

India has ratified the UNFCCC on 1 November 1993 and submitted notification of its participation in the restructured GEF as of 12 May 1994 and is therefore eligible for GEF support. This proposal seeks funds for India for enabling activities defined by the conference of Parties (COP) as those measures that facilitate the implementation of response measures in accordance with the FCCC (Decision 11/CP.1) to prepare Initial National Communication of India to the COP in accordance with Article 12 of the UNFCCC, and to build capacity to fulfil its commitments to the Convention. This proposal has been prepared in accordance with the guidelines issued in the Annex to Decision 10/ CP.2.

In the absence of the UNFCCC, there would be no requirement for India to prepare a National Communication to the UNFCCC. This project is required for India to complete its initial national communications, and its full costs represent the incremental costs of the activity (Table 7).

Table 7: Incremental Costs of National Communications

Benefits/Costs	Baseline	Alternative	Increment (Alternative-Baseline)
Global Environmental Benefits	None	An initial national communication will be submitted in a timely manner to the UNFCCC from the Indian Government	Global commitment to implementing the UNFCCC will be increased, as a key measure to manage and mitigate climate change
Domestic Benefits	None	Strengthened government agencies and institutions, and increased public awareness to climate change	Enhanced capacity to respond to the UNFCCC
Costs	None	\$2 million	\$2 million

B.6 Reasons for Assistance from UNDP

Environmental protection, poverty reduction, sustainable livelihood, and gender issues, are the four global priorities within the overall context of sustainable human development mandate of the UNDP. These priorities are fully reflected in the programs being developed under the GoI-UNDP/India Country Cooperation Framework (CCF-I). This project aims at assisting the Government of India in preparing the national communication to UNFCCC, and addresses the UNDP environmental goals to protect and regenerate the global environment and natural resources asset base for sustainable development. This will be achieved through promoting equity and burden sharing to protect and enhance the global and regional development.

B.7 Special Considerations

This project has significant environmental implications for the country such as the formulation of policy framework for integrating climate change concerns into planning and development of programs/policies related to sustainable development, adaptation measures and response strategies for impacts. It will help the country in meeting its obligations to the UNFCCC by preparing its initial national communication. Other important considerations include sustainability and capacity-building of the line ministries, institutions and agencies involved in addressing climate change issues.

B.8 Co-ordination Arrangements

The MoEF will co-ordinate all arrangements for the execution of the project. Day-to-day co-ordination of the project will be the responsibility of the Project Manager/Team contracted under this project. Links will be established with other ongoing national/state level initiatives, operational GEF projects, and the programmes/sub-programmes being developed by the UNDP/India under CCF-I.

B.9 Counterpart Support Strategy

The MoEF has identified climate change as a major component of their sustainable development strategy, and will provide critical inputs for the successful completion of project activities. The MoEF, line ministries, state governments, national institutions, NGOs and the R&D centres are expected to contribute significantly by way of providing institutional inputs, technical expertise and relevant data from ongoing/completed activities and status reports of earlier completed projects.

C. DEVELOPMENT OBJECTIVE, IMMEDIATE OBJECTIVES, ACTIVITIES, AND OUTPUTS

The development objective of this project would be to facilitate the achievement of the ultimate objective of the United Nations Framework Convention on Climate Change, i.e. to stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.

C.1 Immediate Objective I: To prepare Initial National Communication Document

Output 1: Inventory of GHGs

Activity 1.1: Prepare methodological framework and analytical format for estimating the GHG emissions for the base year 1994 using IPCC 1996 methodology and the Good Practice Report, 2000 for energy and transformation, industrial process, agriculture, land use change, forestry and waste generation sectors.

Activity 1.2: Energy and Transformation Sector Inventory

Sub-activity 1.2.1: Collect and identify combustion activity data of fossil fuel by sector and type of device.

Output: Improved energy balance table and activity data for 1994. The new balance table will match coal and oil product categories and transport activity data with the ones recommended by the IPCC, separate coal used for raw material from that used for fuel.

Sub-activity 1.2.2: Estimate GHG emissions from fossil fuel combustion in energy and transformation sector including the transport sector.

Output: Estimate of carbon dioxide, methane and nitrous oxide emissions due to fuel combustion from the energy and transformation sector for 1994. Including detailed emission estimates from the transport sector as it is a major emitting source in the country.

Sub-activity 1.2.3: Determine methane emissions from Indian coal mining and post activity.

Output: Estimate of methane emissions by types of coal mines – high and low-methane underground state-owned coal mines, township and village coal mines, and surface coal mines.

Sub-activity 1.2.4: Conduct a study of biomass activity level in India and estimate the relevant GHG emissions

Output: Estimates of biomass consumption by type – wood, agricultural residue, livestock manure, etc. for energy purposes and GHG emission estimates.

Sub-activity 1.2.5: Conduct a study of methane leaks and fugitive emissions from oil and natural gas systems.

Output: Estimate of methane emissions from onshore and offshore oil and natural gas production, and from transportation, distribution, storage, processing and transformation of these fuels.

Sub-activity 1.2.6: Estimate India's total methane emission from energy activity in 1994.

Output: Compiled data and information from sub-activities 1.2.2 through 1.2.5 on methane emissions from fuel use in India.

Sub-activity 1.2.7: Estimate India's total GHG emission from energy activity in 1994.

Output: GHG emission inventory for energy activity in 1994.

Activity 1.3: Industrial Process Inventory

Sub-Activity 1.3.1: Estimate 1994 GHG emissions from cement production.

- Determine 1994 cement production by type in India through national and state data collection.

Output: Production volume for various types of cement and cement products.

- Estimate emissions from cement production.

Output: CO₂ emissions from cement production in India.

Sub-activity 1.3.2: Estimate 1994 GHG emissions from lime production.

- Determine 1994 lime production by type in India through national and state data collection.

Output: Production volume for lime.

- Estimate emissions from lime production.

Output: Carbon dioxide emissions from lime production in India.

Sub-activity 1.3.3: Estimate 1994 GHG emissions from iron and steel production.

- Determine limestone consumption in major steel plants.
Output: Limestone consumption data.
- Estimate carbon dioxide emissions from iron and steel production.
Output: Carbon dioxide emissions from iron and steel production.

Sub-activity 1.3.4: Estimate 1994 GHG emissions from calcium carbide production.

- Determine calcium carbide production and purity data for 1994.
Output: Volume of calcium carbide production of standard purity.
- Estimate carbon dioxide emissions from calcium carbide production.
Output: Carbon dioxide emissions from calcium carbide production.

Sub-activity 1.3.5: Estimate 1994 GHG emissions from adipic acid production.

- Determine adipic acid production for 1994.
Output: Volume of adipic acid production.
- Estimate nitrous oxide emissions from adipic acid production.
Output: Nitrous oxide emissions from this sector.

Sub-activity 1.3.6: Estimate India's total GHGs emissions from industrial processes in 1994

Output: GHG emission inventory for industrial processes in 1994.

Activity 1.4: Agriculture Sector Inventory

Sub-Activity 1.4.1: Estimate 1994 methane emissions from wetland rice fields.

- Data on rice paddy harvest area, nitrogen fertilizer and organic manure application, watering regime and rice cultivar will be collected for 1994. Measured methane emission factors and relevant information will be collected and extracted from published data for different types of Indian rice fields.
Output: Database of measured, collated and spatially extrapolated data.
- Determine methane emissions of various rice field sub-categories with calculated emission factors and quantified harvest areas for 1994.
Output: Estimated methane emission of each rice field sub-category.
- Quantify national methane emission by region and rice field type through integrating the results from each sub-category.
Output: Methane emissions of 1994 by region and type of rice fields.

Sub-Activity 1.4.2: Estimate 1994 nitrous oxide emissions from croplands.

- Secondary data on harvest area and nitrogen fertilizer consumption will be collected for 1994.
Output: Data on crop harvest area and nitrogen fertilizer consumption for major crops.
- Collecting nitrous oxide (N₂O) emissions factors from published data for different types of croplands.
Output: Collected emission factors from published data.

- Estimation of nitrous oxide emissions from croplands of India by using collected and collated data.
Output: N₂O emissions for India from croplands.

Sub-Activity 1.4.3: Estimate 1994 methane emissions from enteric fermentation.

- Ruminant animal population number and structure, feed components and feed intake data will be estimated for 1994 using secondary data sources.
Output: Livestock data for 1994.
- Collecting information on feed digestibility and emission factor from published data.
Output: Collected data on feed digestibility and emission factors.
- Estimation of methane emissions from ruminant animals using above data
Output: Methane emissions for India from ruminant animals by type of animal.

Sub-Activity 1.4.4: Estimate 1994 methane and nitrous oxide emissions from animal waste management systems

- Collect activity data from secondary sources for 1994
Output: Database of collated and spatially extrapolated data.
- Methane and nitrous oxide emissions from animal waste using above data will be estimated.
Output: Methane and nitrous oxide emissions for India from animal waste management systems.

Activity 1.5: Landuse Change and Forestry Sector Inventory

Sub-Activity 1.5.1: Collect land cover and landuse change data and validate it using maps, statistical data, by province and forest type.

Output: Database of collated, validated, and mapped data.

Sub-Activity 1.5.2: Collect data on forest soil type and soil carbon content, and estimate changes in soil carbon due to various landuse and land cover change activities.

Output: Database of collated, validated and mapped data on soil carbon by region and forest type.

Sub-Activity 1.5.3: Using above data and the IPCC methodology, estimate carbon and other GHG flows from Indian forests for 1994.

Output: An emissions inventory for the forestry sector for 1994.

Activity 1.6: Waste Sector Inventory

Sub-Activity 1.6.1: Collect data on items such as municipal solid waste (MSW) generation by region and city, decomposable organic fraction, methane released and recovered, oxidation factors for 1994.

Output: Database of collated, validated data for 1994.

Sub-Activity 1.6.2: Estimate methane emissions from wastewater handling systems based on volume by city and region, and percentage of flared methane.

Output: Methane emissions from this source by city and region.

Sub-Activity 1.6.2: Compile 1994 inventory for methane emission from municipal solid waste and waste water handling systems of India.

Output: A 1994 inventory of methane emissions from MSW and waste water for India.

The financial requirements for activity 1.6 will be as under.

Indicators for Output 1: Inventory Reports, databases, trained researchers/technicians.

Output 2: Reducing Uncertainties in GHG Emission Inventory Estimates

Uncertainties in GHG emissions inventory arise due to variability in activity level of source categories (e.g. amount of coal consumption in various sectors, cement production etc.) and emission coefficients. Methodological choice for individual source categories is an important factor in determining overall inventory uncertainty (Table 8). Generally, inventory uncertainty is lower when emissions are estimated using the most rigorous methods, but due to finite resources, this may not be feasible for every source category. It is good practice to identify those source categories that have the greatest contribution to overall inventory uncertainty in order to make the most efficient use of available resources. By identifying these key source categories in the national inventory, we can prioritize the efforts and improve overall estimates. Such a process will lead to improved inventory quality, as well as greater confidence in the emission estimates that are developed.

A key source category is one that is prioritized within the national inventory system because its estimate has a significant influence on a country's total inventory of direct greenhouse gases in terms of the absolute level of emissions, the trend in emissions, or both. The current information suggests that coal consumption for power generation accounts for 30% of total CO₂ equivalent GHG emissions, followed by livestock related emissions (13%), transport sector (10%) and steel industry (9%). There are lower uncertainties in fuel consumption level for large point sources like power and steel plants. However significant uncertainties exist in sector level consumption of petroleum products due to changing technology mix in the transport sector as well as due to agriculture and industrial sectors, similarly for the quality and quantity of fodder consumption by livestock. Though methane emissions from livestock are significant, uncertainties resolution is difficult due to large numbers of dispersed sources.

The other component to reduce emission uncertainties is to increase the reliability of emission coefficients. Some earlier Indian studies (Mitra et al, 1992) have measured emission coefficients for methane from Indian rice paddy fields under different water regimes, and methane due to enteric fermentation in animals etc. Many more similar studies are required for key source categories. However, due to budget constraints only a few key source

categories may be covered under the present proposal for improving the reliability of emission coefficients. These are now discussed.

Activity 2.1: Appropriate QA and QC measures need to be applied to assert the quality of activity data and that of emission coefficient measurements so as to reduce the uncertainty in the GHG budget estimates. This process will also help in identifying those source categories that have the greatest contribution to overall inventory uncertainty and determine the sectors where uncertainties of activity level and coefficients require improvement in their estimation. Scientists estimating the GHG inventories need to be trained for the appropriate methods for QA and QC application. A training workshop therefore needs to be organized for all personnel involved in budget estimates and measurement.

Output: Scientists trained for the appropriate utilization of QA and QC methods for developing a priority list of source categories for uncertainty reduction in activity level and coefficients.

Activity 2.2: Reduction of Uncertainty in the Energy Sector:

The priority areas identified that need measurement of emission coefficients are:

Sub-activity 2.2.1: Determination of carbon dioxide, CH₄ and N₂O from the transport sector.

In the present project it is intended to study the emission factors of CH₄, CO₂ and N₂O of various fuels and from different engine types. In order to reduce uncertainties in the emission estimates, actual measurements are necessary taking into account engine mix in the country, age profile of engines, fuel used etc. It is preferable that this sub-activity is assigned to an institution that is already equipped with basic infrastructure, and will require only additional equipment and accessories to conduct full range of GHG measurements.

Output: Revised Carbon dioxide, CH₄ and N₂O emission coefficients for transport.

Sub-activity 2.2.2: Biomass burning for fuel (this will also measure emissions from crop residue considered under the agriculture sector). Biomass burning for fuel use results in the emission of CH₄ and N₂O. This sub-activity will quantify India specific emission factors for biomass burning (dung cake, fuelwood, charcoal and different agricultural crop residues) in the laboratory.

Output: Revised CH₄ and N₂O emission coefficients from biomass burning.

Activity 2.3: Reduction of Uncertainty in the Industrial Sector

In the earlier inventory estimates only CO₂ and N₂O emissions from selected industries have been reported using default emission factors. In order to reduce the uncertainties, we need to measure emissions from many industrial activities (refer Activity 1). However, budget constraints will not permit such extensive exercise, forcing us to limit measurements to some key source categories only. These are CO₂ emission from the cement industries, N₂O measurements from Nitric and Adipic acid manufacturing, and CH₄ measurements from paper manufacturing.

Output: Revised CO₂, CH₄ and N₂O emission coefficients from cement, nitric acid, adipic acid and paper manufacturing.

Activity 2.4: Reduction of Uncertainty in the Agriculture Sector

The various sub-source categories for which measurements are needed include enteric fermentation in livestock, manure management, rice cultivation and emission from fertilizer application to soils.

Sub-activity 2.4.1: Methane and N₂O measurement from enteric fermentation in animals and animal manure. This is the largest source of methane emission from the agriculture sector as has been indicated during the ALGAS project. CH₄ emission estimates from this sector were based on age and weight profile of animals using rule of thumb method depending on the type and quantity of feed intake and weight of the animals typically relevant to the Indian conditions. The CH₄ budget from this sector was not derived directly from measurements. In this project therefore, it is intended to measure year round, the emission factors from dairy and non-dairy cattle to reduce (the largest source amongst all domestic animals in India) the large uncertainties associated with this sector. The SF6 technique will be used to measure the emission factors for these two types of cattle. This facility will also be used to measure CH₄ and N₂O emissions from manure management.

Output: Revised CH₄ and N₂O emission coefficients from enteric fermentation in animals and animal manure.

Sub-activity 2.4.2: CH₄ emission from rice fields. CH₄ emission coefficients from rice paddy fields under different water regime conditions have been extensively studied and based on these studies IPCC emission factors from this sector has been standardized. However, uncertainties still remain in terms of CH₄ emission due to organic amendment, cultivar and different environmental impacts. Therefore, further measurements need to be carried out to take into account the addition of organic manure to soils and different cultivars.

Output: CH₄ emission coefficients due to organic amendment and various cultivars.

Sub-activity 2.4.3: N₂O, CH₄ and CO₂ emissions from soils.

Site measurements are to be undertaken for N₂O emissions from application of synthetic fertilizer, crop residue and sewage sludge application, and from cultivation of organic soils. For these studies, a dedicated Gas Chromatograph will be necessary. Samples will be collected all year round and simultaneous measurement of CO₂ and CH₄ also will be made at the selected fields for wheat, gram, pulses and sugarcane.

Output: Revised N₂O, CH₄ and CO₂ emission coefficients from soils.

Activity 2.5: CO₂, CH₄ and N₂O Measurements from Landuse, Land Cover Change and Forestry Sector

In the previous inventory reports from India, budget estimates for CO₂ alone have been reported based on IPCC default emission factors. The other gases due to landuse change have been totally ignored. In order to strengthen the inventory and reduce the uncertainty in emissions from this sector in the national budgets, it is imperative that campaign mode measurements be under taken.

Output: Revised CO₂, CH₄ and N₂O coefficients from land use land cover change and forestry sector.

Activity 2.6: CH₄ and N₂O Measurements from the Waste Sector

Increased urbanization is leading to large solid waste generation within cities. The Indian GHG emission inventories reported earlier, have made budget estimates only for CH₄ from this source based on sporadic measurements. The municipal and industrial waste water are also large sources of both CH₄ and N₂O emissions.

Output: Revised CH₄ and N₂O emission coefficients from the waste sector.

Output 3: Enhanced Institutional Capacities

Activity 3.1: Organize two workshops to train participants for 3-5 days in data collection, collation and analysis for inventory estimation, impact assessment and various other aspects of climate change including capacity-building to integrate climate change concerns into national planning.

Output: Participants trained to assist the project in above activities.

Activity 3.2: Organize workshops to train participants in vulnerability assessment due to climate change and adaptation strategies for agriculture, forestry, natural ecosystems, coastal zones, public health and water resources sectors. These workshops will be a part of the sub-contract for vulnerability and adaptation activities in each of the identified sectors (refer sub-output 4c). Also as a part of this activity inception and final workshops will be organized.

Output: Workshop summary report, project planning guidelines, and review of project activities in the final workshop.

Activity 3.3: Organize planning, consultative and final workshops with different participating institutions and stakeholders at different stages of the project for all key outputs. In addition, an inception workshop with all the stakeholders and participating institutions will be organized at the beginning of the project. Final workshop will relate to consultative processes before finalizing the outputs and the national communication document.

Output: Workshop summary reports and finalization of the national communication document.

Activity 3.4: Lead institutions in the country will be identified to undertake preparation of GHG inventory in different sectors for output 1 earlier. The methodological framework and analytical format for estimating GHG inventories using IPCC 1996 methodology and the Good Practice Report, 2000 for various sectors will be documented. This activity will form a part of Activity 1.1. These will be distributed to various government agencies, industry and other related institutions for enhancing institutional capacities in the country.

Output: Documented methodological framework and analytical format for estimating GHG inventories.

Activity 3.5: Promote publications in international and national journals, and books on climate change issues by Indian authors and prepare multimedia material (CDs, video cassettes etc.) on the same topic for a wider outreach.

Output: About ten publications on climate change issues.

Indicators for Output 3: (i) Participants trained to assist the project in 1994 inventory estimation (ii) Consolidated outputs of various workshops (iii) Publications on climate change issues.

Output 4: General Description of Steps Taken or Envisaged to Implement the Convention

Enable India to fulfil its reporting obligations with respect to options for **a general description of steps taken**, including determining how to best implement sector-specific adaptation options and strategies in a manner that is consistent with national development strategies and priorities. This will include building the capacity of national and provincial experts and institutions to undertake this work.

Sub-Output 4a: Programs Related to Sustainable Development, Research and Public Awareness

Activity 4.1: A meta-data directory of programs already implemented and being planned by the government and other bilateral and multilateral agencies to be compiled which will include related references and key institutes/people working in this area. This will bring out the impact of these programs vis-a-vis sustainable development and identify areas, which need to be further strengthened.

Output: A meta-data directory of programs.

Activity 4.2: Assessing research programs of participating institutions for addressing the identified national priority areas related to sustainable development. The identified institutions will formulate projects on each of the key areas for integration with the targeted research.

Output: A directory of targeted research activities proposed by various participating institutions.

Activity 4.3: Efforts to increase public awareness through various media highlighting relevant information about the issues related to sustainable development.

Output: Publicity material for increasing awareness on climate change issues.

Indicators for Sub-Output 4a: (i) Meta-data directory of ongoing programs (ii) Related publicity material (iii) Directory of targeted research activities.

Sub-Output 4b: Policy Options for Monitoring Systems and Response Strategies for Impacts

Activity 4.4: Consultative Expert meetings to be organized involving experts working on assessment of impacts due to climate change on agriculture, water resources, coastal zones, forestry, natural ecosystems, public health and economy in general. These meetings shall be address issues such as:

- Compilation of existing knowledge base on vulnerability assessment and adaptation measures for various sectors mentioned above.
- Identifying financial and technological needs and constraints to reduce vulnerability of systems due to climate change.
- Identify area for strengthening monitoring systems.
 - Identifying policy options for monitoring systems and response strategies needed to combat the impacts of climate change.
- Identify areas for further thrust in research.

Indicators for Sub-Output 4b: A summary of the meeting proceedings, and an improved awareness of vulnerability and adaptation issues in India.

Sub-Output 4c: Policy Frameworks for Implementing Adaptation Measures and Response Strategies

The potential impacts of climate change on agriculture, forestry, coastal zones, human health and natural ecosystems will be assessed based on the likely climate scenarios using the existing climate models and any material through change in short-lived gases. It is generally agreed that the South Asian region, dominated by the monsoons is one of the most difficult regions to model, with considerable differences among models and high sensitivity to model parameters. Based on the model projections, it is estimated that the mean surface temperature is projected to increase by 1.5-2.5°C in Southern India while in the north, it may be increase by 2.5-3.5°C by 2040. Assessment has become more difficult due to the complex role played by climate forcing due to aerosols, its extent and more regionality. Given such complexities within India itself, this study will attempt to identify regions of higher vulnerability to climate change, and develop possible adaptation measures. The assessment of impacts will focus on social aspects and will attempt to link with the HDI. Due to the high uncertainties involved, efforts will be made further to evaluate the issues and options for appropriate adaptation measures in the proposed targeted research. The following briefly describes sector-wise indicative scope of analysis for determining the vulnerability and adaptation measures and the proposed budget allocations. The level of these details and the exact scope would be finalized after deliberations and discussions on the subject at the project inception workshop.

Activity 4.5: Agriculture Sector Vulnerability Assessment and Adaptation

Independent studies¹ (Swaminathan et al, 1991; Rao and Sinha, 1994; Kalra et al, 1996; Lal, 1998) have assessed the impacts of climate change on Indian agriculture sector. These include impact assessment on grain yield of the two

¹ Sinha S.K., Swaminathan M.S, 1991. "Deforestation, climate change and sustainable nutrition security", in *Climate Change* 16, 33-45.

Rao D.G., Sinha S.K, 1994. "Impacts of climate change on simulated wheat production in India" in *Implications of Climate Change for International Agriculture: Crop Modelling Study, US Climate Change Division Report EPA 230-B-94-003, India, 1-10.*

main Indian staple foods namely rice and wheat due to enhanced levels of CO₂, change in temperature, moisture etc. Also substantial reduction in grain yield has been observed due reduced radiation [Chameides² et. al. 1996].The efforts would derive from these to further identify the regional variations and sensitivity with respect to climate change. Agricultural impacts would be assessed mainly for crop yields and variability, shifts in relative productivity and production.

Output: A status report on vulnerable regions and sectors in India due to climate change and suggesting policy frameworks for implementing adaptation measures and response strategies. This report will also contain a priority list of proposed case studies for targeted research activities in these areas.

Activity 4.6: Forestry Sector Vulnerability Assessment and Adaptation

A few independent studies³ (Ravindranath et al, 1997) have assessed climate change impacts and adaptation strategies for some specific forest zones in India in addition to estimates of GHG emissions due to burning of forest biomass based on satellite and ground based measurements⁴; the efforts would derive from these to further identify the regional variations and sensitivity with respect to these including impact abatement and sink enhancement (refer Activity 4.13). Vulnerability reduction would require sink enhancement. Therefore this activity will identify and support institutions/NGOs that can strengthen efforts to increase GHG sinks and undertake measures to take abatement measures (refer Activity 4.14). Forestry sector would cover changes in species diversity, forest regeneration, growth rates, forest production and migration of species.

Output: A status report on vulnerable regions and sectors in India due to climate change and suggesting policy frameworks for implementing adaptation measures and response strategies. This report will also contain a priority list of proposed case studies for targeted research activities in these areas.

Activity 4.7: Natural Ecosystems Vulnerability Assessment and Adaptation

Limited research has been conducted on the assessment of vulnerability and adaptation to climate change of natural ecosystems in India. Natural ecosystems include natural forest, natural grassland, natural reserve, wetland, freshwater, desert and desertification ecosystems. This project will collect observed available data for 1994 and assess the current status of the main natural ecosystems. It will use the IPCC Methodology and Technical Guidelines

Kalra N., Aggarwal P.K., 1996. Evaluating the Growth Response for Wheat Under Varying Inputs and Changing Climate Options Using Wheat Growth Simulator-WTGROWS. in *Climate Variability and Agriculture*, Narosa Publishing House, New Delhi.

¹Lal M., Singh K.K., Rathore L.S., Srinivasan G., Saseendran S.A., 1998. "Vulnerability of Rice and Wheat Yields in NW India to Future Changes in Climate. In *Agricultural and Forestry Meteorology* 89 (1998), 101-114.

² Case study of the effect of Atmospheric Aerosols and Regional Haze on Agriculture: An Opportunity to Enhance Crop Yields in China through Emission Controls?, W.L.Chameides, H.Yu, S.C.Liu, M.Bergin X.Zhou, L.Mearns, G.Wang, C.S.Kiang, R.D.Saylor, C.Lou, Y.Huang, A.Steiner, and F.Giorgi, From PNAS chameides et al.96(24):13626

³ Ravindranath N. H., Sukumar R., Deshingkar Priya, 1997. Climate Change and Forests: Impacts and Adaptation: A Regional Assessment for the Western Ghats, India. Stockholm Environment Institute (SEI), 1997; and for the Himalayan region by SEI.

⁴ Krishna Prasad V., Prabhat K. Gupta, Yogesh Kant, C. Sharma, T. Rajagopal, K. V. S. Badrinath, and A. P. Mitra; "GHG Emissions from Biomass Burning in India: Estimates from Satellite and Ground-based Measurements", Proceedings of IGES/NIES Workshop on GHG inventories for Asia – Pacific Region, Shonan Village Centre, Japan, 9-10 March 2000.

for Assessing Impacts and Adaptation in this sector. This activity will also draw inputs from the UNDP-GEF supported BSAP project and therefore the budget requirements are lower than the other components.

Output: A status report on vulnerable regions and sectors in India due to climate change and suggesting policy frameworks for implementing adaptation measures and response strategies. This report will also contain a priority list of proposed case studies for targeted research activities in these areas.

Activity 4.8: Coastal Zones Vulnerability Assessment and Adaptation

India is a coastal country with a coastline of over 7516 km. The Lakshadweep islands are particularly sensitive to changes in sea level and climate. In order to strengthen the management of coastal zones, the extent of impact due to rise in sea level and extreme events in the Indian coastal zone needs to be well understood, so that active adaptation strategies for India's vulnerable coastal areas may be adopted. For this purpose, it is important to analyze the trends of sea level change and the occurrence of extreme events, study the tidal difference caused by the rising sea levels, update and upgrade the database on sea level change, and assess adaptation strategies for different vulnerable coastal regions.

Output: A status report on vulnerable regions and sectors in India due to climate change and suggesting policy frameworks for implementing adaptation measures and response strategies. This report will also contain a priority list of proposed case studies for targeted research activities in these areas.

Activity 4.9: Public Health Sector Vulnerability Assessment and Adaptation

The potential changes in temperature and precipitation due to climate change will likely increase the spread of disease on the Indian subcontinent. The increased stress will be felt through higher incidence rate and mortality of vector-borne diseases, and severe impact on India's public health systems, which are already stretched to the limit. Hence, it is important to understand the extent to which public health will be affected due to climate change. Work is needed on the relationship between temperature, rainfall and humidity on incidence rate as well as mortality of various vectors including malaria and effect of climate change on heat stress and incidence of respiratory diseases due to enhanced local pollutants.

Output: A status report on vulnerable regions and sectors in India due to climate change and suggesting policy frameworks for implementing adaptation measures and response strategies. This report will also contain a priority list of proposed case studies for targeted research activities in these areas.

Activity 4.10: Water Resources Sector Vulnerability Assessment and Adaptation

Research on impact, vulnerability assessment and adaptation to climate change on India's water resources could be conducted using alternative equilibrium global circulation models (GCMs). The important dimensions include study of key river systems (e.g. Ganga, Cauvery, Narmada etc), availability of ground water, water quality and water availability. The present work will assess available information on these dimensions, evaluate the range of options for adaptation to potential climate change and variability, including the policies, costs, benefits and challenges as well as development and sustainability factors associated with impact and adaptation at regional and catchment scales.

Output: A status report on vulnerable regions and sectors in India due to climate change and suggesting policy frameworks for implementing adaptation measures and response strategies. This report will also contain a priority list of proposed case studies for targeted research activities in these areas.

Indicators for Sub-Output 4c: A portfolio of reports suggesting policy frameworks for implementing adaptation measures and response strategies in different sectors.

Sub-Output 4d: Building Capacity to Integrate Climate Change Concerns into Planning

Activity 4.11: Indian policy makers, particularly from those sectors that are likely to be more vulnerable, will be exposed to climate change issues through a workshop (refer Activity 3.1).

Output: Policy-makers will have increased awareness on climate change issues and their inter-relation with the national planning process.

Activity 4.12: Modelling tools to be used for projecting future carbon emission scenarios to assess energy efficiency requirements/investments, which can be integrated into the planning process for implementation. This may be developed as a part of Activity 3.5.

Output: Future emission projections and related policy analysis.

Indicators for Sub-Output 4d: Portfolio of future emission scenarios using different energy models for them to be implemented in the national policy planning process.

Sub-Output 4e: Programs to Address Climate Change, Adverse Impacts, Including Abatement and Sink Enhancement

Activity 4.13: Prepare an inventory of previously executed or ongoing programs that are addressing climate change, adverse impacts including abatement and sink enhancement. This activity will be apart of the sub-contract under Activity 4.6.

Output: An inventory of previously executed or ongoing programs addressing climate change, adverse impacts including abatement and sink enhancement.

Activity 4.14: Identify and support institutions/NGOs that can strengthen efforts to increase GHG sinks and undertake measures to take abatement measures. These include CO₂ sequestration through forest regeneration, clean development mechanisms, reducing CH₄ emission through fodder management and also through effective water management etc. This will be a part of the sub-contract under Activity 4.6.

Output: A list of institutions/NGOs that can strengthen efforts to increase GHG sinks and undertake measures to take abatement measures.

Indicators for Sub-Output 4e: (i) An inventory of previously executed or ongoing programs addressing climate change (ii) Strengthen research initiatives of some identified institutions involved in the sink enhancement programs.

Output 5. Other Information

Sub-Output 5a: Material Relevant for Global Emission Trends

Activity 5.1: Compile material relevant to global emission, which would include GHG inventory to be built up for the preceding years from 1980 onwards and leading upto 2000, projections of Indian emissions up to 2035 also to be made. This may be developed as a part of Activity 3.5.

Output: An inventory of global emission trends.

Indicator for Sub-Output 5a: GHG inventory for 1980-2000 and future projections.

Sub-Output 5b: Financial and Technological Needs and Constraints for Vulnerability Assessment and Adaptation

Activity 5.2: Please refer to Activities 4.5 to 4.10 under Sub-Output 4c.

Indicators for Sub-Output 5b: A portfolio of reports suggesting policy frameworks for implementing adaptation measures and response strategies in different sectors.

Sub-Output 5c: Clearing house for database on climate change.

Activity 5.3: Establish an Enabling Activity Data Centre ('clearing house') to archive the huge database generated during this project. This will include setting up necessary hardware and processing equipment, designing interactive software programs for data analysis and developing a website for data dissemination as deemed suitable by the Government of India. This Centre may be housed with the PMC. This activity will be sub-contracted.

Output: Enabling Activity Data Centre

Activity 5.4: A repository of data will be made at the Enabling Activity Data Centre (location to be decided by TAC) which will be disseminated through Internet in a user-friendly format and also the reports and publications arising out of this project will be available through the same medium.

Output: A website containing outputs of this project as deemed suitable by the Government of India.

Indicators for Sub-Output 5c: A user-friendly website.

Output 6. National Communication Document

Activity 6.1: Prepare a draft document on India's Initial national communication as per the UNFCCC guidelines.

Output: The final national communication.

Indicators: The final national communication.

The detailed workplan and activity matrix is given in annex 2 and 3. Indicative TORs for the NPD, NPM and national consultants (for the PMC), and for the other national consultants proposed for various sub-contracts are given in Annex 5.