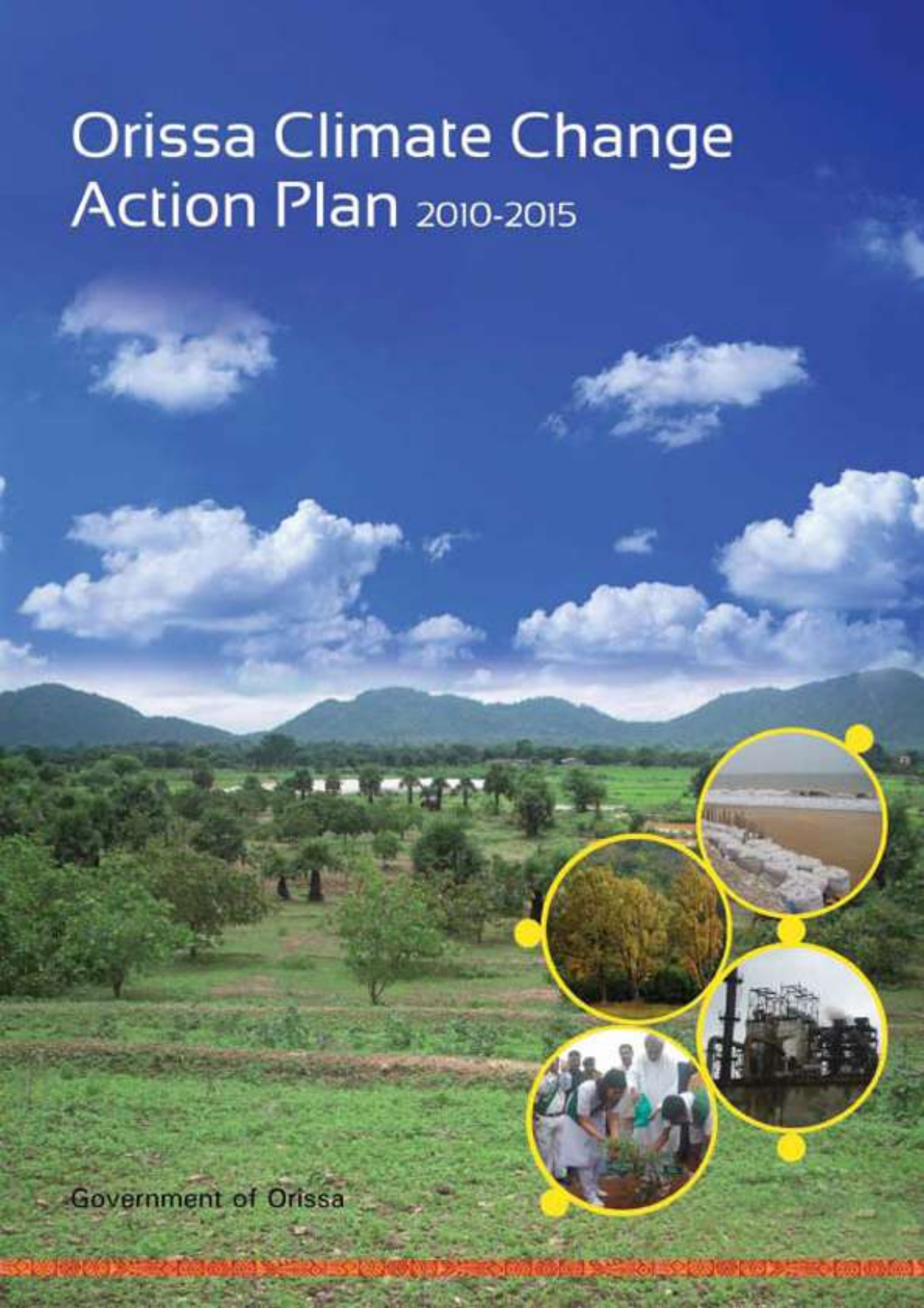
Orissa Climate Change Action Plan 2010-2015



Government of Orissa

NAVEEN PATNAIK
CHIEF MINISTER, ORISSA

सत्यमेव जयते
ORISSA STATE

MESSAGE

Man made green house gas emissions have resulted in a dramatic increase in the earth's temperature over the past century. The projected future increase over the next 100 years due to growing emissions could possibly warm the planet by 5^0C relative to the pre-industrial period. Such a change in the climate can result in physical impacts which in turn could severely limit development. Climate change has special relevance for Orissa for two reasons; because of its location and the geophysical conditions, climate change could have a disproportionate effect on the state and secondly, because the state has an urgent development imperative because of the fact that a large percentage of its population is still deprived of a decent standard living. Under these circumstances the Climate Change Action Plan for the state of Orissa assumes greater significance.

I am happy that different departments, experts and civil society have come together to look at different sectors of the state's economy and put in place an action plan which would help mitigate the impact of climate change in the state and would also help the people cope with climate change. I hope that the action plan will be implemented in right earnest so that the possible adverse impacts of climate change are minimized and the development process is carried out in a manner which reduces carbon foot prints. It will also be necessary to demystify the processes in order that the common people who are the most important stakeholders become willing partners in the implementation of the action plan.

(NAVEEN PATNAIK)

SHRI DEBI PRASAD MISHRA
Minister
Forest & Environment, Orissa

MESSAGE

Climate Change is one of the most important global environment challenges facing humanity with implications for Food Production, Water Supply, Health and Energy, etc. Addressing climate change requires a good scientific understanding as well as coordinated action at Regional, National and Global Level. The adaptive capacity of community likely to be impacted by Climate Change is low in developing countries.

Our state is endowed with rich natural resources which have made us more vulnerable, since three-fourth of our state's population depends on climate sensitive natural resources based livelihood such as Agriculture, Forestry and Fisheries. For more than a decade, the state has been experiencing contrasting extreme weather conditions; from heat waves to cyclones; from droughts to floods. In last four years, calamities have claimed few thousand lives.

Climate change has the potential to derail the current growth strategies and deepen poverty. Considering the concern, our State has taken an early initiative to formulate Climate Change Action Plan in a holistic manner. The Climate Change Action Plan is first of its kind and innovative one. It has focused on 11 critical sectors having linkages to climate change and this is our critical first step and we have a long way to go in reducing the vulnerability. The purpose of the Climate Change Action Plan is to strengthen institutional capacities of different Stage Agencies to integrate environment and climate change issues in development planning, policies and sectoral programmes.

I wish this Climate Change Action Plan will be the foundation stone for preparation of an implementable schedule within a time frame which is urgently required to form an overarching strategic framework for the developmental policy and planning in the State.

(DEBIPRASAD MISHRA)

AUROBINDO BEHERA
Principal Secretary,
Forest & Environment Department

FOREWORD...

Orissa is one of the first states to formulate a comprehensive action plan to address the climate change issues. The plan which has been formulated by an inter-departmental team is a coordinated government response to this important problem which looms large. The plan also incorporates civil society inputs. The climate change advisory firm, CTRAN, was the knowledge partner in facilitating the preparation of the action plan and World Bank provided the sectoral experts who have shared their expertise in giving shape to the plan. The Action Plan which is for a period of five years identifies measures that address climate change issues while recognising the developmental imperatives in the State of Orissa.

The implementation of the plan will be actively monitored. If needed, it will be adapted to changing circumstances. It is our hope that the Climate Change Action Plan will foster cooperative approaches rather than relying exclusively on command and control mandates. There is an implicit assumption that private sector units, civil society and government would work together to improve environmental performance while pursuing goals of economic development in the state. While many of the proposed actions are already a part of Government's regular activities and existing programmes, additional initiatives would also be required on the part of different government departments. A climate change cell has been set up in the Forest and Environment Department to closely coordinate all the recommended actions and also work towards resource mobilisation to implement different components of the action plan in a systematic and time bound manner.

I am sure with the active involvement of all the stakeholders, Orissa would be in a position to achieve important milestones in realising the goal of a climate resilient society.

Aurobindo Behera,
(AUROBINDO BEHERA)

BHAGIRATHI BEHERA, IFS
Director,
Environment Cum Special Secretary,
Forest & Environment Department
Government of Orissa

Acknowledgement

This Climate Change Action Plan has been prepared by Forest and Environment Department of Government of Orissa under the guidance of Principal Secretaries of the Department. The overall guidance and support of Sri T K Mishra, Former Chief Secretary and Sri B K Pattnaik, Chief Secretary, Orissa is gratefully acknowledged. We are indebted to Sri U N Behera, former Principal Secretary of Forest and Environment Department and Dr Aurobindo Behera, Principal Secretary of Forest and Environment Department for their support and constant guidance throughout the preparation of Action plan to bring it to a definite shape. Thanks are due to all Chairpersons, Convenors and working group members of all 11 sectors who had taken pains to participate in deliberations and working group facilitation and moderation of various inputs. Thanks are due to Dr Virinder Sharma of DFID for initial scoping study, Dr Muthukumar Mani and Dr Vaideeshwaran of World Bank for extending technical support and providing sectoral experts for preparing draft Climate Change Action Plan. Thanks are also due to Sri Ashok Kumar Singha, CEO of CTRAN Consulting services and his team members for their active support in consultation workshop and in preparing the draft. Significant contributions from number of Non-Government Organisations, Civil Society Representatives and members of the political parties and academic institutions at several meetings and consultation workshops held at various stages are gratefully acknowledged.

Bhagirathi Behera

(BHAGIRATHI BEHERA,IFS)

Contents

Abbreviations and Acronyms

BCM	Billion Cubic Metres
CEA	Central Electricty Authority
CAP	Climate Change Action Plan
CBO	Community Based Organization
CDM	Clean Development Mechanism
CDP	Comprehensive Development Plan
CNG	Compressed Natural Gas
CO_2	Carbon Dioxide
CPP	Captive Power Plant
DFID	Department for International Development, UK
DPR	Detailed Project Report
DSM	Demand Side Management
ECBC	Energy Conservation Building Code
FSI	Forest Survey of India
GHG	Green House Gas
GoI	Government of India
GoO	Government of Orissa
GSDP	Gross State Domestic Product
ICZMP	Integrated Coastal Zone Management Project
IPCC	Inter-Government Panel on Climate Change
IPP	Independent Power Producer
IPR	Industrial Policy Resolution
JFM	Joint Forest Management
km	Kilometre

LPG	Liquefied Petroleum Gas
Mm	Millimetre
MoEF	Ministry of Environment & Forests
MRTS	Mass Rapid Transport Systems
MSME	Micro, Small & Medium Enterprise
MT	Metric Tons
MW	Mega Watt
MSW	Municipal Solid Waste
NAPCC	National Action Plan on Climate Change
NTFP	Non-timber Forest Produce
NTPC	National Thermal Power Corporation
OERC	Orissa Electricity Regulation Commission
OREDA	Orissa Renewable Energy Development Agency
OSDMA	Orissa State Disaster Management Agency
OWDM	Orissa Watershed Development Mission
PV	Photovoltaic
Rs.	Rupees
SEZ	Special Economic Zones
T & D	Transmission and Distribution
ULB	Urban Local Bodies

Summary

Why Climate Change is a Serious Issue for Orissa?

With a 480 km coast line that is prone to climate-mediated cyclones and coastal erosion and water resources dependent on monsoons, Orissa is relatively more vulnerable to climate change. Water-consuming rice is its main crop and therefore its agriculture is vulnerable to the vagaries of climate-induced weather changes. Though 38 percent of the state's geographical area is recorded as forests, much of these forests are degraded. Vector-borne diseases, particularly malaria, are fairly rampant and climate change may make the prevalence of the disease even more widespread.

Indeed, climate change has the potential to derail the current growth strategy and deepen poverty in Orissa. Continuing climate variation is predicted to alter the sectoral growth, including the ability of the poor to engage in farm and non-farm sector activities. The direct impacts of extreme climate-induced events could include loss of life, livelihoods, assets and infrastructure. All of these could affect the state's economic growth and nullify the effectiveness of macro economic policies and pro poor initiatives.

Climate Risks in Orissa

- High variability of rainfall, leaving people with two peak periods of food shortage
- Drought and dry spells at an interval of every two years in Western Orissa with a major drought every 5-6 years
- Flash floods during rainy season
- Heat waves in summer
- Intense coastal flooding and cyclones

What the Government of Orissa (GoO) is doing?

Context

Of late Orissa has made significant progress in economic and fiscal terms. The Gross State Domestic Product (GSDP) during the 10th five year period (2002-2007) has grown by 8.5 percent per annum which is slightly more than the national rate. Private investment of funds in the state has increased, employment opportunities have grown and growth is also leading to poverty reduction. A remarkable fiscal turnaround was achieved through the state's own efforts and complemented by performance-linked support from the central government. The state's 11th Five Year Plan focuses on addressing the challenges in achieving sustainable, shared economic growth and accelerating human development. GoO recognizes that climate change should not undermine the process of economic development.

Process

Orissa took an early initiative to formulate the State Climate Change Action Plan (CAP). The Chief Minister appointed a High Level Coordination Committee headed by the Chief Secretary to steer its preparation. Eleven sectoral missions were identified and inter-departmental representation ensured co-ordination among sectors. Individual working groups under the chairmanship of concerned departmental Secretaries who are also members of high level coordination committee, deliberated on the issues.The support for the process was available from the World Bank and DFID. The Working Groups interacted with experts in various sectors. Key priorities consistent with those of the National Action Plan on Climate Change (NAPCC) were identified (Agriculture, Coastal Zones and Disasters, Energy, Fisheries and Animal Resources, Forestry, Health, Industry, Mining, Transport, Urban Planning and Water Resources). These key priorities were vetted through a series of stakeholder consultations held at Bhubaneswar, Berhampur, Anugul and Balasore in which representatives of business as well as civil society organisations participated. A synthesis workshop in Bhubaneswar collated and discussed all the feedback received and relevant inputs were incorporated in the CAP.

High-Level Coordination Committee

Chief Secretary	Chairman
Development Commissioner	Member
Agriculture Production Commissioner	Member
Principal Secretary, Finance Department	Member
Principal Secretary, Housing and Urban Department	Member
Principal Secretary, Fisheries and ARD,	Member
Principal Secretary, Steel and Mines Department	Member
Commissioner-cum-Secretary, Agriculture Department	Member
Commissioner-cum-Secretary, Commerce & Transport Department	Member
Commissioner-cum-Secretary, Health and Family Welfare Department	Member
Commissioner-cum-Secretary, Revenue & Disaster Management Department	Member
Commissioner-cum-Secretary, Energy Department	Member
Commissioner-cum-Secretary, Industry Department	Member
Commissioner-cum-Secretary, Water Resources Department	Member
Managing Director OSDMA	Member
Principal Secretary, Forest & Environment Department	Member Convenor

Agriculture

Agriculture holds a predominant position in the state's economy. About 80-85 percent of the state's population is rural and depend on agriculture. The agriculture sector contributes about 26 percent of the GSDP. With almost 60 percent of land under rain fed agriculture and with water-dependent rice, as its main crop, the agriculture sector is particularly vulnerable to the vagaries of climate change. Further, paddy fields in the coastal areas are prone to frequent erosion, salinisation and inundation. Climate projections indicate that drier areas will become drier and flood prone areas will be subject to more flooding. Other problems such as pest and disease outbreaks are also likely to increase due to climate variability.

Agriculture – Key Priorities

- Rapid screening and strategy assessment of State Agriculture Policy
- Establishing an effective institutional delivery mechanism to promote best practices on climate change
- Undertaking capacity building
- Continuing the livelihood-focused, people-centric integrated watershed development in rain fed areas
- Increasing the area under perennial fruit plantation
- Developing water use-efficient micro irrigation methods and individual / community farm ponds
- Improving monitoring and surveillance techniques
- Developing sustainable soil, water and crop management practices
- Breeding studies on major crops for tolerance /resistance
- Conducting climate-linked research studies

Coastal Zones and Disasters

Orissa has long been prone to disasters. Frequent droughts, floods and cyclones are recurrent features in the state and have had a crippling effect on the economy. In 1999 a severe cyclone followed by a super severe cyclone lashed the entire coast of Orissa causing large scale loss of life. Whilst the extent to which climate change will exacerbate floods and droughts is not yet fully understood, it is clear that their frequency and intensity will increase. While Orissa has done pioneering work on disaster management through the Orissa State Disaster Management Authority (OSDMA), the first of its kind in the country, there is a considerable need to improve own understanding of the climatic impacts on disasters and to build capacity of communities to adapt, manage and mitigate their impacts.

Coasts & Disasters – Key Priorities

- Flood mapping, flood forecasting and downscaled climate change projections modeling
- Assessment of erosion prone areas with the help of Digital Elevation model
- Studying coastal erosion
- Conducting micro-level vulnerability assessment
- Constructing flood shelters in unconventionally vulnerable locations
- Needs assessment and constructing multipurpose cyclone shelters
- Developing a hydrological framework
- Dredging and river mouth widening to improve flood management
- Strengthening coastal protection methods
- Developing a techno-legal regime for construction of disaster resilient housing and public infrastructure
- Integrating climate change risk in the state's disaster management policy
- Setting up an integrated training and capacity building protocol
- Assessment of risks due to lightning and thunderstorm
- Improving flash flood management
- Prediction through appropriate modeling the impact of sea level rise on coastal ecosystem
- Study of impact of global warming on the biodiversity of coastal ecosystem with special emphasis on flagship species

Energy

The need for energy is increasing in Orissa which is poised for rapid industrial development. With abundant reserve of coal, power generation is bound to be a priority. Orissa is also on the way to becoming a major energy supplier to the grid and this could come at a high cost in terms of both local environmental quality and contribution to global emissions. The State has had the distinction of being the first state in the country for ushering in sweeping reforms in power sector, which had the objective to provide consumers with reasonably cheap, reliable and uninterrupted supply of power. There are already several initiatives to promote renewable energy, reduce Transmission & Distribution (T&D) losses and to promote energy efficiency in the state. All these efforts become much more important in the climate change context.

Key priorities - Energy

- Generating cleaner energy through clean coal approaches
- Institutional development (Capacity building/ restructuring) of Energy Department
- Reduction of Transmission & Distribution losses
- Promoting demand side management & energy efficiency
- Fly ash utilization and emission reduction from power plants
- Promotion of Small and Medium Hydel plants
- Harnessing biomass potential
- Promotion of Grid based wind power generation
- Maximize solar power generation
- Development of Biogas and manure management

Fisheries and Animal Resources

Being water dependent, the fisheries sector in Orissa will be impacted by climate change. The livelihoods of the fisher folks will be affected most, not only due to sea level rise and climate mediated hazards, but also due to erratic rainfall that affects the open reservoirs and ponds/tanks. Animal resources - support a large part of rural livelihoods – will be impacted by heat stress and other climatic impacts. Methane emission from the livestock is a key concern.

Fisheries and Animal Resources – Key Priorities

- Vaccination against contagious diseases,
- Deworming and early disease warning system, emphasis on Green fodder, pasture development and grazing,
- Training on fodder production, fodder conservation, rotational grazing, Rain Water harvest technology, Methane gas harvesting technology, biogas tanks management
- Conservation of local hardy animals.
- Gobar Gas tanks/packing to cylinders
- Easy and handy Methane Harvest at farmers point
- Enhancing Disease Early Warning Systems with climate change considerations
- Application of biotechnology and skilled animal breeding for development of better adopted species
- Capacity building of livestock keepers
- Research on disease early warning system relevant to livestock
- Impact of climate change on inland and coastal aquaculture
- Development of infrastructure for early warning systems in coastal areas for fishermen

Forests

Forests provide livelihoods to a large proportion of tribal populations and rural poor. The forests also have important ecological functions, checking soil erosion and reducing the impact of droughts, floods and cyclones (mangroves).

Mining and other industrial projects are bound to have some adverse effects on forests, and would create conflicts between wild animals and local inhabitants due to fragmentation of forests. Forestry sector is also particularly important both from climate mitigation as well as adaptation perspectives. While no assessment of the impact of climate changes on Orissa's forests has yet been undertaken, it is nonetheless necessary to evaluate the long-term effects of climate change on forests and determine what the community might do in response.

Forestry - Key Priorities

- Increasing reforestation / afforestation activities in degraded forest areas
- Protecting existing forest stocks to act as carbon sink with stronger conservation
- Increasing planting on non-forest land and also exploring where new and increased tree planting could create barriers to storm and cyclone impacts in coastal zones
- Covering bald-hills with suitable species mix
- Increasing and protecting existing mangrove cover along the coast
- Assessing fire management strategies
- Improving tree planting and forest management to integrate with watersheds and water resources management
- Working to establish new systems to support for community users.
- Undertaking studies on indigenous trees species to assess their vulnerability to climate change
- Assessing additional threats to biodiversity and wildlife
- Obtaining access to updated knowledge on climate change science and policy developments
- Capacity building of Panchayati Raj institutions/communities/JFM institutions to adapt to climate change
- Monitoring carbon stock and biodiversity at regular intervals

Health

In Orissa, increased health risks will arise due to climate change. There is already high prevalence of malaria and vector-borne diseases in certain areas. With erratic nature of rainfall and extending seasons, these may become more widespread. Climate change has the potential to aggravate vector-borne, water-borne and food-borne diseases . The intensity and frequency of extreme events such as heat waves and cyclones could further expose the vulnerable population to health risks.

Health - Key Priorities

- Capacity Building of the health sector on climate change
- Integrating climate change considerations in the State Health policy
- Strengthening approaches to manage vector borne disease that have worsened due to climate change impacts
- Strengthening approaches to deal with heat wave conditions exacerbated due to climate change
- Strengthening approaches to deal with the physical and psychological impacts due to extreme weather conditions caused by climate change
- Addressing drought, nutrition & food security due to increased risk of drought, consequent decline in agriculture and increased malnutrition & food security
- Undertaking measures to manage water borne disease that have worsened due to climate change impacts
- Research & studies on climate change and health impacts
- Addressing food safety that is undermined as a result of increased ambient temperatures and extreme events
- Studying the interlinkages between air quality and climate change, and implications on health

Industry

The industrial sector in Orissa mainly comprises mineral-based industries. Since these industries are energy-intensive, the acceleration of industrialization is closely linked to carbon emission. There is significant potential for improving energy efficiency through the use of cleaner production technologies, methods and practices. The workers in mineral-based industries have to work in extremely hot conditions and with the likely increase in the average temperatures due to climate change, this will also become an occupational health issue in future. With the prediction of increased intensity and frequency of extreme weather events, protection of coastal industrial assets will have to be accorded greater attention.

Industry - Key Priorities

- Integrating climate concerns in policies and plans
- Assessing GHG profiles of major industrial clusters
- Conducting heat-island study for Talcher and Jharsuguda area
- Training various stakeholders on climate change issues
- Implementing a system of compensatory water harvesting
- Streamlining institutional arrangement and strengthen OSDMA to tackle extreme climate events in coastal area
- Carrying out energy efficiency studies
- Promoting recovery, recycle and reuse of waste material
- Setting emission standards for thermal power plants

Mining

Mining is a major economic activity in the state and it contributes significantly to the growth process. Yet mining in Orissa has serious local environmental and social impacts. These include air pollution (particulates), water pollution (mine water discharges), social impacts (displacement and rehabilitation) and forest impacts (most of the mining area is in forest areas or in their vicinity). Mining being energy intensive is also a big contributor to global greenhouse gas emissions.

Mining – Key Priorities

- Incorporating climate concerns in State Mineral Policy
- Analyzing appropriate policies to promote energy-efficiency
- Realizing the potential of low-grade mineral beneficiation
- Strengthening environmental monitoring
- Protecting water bodies
- Expanding and maintaining green zones
- Building capacity and generating awareness
- Realizing energy-savings potential in mining

Transport

Increasing motorization with greater availability of affordable vehicles has resulted in a commensurate increase in the emissions from the transport sector. In the absence of railway connectivity to interior areas and without any inland water way worth the name. Orissa is largely dependent on the road network that is the least carbon friendly among different modes of transport. This has local pollution implications as well. No alternative such as less carbon-emitting CNG fuel exists in the state and effort to move to a more carbon-friendly mass rapid transport system is only at a very early stage.

Transport – Key Priorities

- Revising state transport policies
- Integrating urban and transport planning
- Enhancing the use of rail
- Moving towards low carbon fuel
- Piloting low carbon, green highways
- Encouraging fuel use efficiency and tightening enforcement
- Promoting non-motorized transport
- Sequestering carbon through avenue plantations
- Estimating carbon emissions from the sector
- Developing inland waterways

Urban Planning

The continuous exodus of rural population to urban areas in Orissa has contributed to urban growth. There is already a severe strain on the existing urban infrastructure. However, as the population living in urban areas in Orissa is significantly lower than the national average, GoO is in a unique position to chart out an urban development path that is based on lessons from past mistakes / experiences of other Indian cities (particularly the metropolitan cities). Given the climate change dimension, Orissa can go further by defining a climate-responsible urban development path.

Urban – Key Priorities

- Building capacity on climate change
- Incorporate climate considerations in water supply and sewerage design
- Working towards greater water-efficiency
- Preparing a climate-friendly MSW management plan
- Orienting towards energy-efficient street lighting through CDM
- Developing a climate-responsible master plans
- Strengthening infrastructure for promoting non-motorized transport
- Improvements to water harvesting in urban areas with restoration of water tanks and artificial recharge
- Developing models of urban storm water flows and capacities of existing drainage systems with climate change

Water

Impact of climate change on water resources in Orissa is likely to be due to the vagaries of monsoons creating variability in river flows and increased frequency/intensity in extreme events such as floods, droughts and cyclones. Heavy flood or drought occurs almost every alternate year due to disproportionate distribution of rainfall. In recent years, wide fluctuation in climate has been observed and irregular rainfall causing both floods and droughts is a major concern. The impact of droughts on farmers has been crippling in some areas.

Water Resources – Key Priorities

- Expansion of hydrometry network
- Development of flood forecasting models
- Downscaling of Global Circulation Model
- Increasing the water use efficiency in irrigation
- Constructing and protecting water harvesting structures
- Improving drainage systems
- River health monitoring and eco-systems environmental flow demand studies
- Raising awareness raising with Pani Panchayat through Farmers' Training Programme and creating agro-climatic stations
- Integrated Water Resources Management

Way Forward

The CAP will lead Orissa to move towards a carbon-conscious, climate resilient development path. A monitoring and evaluation framework will be put in place to supervise progress and effectiveness of interventions. Besides the existing provisions in the budget for activities which are climate and environment friendly, additional resources which may be required for undertaking mitigation and adaptation measures will also have to be located. A rough and ready estimate puts the resource requirement at Rs. 17000 crores over a period of five years. Efforts would be made to take advantage of global funds available for both adaptation and mitigation. Setting up a climate change cell/agencies would be considered to provide a single-window contact.

Chapter 1

Background

1.1 Introduction

The Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) indicates that the Earth's climate is changing at an unprecedented pace with potentially serious economic impacts and implications for sustainable development. Climate model projections indicate that global average temperature will increase, with disproportionately higher temperatures in the tropics and at the poles. South Asia is especially vulnerable to climate change due to its high levels of population density, prevalent poverty and a high dependence on natural resources.

India is already the fifth largest emitter of greenhouse gases. From the viewpoint of per capita emissions, India's contribution is very low but it is substantial in a cumulative sense. Climate projections for India suggest that impacts are likely to be varied and heterogeneous, with some regions experiencing more intense rainfall and flood risks, while others will encounter sparser rainfall and prolonged droughts. Among the more substantial effects is a projected spatial shift in the pattern of rainfall towards the already flood-prone coastal areas, while water-scarce regions become even more drought-prone and unproductive. India will also suffer from higher tides, more intense storms fueled by warmer oceans and further erosion along its coastline due to sea level rise. For India, climate variability and climate change pose huge risks to human life and threaten to endanger the sustainability of the country's fast growing economy. India's immense geographic diversity adds to the complexity of developing and implementing an adaptation strategy. The impacts will vary across states, sectors, locations and populations. Consequently, there can be no one-size-fits-all climate change strategy. Approaches will need to be tailored to fit state and local vulnerabilities and conditions.

In June 2008, Government of India's (GoI) National Action Plan on Climate Change (NAPCC) was announced. The objective is to adapt and to enhance ecological sustainability of India's development path. The vision is to create a prosperous (not wasteful) self-sustaining economy. The principle is to maintain a high growth rate and reduce vulnerability. There are 8 national missions that are to be developed in greater detail (Refer to Chapter 3 for a further elaboration). These include the following subjects: solar, energy efficiency, water, sustainable habitat, water, Himalayan eco-system, forests, sustainable agriculture and strategic knowledge. In August 2009, the Hon'ble Prime Minister of India urged each state Government to formulate its own state level action plan consistent with the strategies in the National plan. This was re-emphasized by the Union Minister of State, Environment & Forests (MoEF), at the meeting of the Chief Secretaries in February 2010. Simultaneously the Honb'le Chief Minister Shri Naveen Pattanaik, while expressing his concern as the climate change issues, constituted the High Level Co-ordination committee for formulation of State Climate Change Action Plan for Orissa.

Orissa is a state that is endowed with a variety of mineral resources. It has the potential to generate coal-based thermal power not only to meet the state's needs but also need of the region. Being mineral-rich, the state has a predominance of mineral-based industries that are both energy and water intensive. The energy, mining and industry sector also contribute to the local environmental and social problems. About 38 percent of the state's geographical areas belong to the catagory of forests, and therefore in an advantageous situation in terms of providing for carbon sinks. The state also has 10 percent of the country's water resources for just 4 percent of the population. There is sufficient water in the state as a whole but still there are water shortages in certain parts of the state and in certain times of the year. Agriculture is largely rainfed as the irrigation network is limited.The main crop of the state is rice, which is highly water-intensive crop. It has a 480 km vulnerable coast line, which is prone to climate risks such as cyclones and coastal erosion. In terms of health, the vector-borne disease - malaria - is fairly rampant in many parts of the state. Given its profile, climate change is an important concern for the state as it is presently on a carbon-oriented development path and at the same time, it is vulnerable to climate variations.

GoO recognizes that the climate change has the potential to erode the progress achieved and to be achieved through economic growth. Given its importance, GoO is committed to demonstrate continued leadership in this new and important area.

1.2 Methodology

GoO initiated the climate change scoping study with a view to understanding the range of issues that need to be addressed. GoO provided information on possible issues and the Orissa context to consultants who put together a short, focused report on the issues that GoO needs to address. Most of the GoO Departments that deal with activities which contribute to carbon dioxide emissions or will need to adapt to climate change were consulted during the scoping study. This scoping study was done between November 2009 and February 2010.

When the findings of the scoping study were presented, GoO decided to establish a High Level Co-ordination Committee headed by the Chief Secretary to steer the preparation of the CAP. This was done recognizing the need for the senior bureaucracy within the GoO to be involved in the assessment of climate change issues that the scoping study revealed. The composition of the Committee is shown in the adjoining text box. At the same time, the GoO established 11 working groups to cover issues in 11 different sectors that are relevant to climate change. The list of the working groups formed and sectors addressed are in the text box

High-Level Coordination Committee

Chief Secretary	Chairman
Development Commissioner	Member
Agriculture Production Commissioner	Member
Principal Secretary, Finance Department	Member
Principal Secretary, Housing and Urban Department	Member
Principal Secretary, Fisheries and ARD,	Member
Principal Secretary, Steel and Mines Department	Member
Commissioner-cum-Secretary, Agriculture Department	Member
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Commissioner-cum-Secretary, Energy Department	Member
Commissioner-cum-Secretary, Industry Department	Member
Commissioner-cum-Secretary, Water Resources Department	Member
Managing Director OSDMA	Member
Principal Secretary, Forests & Environment Department	Member-Convenor

below. GoO ensured that the membership was drawn not only from the primary department but also from the different associated departments/organisations. Chaired by the Principal Secretary/Secretary of the primary Department, meetings were held by these working groups to deliberate on the relevance of climate change pertaining to the sectors in the Orissa context. A convenor was appointed to co-ordinate the regular conduct of meetings, to collect/collate the required information and to develop the plans pertaining to each of the sectors. Annex 1 provides the composition of all the working groups – chairpersons, convenors and the individual members.

Templates were prepared for listing the various activities relevant to climate change, prioritizing the activities as high, medium and low priorities, and developing an outline of the sub-activities to be done under the high priority activities while estimating the budget and sources of funding. These templates are included in Annex 2. Each Working Group completed these templates and the high priority activities were reviewed. In the deliberations of the high priorities during the meeting of the High-Level Co-ordination Committee, it was agreed that each Working Group will rationalize and determine about 10-12 key priorities which will be focus of the first period of the CAP [2010-2015].

To provide technical advice to these working groups, climate change specialists as well as national / international sector experts were invited for interactions on different subjects. This ensured that the working groups were on track, were addressing issues that are important in context of Orissa and were in line with the responses both at the national/ international level. A list of climate change specialists and sector experts, who advised the different working groups, is provided in the Acknowledgements.

Using the scoping study findings as the first-cut, the different working groups expanded to all the possible activities that are relevant in the climate change context in their respective sectors. Recognizing that all activities are equally important , the working groups developed a prioritization approach to divide the comprehensive list of activities into high, medium and low priority activities. Once this was done, the working groups went ahead and defined key priorities in order to get a sharper focus. Finally, each working group identified 10-12 key priorities for the five year period between 2010 and 2015. Description of the key priorities was developed, organizations to be involved in the implementation were identified and budgets to implement these activities were estimated.

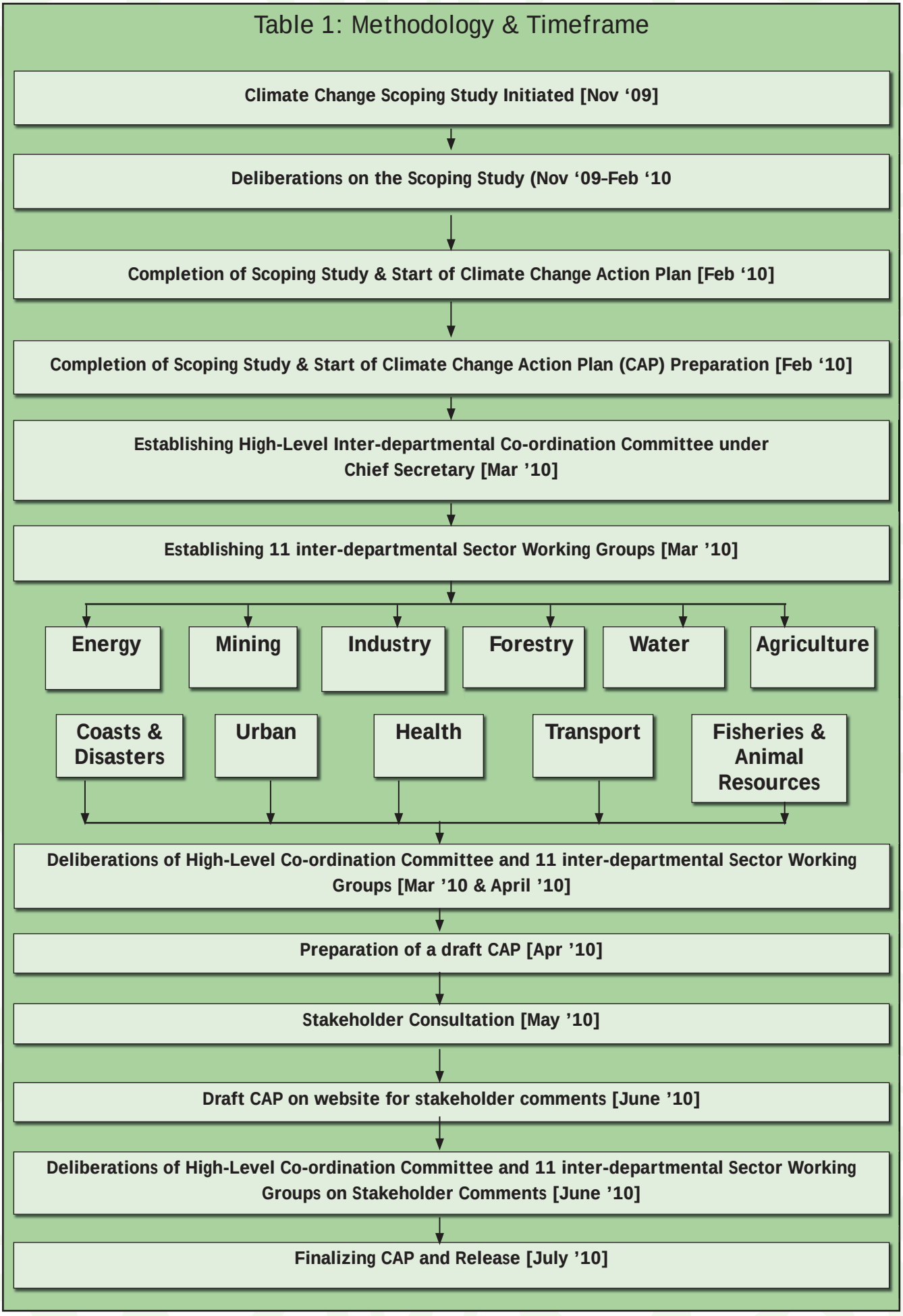
Working Groups

- Agriculture
- Coastal Zones and Disasters
- Energy
- Fisheries and Animal Ressources
- Forestry
- Health
- Industry
- Mining
- Transport
- Urban Planning
- Water Resources

The process adopted and the key priorities identified were then shared with the external stakeholders. With a view to collecting feedback from across the state, GoO arranged stakeholder consultation workshops at Bhubaneswar, Berhampur, Angul and Balasore. In each of these consultation workshops, specific sectors were discussed in detail. These stakeholder consultations concluded with a synthesis stakeholder workshop that covered all the 11 sectors. The feedback obtained from these stakeholder workshops were considered by the different working groups.

The scoping study was done with technical support from the Department for International Development (DFID), UK. The World Bank provided technical assistance in providing

Table 1: Methodology & Timeframe



the climate change experts, assigning the sector experts to different working groups and in supporting the external stakeholder consultations. DFID-UK also assisted in sourcing sector experts and provided support for the first printing of this CAP document.

1.3 Structure of the CAP document

The CAP document begins with this background chapter, which introduces the context, provides the methodology and outlines the structure of the document. The second chapter gives an overview of the National Action Plan on Climate Change, eight missions and other initiatives. The third chapter describes the vulnerability assessment of Orissa and highlights climate sensitivity from both biophysical and socio economic perspectives. The fourth chapter indicates the green house gas emission with per capita emission in the state.

The next chapter highlights a detailed overview of the Climate Change Issues relevant to Orissa. This covers all the 11 sectors and also includes a section that identifies the issues that are cross cutting. The subsequent chapter analyses and synthesizes the sector information to arrive at the key findings. The last chapter provides the conclusions and recommendations. The Annexes include the composition of the working groups (Chairpersons, Convenors and Members), list of external stakeholder consultations held, summary of stakeholder consultations, sectorwise table of key priorities, comprehensive list of activities considered and list of references.

Chapter 2

National Action Plan on Climate Change

2.1 Introduction

India released its National Action Plan on Climate Change (NAPCC) on 30th June 2008 to outline its strategy to meet the challenge of Climate Change. The National Action Plan advocates a strategy that promotes, firstly, the adaptation to Climate Change and secondly, further enhancement of the ecological sustainability of India's development path.

2.2 Approach to Climate Change

The National Action Plan recognises that climate change is a global challenge and, that it should be successfully overcome through a globally collaborative and cooperative effort based on the principle of equity. The Action Plan expresses India's willingness to play its role as a responsible member of the international community and to make its contribution. However, it emphasises that, this requires not only sustainable production processes, but also sustainable life styles across the globe. In this effort, every citizen of the planet should have an equal share of the planetary atmospheric space. The Action Plan suggests that the long-term convergence of per capita GHG emissions is the only equitable basis for a global agreement to tackle climate change. The Action Plan assures the international community that India's per capita GHC emissions would not exceed the per capita GHG emissions of developed countries, despite India's developmental imperatives.

2.3 Domestic Action

India's National Action Plan stresses that maintaining a high growth rate is essential for increasing living standards of the vast majority of people of India and reducing their vulnerability to impacts of climate change. Accordingly, the Action Plan identifies measures that promote the objectives of sustainable development of India while also yielding co-benefits for addressing climate change. Eight National Missions which form the core of the National Action Plan represent multi-pronged, long term and integrate strategies for achieving key goals in the context of climate change. The focus is on promoting understanding of Climate Change, adaptation and mitigation, energy efficiency and natural resource conservation. While, several of these programmes are already a part of the current actions, the Action Plan seeks to enhance them in scope, and effectiveness and implement them in an accelerated manner through time bound plans.

2.3.1 Solar Mission

This mission aims at promoting the development and use of solar energy for power generation and other uses, as well as to render solar energy competitive with fossil-based energy options in urban areas, industry, and commercial establishments. Its goal is to generate at least 10,000 megawatts of solar power and to create a solar research center, among other things.

2.3.2 Mission for Enhanced Energy Efficiency

This mission seeks to yield savings of 10,000 megawatts by 2012 through the implementation of certain initiatives, such as energy incentives (including differential taxation on energy-efficient appliances); setting up financing platforms for public-private partnerships to reduce energy consumption through demand-side management programs; and establishing a system for large energy-intensive industries and facilities to trade energy-savings certificates so that they can meet government-mandated reductions in energy consumption, as per the Energy Conservation Act.

2.3.3 Mission on Sustainable Habitat

This mission seeks to promote energy efficiency in urban planning through measures such as putting more emphasis on urban waste management and recycling, strengthening the enforcement of automotive fuel economy standards, using pricing measures to encourage the purchase of fuel-efficient vehicles, and providing incentives for people to make greater use of public transportation.

2.3.4 Water Mission

This mission aims to increase water use efficiency by 20 percent through pricing and regulatory measures, including the recycling of wastewater, increases in irrigation efficiency, and incentives to promote water-neutral or water-positive technologies and groundwater recharge.

2.3.5 Mission for Sustaining the Himalayan Ecosystem

This mission seeks to promote the conservation of biodiversity, forest cover, and other ecological values in the Himalayan region to help stop the retreat of glaciers, as they constitute a major source of India's water supply.

2.3.6 Mission for a "Green India"

The mission plans to expand forest cover in India by 10 percent through afforestation of 6 million hectares of degraded forest lands.

2.3.7 Mission for Sustainable Agriculture

The mission will foster adaptation in the agricultural sector by supporting the development of climate-resilient crops and the expansion of weather insurance mechanisms, among other measures.

2.3.8 Mission on Strategic Knowledge for Climate Change

This mission will promote "a better understanding of climate science, impacts and challenges." It calls for the establishment of a new Climate Science Research Fund, improved climate modeling, and increased international collaboration. It will also foster private sector initiatives aimed at developing adaptation and mitigation technologies through venture capital funds.

2.4 Other Initiatives

Apart from the eight National Missions, the National Action Plan also envisages other initiatives aimed at enhancing mitigation and adaptation. These include research & development in the area of ultra super critical boilers in coal-based thermal plants; integrated gasification combined cycle technology to make coal based power generation efficient; setting up more combined cycle natural gas plants; promotion of nuclear energy through adoption of fast breeder and thorium-based thermal reactor technology in nuclear power generation; adoption of high-voltage AC and high-voltage DC transmission to reduce technical losses during transmission and distribution; small and large scale hydro power; promotion of renewable energy technologies such as bio-mass combustion and gasification-based power generation;

enhancements in the regulatory/tariff regimes to help mainstream renewable-based sources in the national power system; and renewable energy technologies for transportation and industrial fuels. In addition, the Action Plan envisages effective disaster management strategies that include mainstreaming disaster risk reduction into infrastructure project design, strengthening communication networks and disaster management facilities at all levels; protection of coastal areas, provision of enhanced public health care services, and assessment of increased burden of disease due to climate change. The Action Plan also highlights the role of Central Government, State Governments and local Bodies in putting in place appropriate delivery mechanisms and building adequate capacity and knowledge in the relevant institutions for effective adaptation and mitigation actions.

2.5 Institutional Mechanism

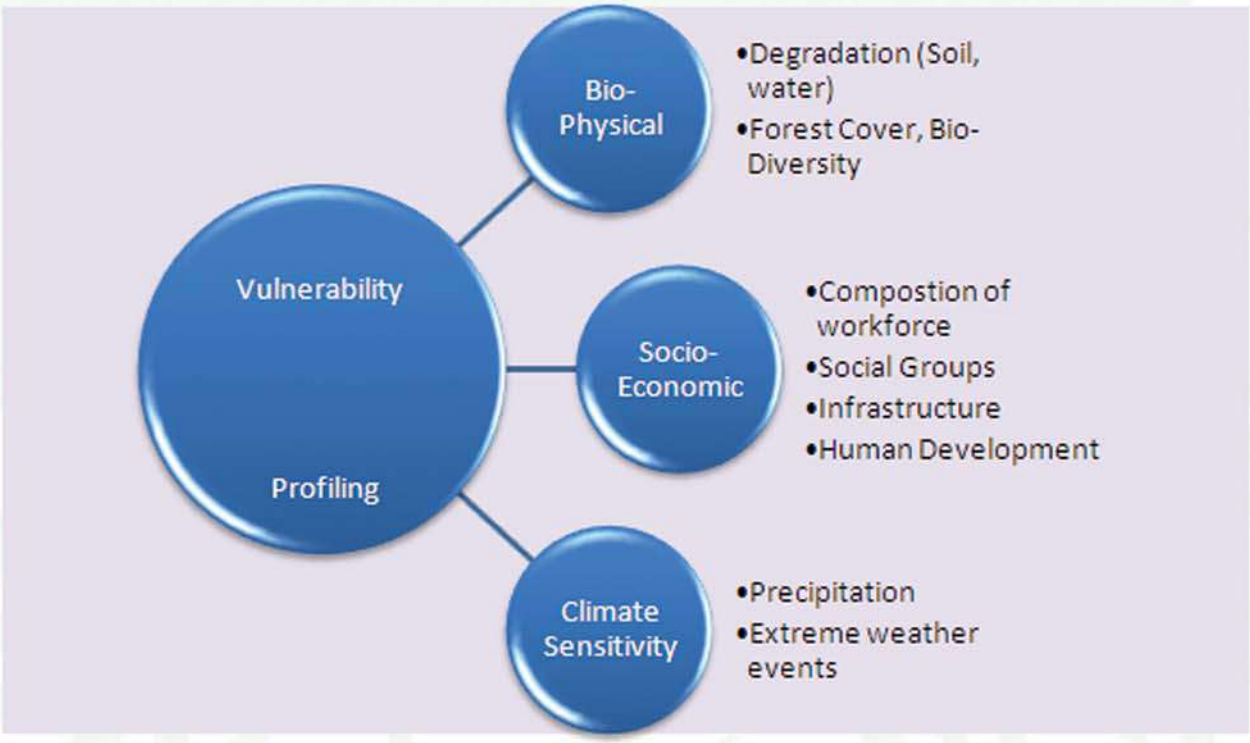
The National Missions are to be institutionalized by the respective Ministries and will be organized through inter-sectoral groups. Appropriate mechanisms including public-private partnership and civil society actions, will be devised, as suited, for effective delivery of each individual Mission's objectives. Comprehensive Mission documents detailing objectives, strategies, plan of action, timelines and monitoring and evaluation criteria of all eight Missions and Other Initiatives are to be developed by December 2008 and submitted to the Prime Minister's Council on Climate Change. The work is to be coordinated by the Ministry of Environment & Forests.

Chapter 3

Vulnerability Analysis

3.1 Introduction

Climate Change is a multi dimensional problem therefore, the vulnerabilities arising out of climate change are multidimensional and inter-linked. One sector can compound the vulnerability in the other. The vulnerability and adaptive capacities are diverse and varies from state to state based on several sectoral and cross sectoral parameters. Sectoral parameters include key sectors of the state's economy and cross sectoral factors include (a) Poverty (b) inequality and social discrimination over property rights (c) access to resources (d) social attrition/ migration, and (e) unequal and unsustainable competition for scarce natural resources.



The composite profiling done by TERI has been shown below:

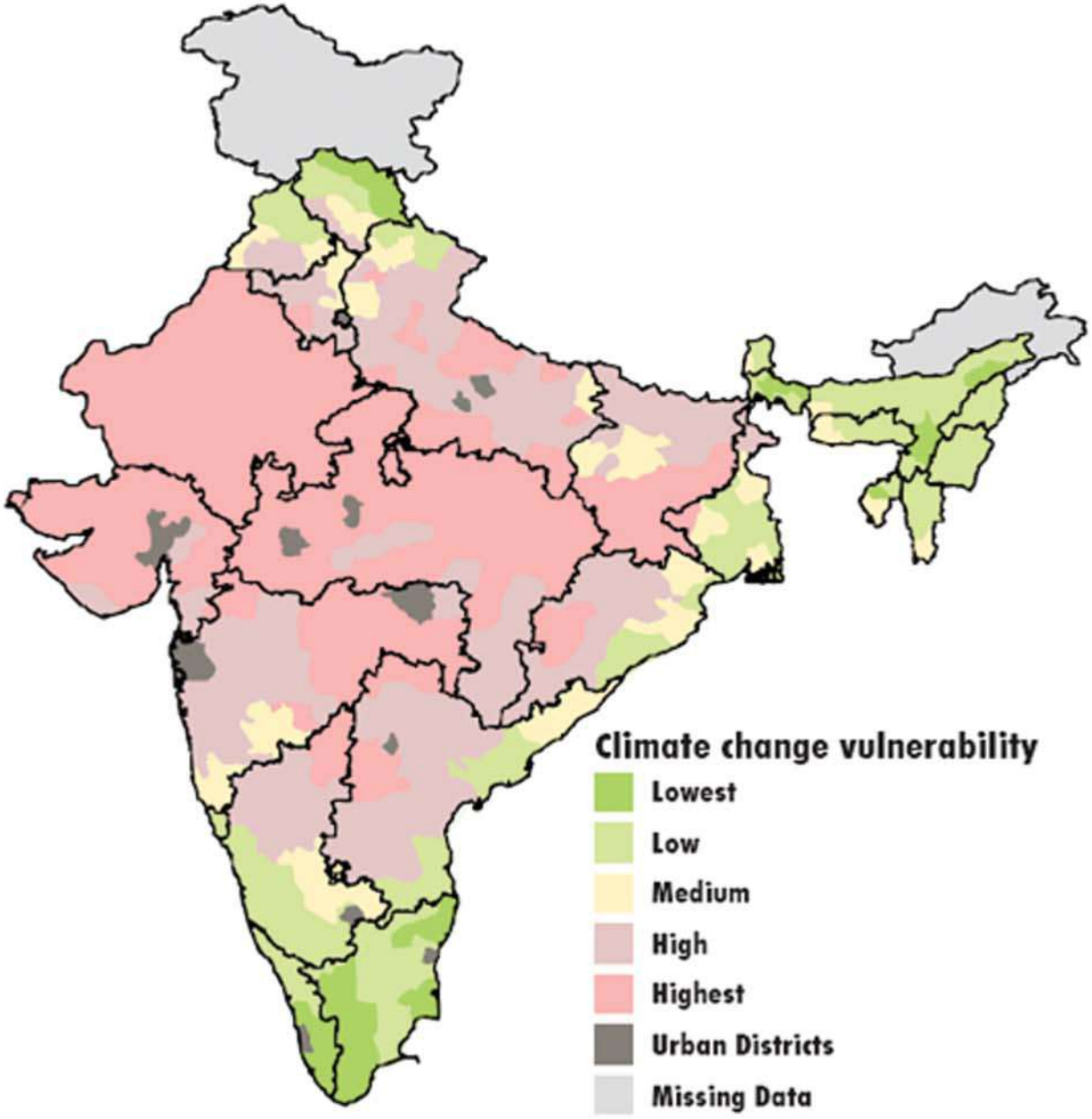


Figure Climate change vulnerability profile generated by integration of adaptive capacity & climate sensitivity profiles (TERI, 2003)

The spatial data show that the state has moderate to the highest level of vulnerability in several pockets. This has prompted designing the Climate Change Action Plan in such a manner that the local as well as holistic vulnerabilities are addressed in a cogent manner.

In order to prioritise programmes/ schemes and assess their performance vis-à-vis adaptation targets, it is imperative to take into consideration intended outcomes of these against their impact on the local communities and in building resilience to climate change.

3.2 Climate Sensitivity

Orissa State Disaster Management Authority has done a multi-hazard mapping for all the thirty districts of the state. The results are given below:

HAZARDS / DISTRICTS	WIND & CYCLONE	FLOOD	DROUGHT	EARTHQUAKE	ACCIDENTS
Mayurbhanj	1, 2	2	3	1, 2, 3	2
Balasore	1	1	3	1, 2	1
Bhadrak	1	1	3	2	1
Cuttack	1, 2	1, 2	2	1, 2	1
Jajpur	1	1, 2	2	1, 2	2
Jagatsinghpur	1	1, 2	3	1	2
Kendrapada	1	1, 2	3	1	2
Puri	1	1, 2	3	1	1
Khurda	1	2	3	1, 2	1
Nayagarh	2	2	3	2, 3	1
Ganjam	1,2	1, 2	3	2, 3	1
Gajapati	1,2	2	3	2, 3	1
Boudh	3	2	3	2, 3	2
Phulbani	4	2	3	3	2
Dhenkanal	1,3	2	2	1, 2	1
Angul	3	2	2	1, 2	1
Keonjhar	1, 2, 3	2	2	2, 3	1
Sundergarh	3, 4	2	1	1, 2	1
Jharsuguda	4	2	1	1, 2	1
Deogarh	3	2	1	1, 2	2
Bargarh	3	1, 2	1	1, 2, 3	1
Sambalpur	3, 4	1, 2	1	1, 2	1
Sonepur	3	2	1	1, 2	2
Bolangir	3	2	1	3	2
Kalahandi	3, 4	2	1	3	2
Nuapada	3	2	1	3	2
Koraput	2, 4	1, 2	2	3	2
Nowrangpur	4	2	1	3	2
Malkangiri	2, 4	1, 2	2	3	2
Rayagada	2, 4	2	2	3	2

WIND & CYCLONE: 1=Very High Risk Zone; 2=High Risk Zone; 3=Moderate Risk Zone ; 4=Slight Risk Zone ;

FLOOD: 1=Liable to get flooded; 2= Protected areas;

DROUGHT: 1=Very High Risk Zone; 2=High Risk Zone; 3=Slight Risk Zone;

EARTHQUAKE: 1=Moderate Damage Zone; 2=Less Damage Zone; 3=Very Low Damage Zone;

ACCIDENTS: 1=Major Accident Prone Areas; 2=Minor Accident Prone Areas;

As per the statistics of IMD, Orissa is most vulnerable to floods and heavy rainfall. The state has experienced about 88 such disasters within a 20 years timeframe. Heavy lightning and corresponding losses and deaths are also quite frequent in the state.

An account of Natural disasters in Orissa

Year	Normal Rainfall	Actual Rainfall ((mms))	Khariff Rice Production (in lakh mts)	Remarks	Year	Normal Rainfall	Actual Rainfall ((mms))	Kharif Rice Production (in lakh mts)	Remarks
1961	1502.5	1262.8	36.99		1984	1502.5	1302.8	38.5	Drought
1962	1502.5	1169.9	36.32		1985	1502.5	1606.8	48.8	Flood
1963	1502.5	1467	42.47		1986	1502.5	1566.1	44.56	
1964	1502.5	1414.1	43.59		1987	1502.5	1040.8	31.03	Severe drought
1965	1502.5	997.1	31.89	Severe drought	1988	1502.5	1270.5	48.96	
1966	1502.5	1134.9	35.37	Drought	1989	1502.5	1283.9	58.4	
1967	1502.5	1326.7	34.43	Cyclone and flood	1990	1502.5	1865.8	48.42	Flood
1968	1502.5	1296.1	38.48	Cyclone and flood	1991	1502.5	1465.7	60.3	
1969	1502.5	1802.1	38.39	Flood	1992	1502.5	1344.1	49.76	Flood, Drought
1970	1502.5	1660.2	39.13	Flood	1993	1502.5	1421.6	61.02	
1971	1502.5	1791.5	33.76	Flood, Severe Cyclone	1994	1502.5	1700.2	58.31	
1972	1502.5	1177.1	37.35	Drought, flood	1995	1502.5	1588	56.48	
1973	1502.5	1360.1	41.91	Flood	1996	1502.5	990.1	38.27	Severe drought
1974	1502.5	951.2	29.67	Flood, Severe Drought	1997	1502.5	1493	57.51	
1975	1502.5	1325.6	42.74	Flood	1998	1502.5	1277.5	48.85	Severe drought
1976	1502.5	1012.5	29.58	Severe drought	1999	1502.5	1435.7	42.75	Severe cyclone
1977	1502.5	1326.9	40.5	Flood	2000	1502.5	1035.1	41.72	Drought, flood
1978	1502.5	1261.3	41.89	Tornados, Hail storm	2001	1482.2	1616.2	65.71	Flood
1979	1502.5	950.7	27.34	Severe drought	2002	1482.2	1007.8	28.26	Severe drought
1980	1502.5	1321.7	40.31	Flood drought	2003	1482.2	1663.5	61.99	Flood
1981	1502.5	1187.4	36.63	Flood drought, Tornado	2004	1482.2	1256.7	58.84	Moisture stress
1982	1502.5	1179.9	27.07	Severe flood, drought, cyclone	2005	1451.2	1497.7	62.49	Moisture stress
1983	1502.5	1374.1	47.63		2006	1451.2	1682.8	61.96	Moisture stress, flood
Source;Status of Agriculture in Orissa, 2008, Directorate of agriculture and Food production					2007	1451.2	1583.2	68.26	Flood

From the above table it is clear that flood, drought and cyclone with varying intensity are regular phenomena in the state. The frequent occurrence not only has a negative impact on human, animal life and agriculture based livelihoods, it also involves a lot of human and capital resources that go into repair, restoration and relief work to reduce the effects of various kinds of natural disasters impacting the lives of human beings. The centre and the state shell out a huge amount of money in the Five Year Plans for mitigation of natural calamities. The anticipated expenditure under Drought prone Area Programme

was Rs 486.72 crore during 9th Plan period and for the Irrigation and Flood Control Programmes it was Rs 4376 crores. The 9th plan anticipated expenditure for crop insurance was about Rs708.08 crore.

3.3 Bio-Physical Factors and Sectoral Segmentation of Climate Induced Vulnerability in Orissa

The following table shows the sectoral segmentation of vulnerability in Orissa.

Sectors	Vulnerability	Socio-Economic Risks
Agriculture & Food security	• Temperature Stress • Erratic Precipitation • Reduced soil moisture • Flood/Drought Conditions • Invasion of parasiticspecies or disease	• Increased risk of desertification & land degradation (South_west Orissa) • Decline in crop yield and production (Northern Orissa) • Decline in availability of food and increased incidence of malnutrition (South_west Orissa)
Coastal Zones and Fishing	• Salt water intrusions • Storm surges and Flooding • Cyclonic events • Stability of wetlands and mangroves • Ocean ecosystems • coral reefs	• Threat to inland freshwater resources • Degradation of coastal infrastructure • Threat to livelihood dependent on marine fisheries and aquaculture • Dislocation of coastal and island population
Forestry and Bio-Diversity	• Long dry spells • Intensity of land use • Fragmentation of habitats • Species invasion • Desertification and land degradation	• Loss of ecosystems services • Loss of livelihood for people dependent on forestry resources • Decline in ambient air and water quality leading to health hazards • Extinction of species
Health	• Availability of fresh water • Availability of sanitation facilities • Vector borne diseases • Thermal stress	• Increased morbidity & mortality • Increased burden of health care on households in affected areas
Water Resources	• Availability of fresh water • Reduced quality of available water resources • Reduced stream flow • Depletion in groundwater resources • Flood anddrought conditions	• Stress on water storage • Reduced supply of drinking water • Increased morbidity • Reduced availability of water for industrial and food production purposes • Reduced potential of hydroelectric power generation

Climate determines the season and seasonality has a bearing on agriculture, the mainstay of the people in the state (3/4th of the population depends on agriculture and a single crop paddy). Over the years implementation of various programmes in the realm of food and agricultural production, income generation and distribution has substantially improved the general food security situation in vulnerable pockets. The extreme weather events often upset the delicate gains achieved so far. The crop loss due to the combination of weather events has been given below.

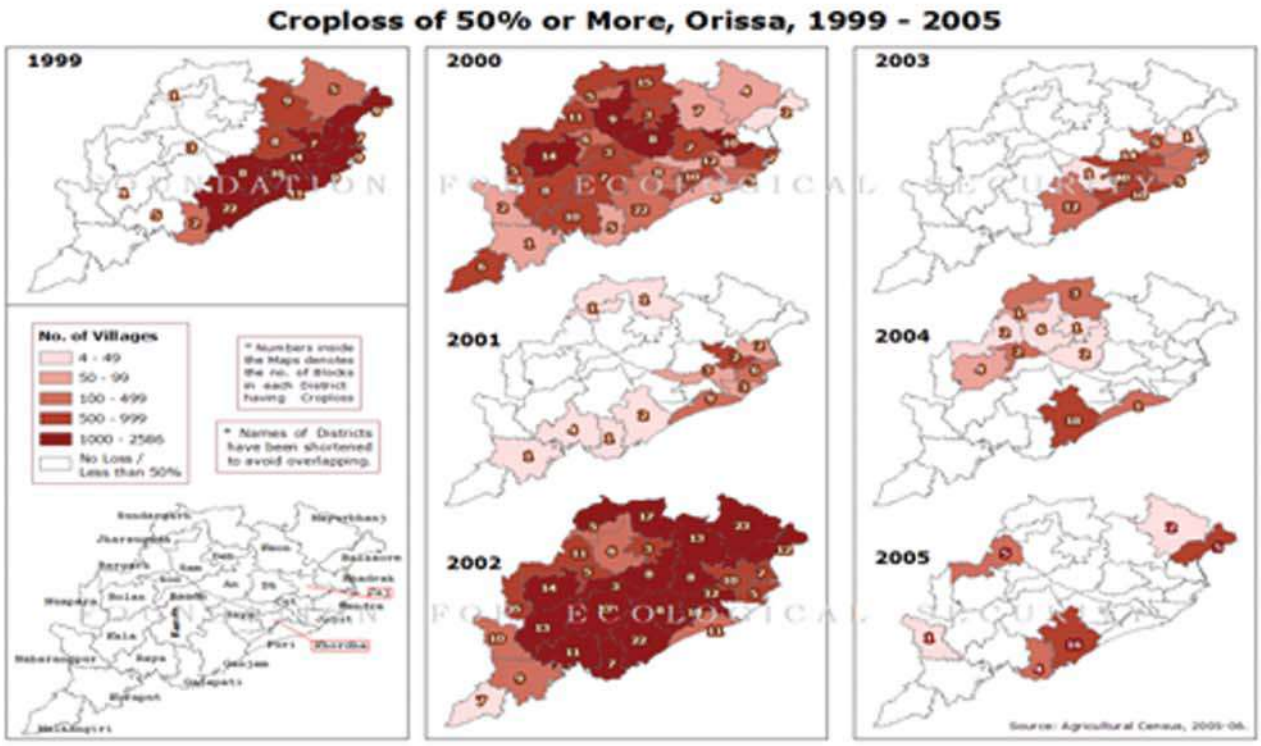


Figure Crop Loss due to various weather events

3.3.1 Seasonality, agriculture and food security:

Seasonality is related to food security and vulnerability especially amongst rural households. In certain periods of the year, the vulnerable people do not even have access to 30% of their food requirement. Overall in Orissa, June to September are critical months for most food vulnerable population with as high as 77% facing food shortages.

Vulnerable Segment	% Vulnerable to sample population	% Vulnerable to sample population
Coastal	3.36	9.63
Northern	9.07	15.11
Southern	14.78	19.81
KBK	13.19	18.00
WODC	8.14	12.28
Agricultural labour	11.84	17.41
Cultivator	10.9	14.51
Other Labourer	5.81	9.44
Self employed	3.36	9.24
General	4.58	9.55
SC	7.76	12.92
ST	16.53	21.61
Orissa	8.63	14.76

Source: Poverty Task Force Report

3.3.2 Climate Determined Low Productivity

The irrigation intensity of Orissa is 30.9% and is below the national average of 44.3%. The reduction of net sown area and decline in the yield of the main crop paddy (74% of the area is under paddy) is largely due to vagaries of monsoon. Rice productivity, even though has doubled in 2008-09 since 2002, is below the national average.

3.3.3 Desertification

Orissa has about 54,69,336 ha of degraded land, more than that of geographically bigger states like Andhra Pradesh, Uttar Pradesh, Madhya Pradesh and Karnataka. Orissa's degradable land mass constitutes 5.18 percent of total geographical area of India. Water erosion is the most pronounced process of land degradation and desertification. Water erosion is witnessed in an area of 32,06,507 ha of land of the State, which ranks close to States like Rajasthan. Only Maharashtra and Gujarat have more areas categorised under water erosion. Another major feature relating to Orissa is that it has more area getting waterlogged than any other State in the country.

3.3.4 Food security

The hunger profile of the state computed by experts has been presented below which is based on requirement, availability and absorption basis:

DIST	Availability		Access		Absorption		FSI		FSOI	
	Index	Rank	Index	Rank	Index	Rank	Index	Rank	Index	Rank
Angul	0.326	27	0.473	11	0.266	29	0.390	18	0.465	12
Balangir	0.433	17	0.356	17	0.519	9	0.409	15	0.467	13
Balasore	0.495	11	0.505	9	0.658	2	0.526	7	0.600	5
Bargarh	0.601	4	0.410	13	0.742	1	0.529	6	0.410	21
Boudh	0.441	15	0.351	19	0.337	23	0.379	20	0.402	22
Bhadrak	0.601	3	0.576	3	0.632	4	0.594	3	0.414	20
Cuttack	0.593	5	0.567	1	0.375	19	0.553	4	0.692	3
Deogarh	0.443	14	0.334	20	0.306	27	0.366	21	0.504	11
Dhenkanal	0.406	20	0.478	10	0.276	28	0.420	14	0.565	6
Gajapati	0.274	29	0.320	22	0.315	26	0.304	29	0.294	28
Ganjam	0.511	9	0.442	12	0.389	18	0.456	12	0.389	24
Jagatsinghpur	0.654	1	0.561	2	0.629	5	0.624	1	0.624	4
Jajpur	0.515	8	0.572	4	0.365	20	0.518	8	0.452	15
Jharsuguda	0.503	10	0.385	15	0.513	10	0.446	13	0.830	1
Kalahandi	0.484	12	0.297	25	0.535	8	0.399	16	0.395	23
Kandhamal	0.164	30	0.302	24	0.249	30	0.247	30	0.237	30
Kendrapara	0.441	16	0.571	6	0.503	12	0.516	9	0.508	9
Keonjhar	0.406	19	0.396	14	0.330	25	0.389	19	0.415	19
Khordha	0.531	7	0.571	5	0.457	16	0.538	5	0.507	10
Koraput	0.395	21	0.253	28	0.468	13	0.336	26	0.386	25
Malkangiri	0.381	24	0.284	27	0.504	11	0.353	23	0.276	29
Myurbhanj	0.393	22	0.330	21	0.331	24	0.351	24	0.564	7
Nabarangpur	0.365	25	0.207	30	0.585	7	0.322	27	0.452	14
Nayagarh	0.424	18	0.516	8	0.363	21	0.461	10	0.706	2
Nuapada	0.447	13	0.291	26	0.586	6	0.392	17	0.344	26
Puri	0.625	2	0.561	7	0.641	3	0.596	2	0.563	8
Rayagada	0.362	26	0.232	29	0.461	14	0.313	28	0.302	27
Sambalpur	0.385	23	0.354	18	0.343	22	0.362	22	0.422	16
Sonepur	0.586	6	0.374	16	0.457	15	0.456	11	0.422	17
Sundargarh	0.322	28	0.320	23	0.453	17	0.343	25	0.416	18

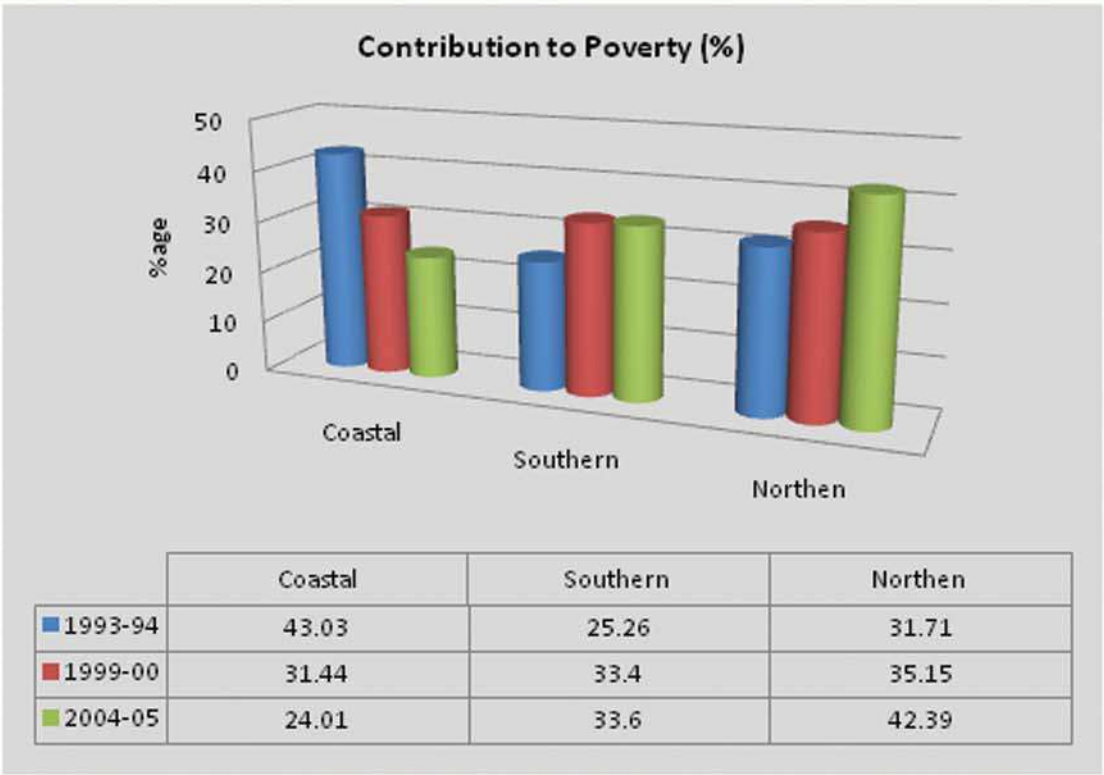
Figure Food Security Index of Orissa, Source: Food Security Atlas of Rural Orissa, WFP, 2008

3.4 Socio-Economic Factors: Poverty and Vulnerability:

3.4.1 People in climate stressed regions

Orissa is prone to climate related disasters. The history of disasters substantiates the fact that about 80% of the State's population is prone to one or more forms of natural disasters. There are two major climate stressed regions in the state (a) the coastal belt and flood plains; the area has higher population density. More than human tragedy, the people in this region suffer most due to the loss of their livestock, crops and agricultural implements. Out of total geographical area of 15.751 lakh hectares; 1.40 lakh hectares are flood prone. There are 516 nos. of vulnerable points in Orissa. In the last 25 years, floods have occurred 12 times with varying severity. Over the years, the people have faced floods and cyclones and are somewhat prepared to save human lives but not the other assets. This leads to high indebtedness and many of them never come out of the poverty traps.

(b) The other region is the drought prone western and south-western part of Orissa, where the indicators of development are comparable to the sub-saharan region. Here the people face perpetual water-stress and a drought like situation. The pattern of drought in the State is of a varied one, sometimes affecting the entire state, sometimes a few regions, and sometimes a few districts. However, the contiguous patch consisting of the Subdivisions of Padampur, Bolangir, Titlagarh, Patnagarh, Nuapada, Khariar, Bhwanipatna and Phulbani comprising 47 blocks have been identified as the drought prone zone. Hilly areas are also prone to flash floods because of its high gradient and poor distributary system and this kind of flood leads to sand casting and permanent damage to top soil. Characterised by high indebtedness, high migration and poor nutrition, this area is highly vulnerable to climate change and large public investments in this region have not been very effective to reduce the poverty (low investment multiplier benefit).



	Coastal	Southern	Northen
1993-94	43.03	25.26	31.71
1999-00	31.44	33.4	35.15
2004-05	24.01	33.6	42.39

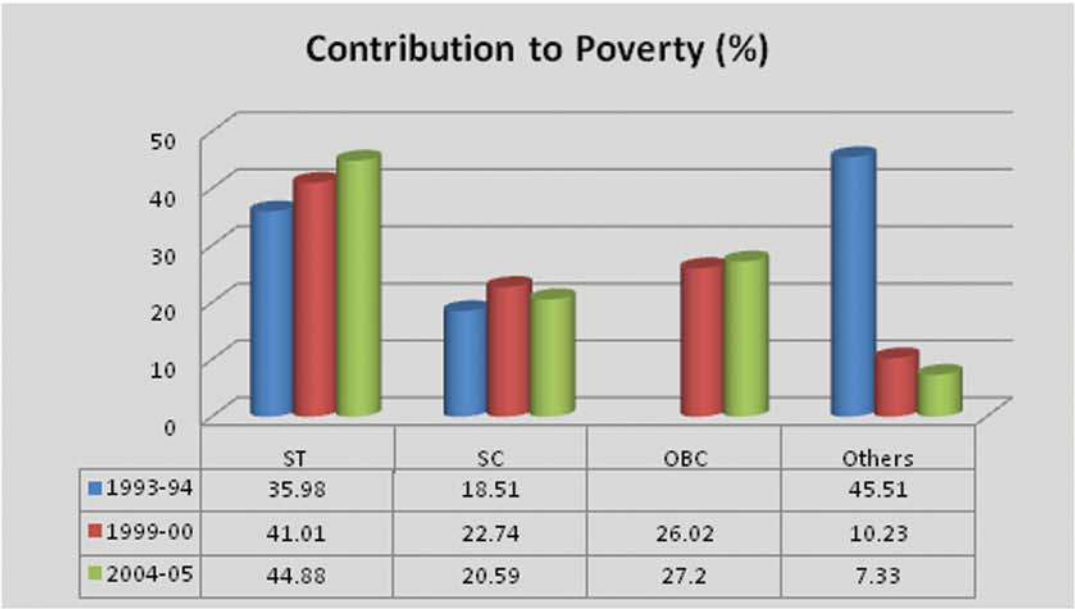
Figure Poverty profile of the state, Source: Economic Survey, Government of Orissa, 2009-10

The above table shows the structure of poverty in the state and confirms the theory that fast depleting resources in northern Orissa is increasing the poverty while southern Orissa structurally remains poor due to adverse climatic conditions apart from other cross-sectoral factors listed below.

3.4.2 Indigenous Community:

Poverty and social grouping are interlinked. Especially the indigenous communities who are embedded in a forest and natural resource based eco-system are highly vulnerable to climate change and Orissa has a high percentage of people depending on natural resource based eco-system, forest, bio-diversity and water resources.

All the districts of Orissa have tribal populations in them. While some regions have large presence of tribals. Koraput, Rayagada, Kalahandi, Nabarangpur and Malkangiri are few districts where more than half of the population is tribal.There are 62 tribal communities residing in Orissa todaywith a total population of 8.14 million (Census of India 2001), about 22% of the state's total population. Almost 44.21 per cent of the total land area in Orissa has been constitutionally declared as Scheduled Area. The major tribes of the state are Kondhs, Koyas, Gadabas, Oraon, Juangs, and Santhals. The tribal life is natural resource dependent and any disturbance in the climate that affect the natural eco-systems where the tribals co-habit is highly detrimental to their survival. Their high poverty and natural resource dependency makes them the most vulnerable stakeholders. The structure of poverty clearly shows the vulnerability of such groups.



	ST	SC	OBC	Others
1993-94	35.98	18.51		45.51
1999-00	41.01	22.74	26.02	10.23
2004-05	44.88	20.59	27.2	7.33

Figure Incidence of Poverty by social groups, Rural Orissa, Source: NSS, rounds

3.4.3 Migrants and Urban Poor:

More than 30 million people in India are seasonal migrant labourers. Orissa's share is 2.5 million and considered a key state for supply of migrant labour. Out migrants from Orissa prefer Gujarat and Maharashtra as the destination even when these states are not border states. Out-migration to these states made up to 34 percent of total out-migrants from Orissa. In migration from the Western and Southern part of Orissa to urban areas and coastal areas are also widely seen and exact estimates are difficult to get. But high growth in the construction sector has drawn such labour force to urban areas and that pushes the resource intensity /congestion in urban areas. On the reverse side, the climate-related in-migration from climate stress regions is becoming more prevalent (popularly termed as climate refugees).

Migration is one of the crucial parameters that depict the development context of the state. According to 2001 census about 937,148 people have migrated to other states of India for variety of reasons many of them are due to climate stress and non-availability of work in their native places in their main occupation i.e. agriculture.. Out of the total migrants about 24% people have almost shifted their residence with the duration of migration of more than 20 years. A large chunk of population falls under the category of migration for less than 10 years. Chhatisgarh has maximum number of immigrants followed by West Bengal, Gujarat, Andhra Pradesh, Maharastra and Jharkhand. Very few people have migrated to other states except for Delhi. The cities like Surat, Kolkata, Mumbai, Delhi and Raipur are having 90135, 80476, 50910, 38456 and 21459 migrants from Orissa respectively. Migration induces resource congestion and related vulnerabilities.

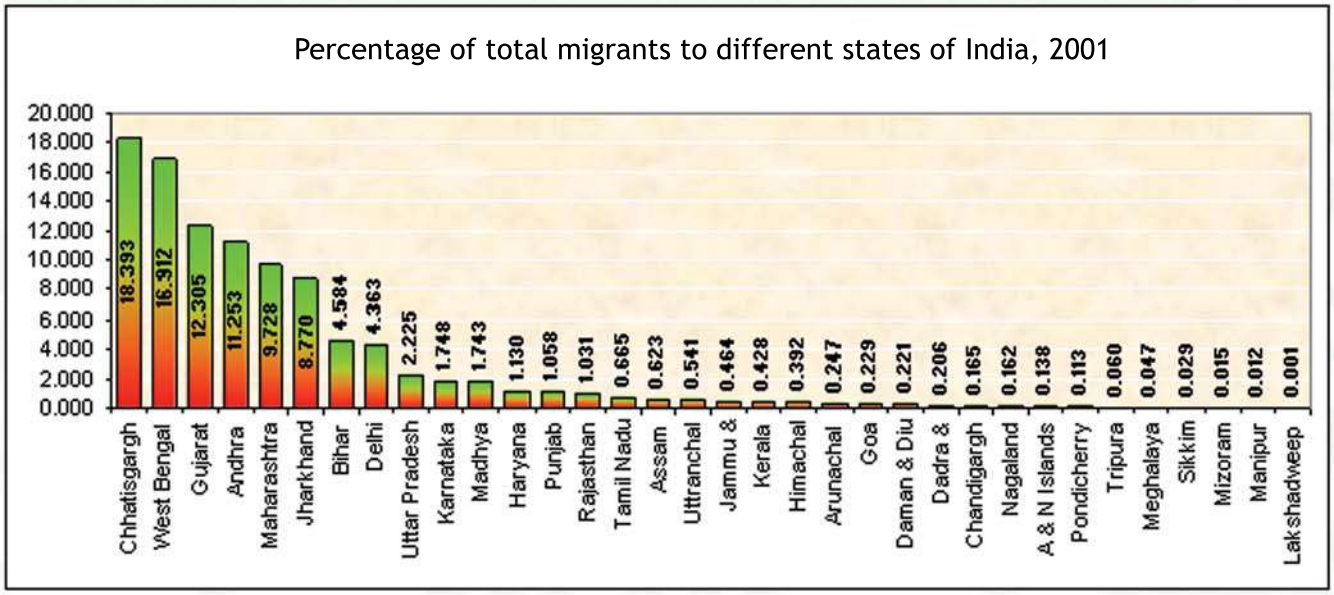


Figure Migration in Orissa, 2001

For work/employment, the most favoured destinations are Gujarat, West Bengal, Maharastra, Chhatisgarh and Andhra Pradesh with migrant population of 76109, 53727, 48138, 34647 and 23939 respectively. Many people from southern and western Orissa are working in and around Raipur as daily wage earners in Brick kilns, rickshaw pullers , Casual labours in spinning mills and diamond industries of Gujarat. In other cities most of the Oriya people are engaged as domestic help, hotel boys, plumbers and security guards. There are also some people who are employed in higher positions in various sectors. More migration is happening to neighbouring states through marriage with chhatisgarh having the highest number of immigration with 81014 people followed by West Bengal, Jharkhad, Bihar and Andhra Pradesh. For Education about 10200 people have migrated to other states and Delhi. Kolkata, Mumbai and Bangalore being the most favoured destinations. The main point is that migration creates unequal pressure on resources such as ground water, habitation, energy usage, etc. This in turn enhances Green House Gas concentration in few pockets.

3.4.4 Gender Dimensions

Gender dimension of climate change is very tricky. Climate change is increasing scarcity of water in several parts of Orissa, in some areas there are reductions in yields of biomass adding to the labour of the women to fetch them for cooking. There is increased risks to human health with children, women (especially the pregnant ones) and the elderly in a household becoming the most vulnerable. The other important issue is that the women's contribution to increasing the social capital and make the community resilient. It has been seen through the work of SHG groups and especially during the post disaster recovery period.

Chapter 4

State GHG Inventory

4.1 Introduction

While finalizing the State Climate Change Action Plan (SCCAP), it was felt necessary that knowledge of baseline emission is necessary to prioritize the action plans. This exercise was taken up to estimate the emission from various activities in the state.

For the purpose of estimation, UNFCCC approved, latest IPCC-2006 methodologies were used for computing the emission from energy and industrial sector. The sectors and sub-sectors were selected exactly as per IPCC-2006 guidelines for GHG emission estimation.

4.2 Methodology

The IPCC-2006 guidelines suggest a three tier approach for estimation of GHG emission, whiletier-1 approach needs less complex data and depends mostly on default emission factors, the higher tier approaches will require data in greater details and specific emission factors. The uncertainties in estimation however are reduced when it moves up the tier ladder. For the purpose of estimation the following six Green House Gases were considered:

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_2O)
- Per fluorocarbon (PFC)
- Hydro fluorocarbon (HFC)
- Sulphur Hexafluoride (SF_6)

At the time of estimation little baseline data was available, thus it was decided to prepare a quick estimation using tier 1 methodology and in most cases with default emission factors. The 2006 IPCC Guidelines generally provide advice on estimation methods at three levels of detail, from tier 1 (the default method) to tier 3 (the most detailed method). The advice consists of mathematical specification of the methods, information on emission factors or other parameters to use in generating the estimates, and sources of activity data to estimate the overall level of net emissions (emission by sources minus removals by sinks). Properly implemented, all tiers are intended to provide unbiased estimates, and accuracy and precision should, in general, improve from tier 1 to tier 3.The estimation under tier 1 is considered to be adequate for prioritizing the State Climate Change Action Plan.

This estimation in the energy sector includes production of solid fuel (e.g. coal mining and coke making),and energy generation like thermal power generation. For transport state-wide emission from road transport and railway emission has been covered. Emission from international shipping, inland waterways like fishing boats, trawlers and aviation has been excluded since enough data was not available at the time of preparation of this report. Similarly in the industry, all key sectors in Orissa have been included in this estimation. This initial estimation is done on the basis of average plant availability in that sector and not on the basis of actual production, since actual data collection would require more time for completing the estmate.

The IPCC 2006 guidelines divide the entire activities

which result in anthropogenic GHGemissions into four sectors. They are:

- Energy
- Industrial process and product use (IPPU)
- Agriculture, forest and other land use(AFLOU)
- Waste

The sub-sectors under these sectors as per the IPCC 2006 guidelines are:

- **Energy**
    1. Stationary combustion
    2. Mobile combustion
    3. Fugitive emission
    4. CO2 transport, injection and geological r eserve
- **Industrial Process and Product Use**
    1. Mineral industry emission
    2. Chemical industry emission
    3. Metal industry emission
    4. Non-energy products from fuel and product use
    5. Electronic industry emission
    6. Emissions from fluorinated sub-stitutes from Ozone Depleting Sub-stance
    7. Other product manufacture and use

The key sectors relevant to Orissa were selected and the extent of these activities in the state was determined. The product of activity data and corresponding emission factor is used to determine the emission of GHG. The emissions of the GHGs were then multiplied with the corresponding Global Warming Potential (GWP) to express the emission in terms of CO2 equivalent (CO2-eq). The basic equation involved in estimating the emission is thus; Emission j = Σ ADi·EFij; Where AD is activity data of ith activity and EF is emission factors of ith activity for jth GHG emission.

For urban sector (Municipal Solid Waste and Sewage), the equation as per UNFCCC and IPCC guidance, is as below:

$$LW_{CH4,y} = EQF * \sum_{x=1}^{y} \sum_{j=d}^{D} EQL$$

$$QAFL_{j,x} * DOC_j * (1 - \exp(-k_j)) * \exp(-k_j(y-x)) * NFL * GWP_{CH4}$$

$$\varphi * \frac{16}{12} * F * DOC_f * MCF$$

Emission from Municipal Solid Waste and Sewage

Waste, be it industrial or domestic contributes considerably to the GHG emission in a geographic region. Basically the waste comprising organic components result in emission of methane which has a global warming potential of 21 times that of carbon-di-oxide. For the purpose of estimation of net GHG emission the waste generated from the domestic sector is only considered. For the purpose of estimation solid waste and sewage disposal are taken into consideration.

Emission due to solid waste disposal: Based on the urban population of 5,517,238 and considering solid waste generation at the rate of 0.00045ton/capita/day the net green house gas emission on an annual basis is estimated at 0.45 million tCO2e/annum(considering 10 years of emission and annualised). The estimation is carried out on the basis of the approach outline by UNFCCC and IPCC default value.

Emission due to sewage: Similar as above by considering a population of 5,517,238 and waste water generation potential of 120 litre/capita/day with BOD of 205 and maximum methane production capacity value of 0.8 kg CH4/kg BOD the net green house

gas emission on an annual basis is estimated at 0.112 million tCO2e/annum. The estimation is carried out on the basis of the approach outline by UNFCCC and the value obtained from IPCC.

The total green house gas emission considering the above two aspects is estimated to be around 0.56 million tCO2e/annum.

4.3Result

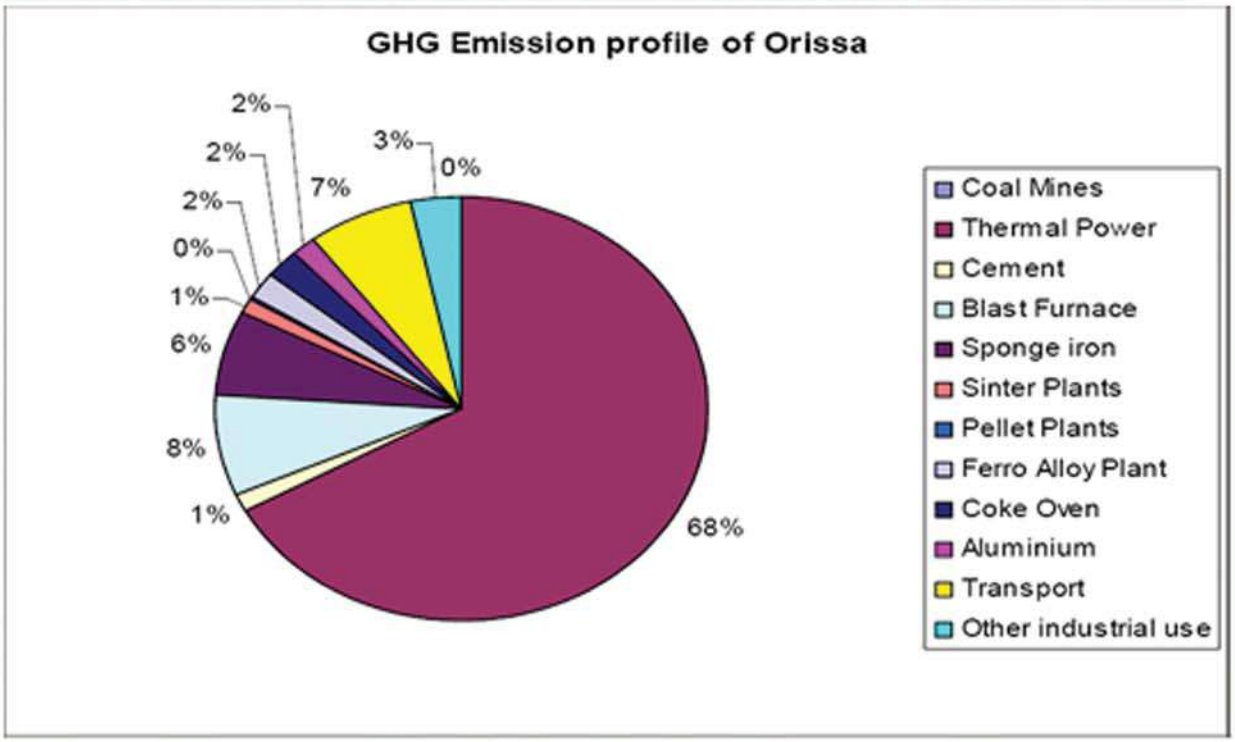
The estimation of major industrial and energy sector are made using Tier 1 methodology as per IPCC-2006 guidelines and available data. The emissions were calculated on the basis of installed capacity of the respective sectors, where credible data on plant utilisation were not available. In iron and steel sector, the overall capacity utilization was taken as 0.7. The transport sector emission was calculated on the basis of actual fuel consumption through retail selling of petroleum products. The

summarized emission details are presented in Table ** and the GHG profile of Orissa is presented at Figure ** below.

The emissions from energy, industry, mining and transport sectors are presented in the table below:

Table 1 Emissions from Industrial, Transport and Energy Sector

Sector	CO2 (Million Tons)	CH4 (Million Tons)
Coal Mines	0	0.0239
Thermal Power	54.9	0
Cement	1.22	0
Blast Furnace	6.475	0
Sponge iron	5.1	0
Sinter Plants	1.048	3.67E-04
Pellet Plants	0.2478	0
Ferro Alloy Plant	1.573	0
Coke Oven	1.799	3.21E-07
Aluminium	1.4124	0
Transport	5.707	6.00E-04
Other industrial energy use	2.683	0
Total	82.1652	0.024867121



Out of the total emission 68% emission takes place in thermal power generation and 14% is generated from iron making process through blast furnace and DRI kilns. Processes associated with iron and steel making, like sintering, pollicisation, coke making contribute 3% of the total emission. Aluminium smelting and ferro-alloy production contribute 2% each. In non-industrial sector transport contributes 7% of the total emission.

Government of India estimation indicates total GHG emission in 2007 was 1727.71 million ton of CO2-eq, of which contribution of energy and industry sector is 58% and 22% respectively. Thus, total estimated emission from these two sectors is 1382 million tonnes. Our estimation indicates that energy and industry sector in Orissa contributes about 6% to the national emission.

Emission from Municipal Solid Waste and Sewage is about 0.56 MT CO2 equivalent per annum (taking 2010-2020 time period). **This makes total emission to be about 83.243 MTCO2 equivalent per annum form Orissa.**

The estimation carried out in this report is on the basis of installed capacities of respective industrial units. Plant availability or production efficiency have been factored into wherever relevant data was available, else full capacity utilization has been assumed and emissions were estimated on that basis. These assumptions might have resulted in slight over-estimation than the actual. It is thus necessary that this estimation process may be carried forward along the IPCC tier ladder for a more accurate GHG estimation. For completeness emissions from other sectors may also be considered to be incorporated.

4.4 Possible Mitigation from Conservation

The COMAP model (Sathaye et al., 2000,Ravindranath et al., 2001 and Ravindranath et al., 2008) has been used for estimating the mitigation potential at the global and national level. Mitigation potential estimated is determined by the following;

- area brought under afforestation /protection/management
- species-mix and density
- carbon pools (aboveground and below ground biomass, soil organic carbon and dead organic matter) considered
- rates of change in the carbon pools: Mean Annual Increments
- transfer and dynamics of different carbon pools
- harvest and extraction of timber, fuel wood etc.
- initial stock of different carbon pools
- Phasing of the activity and area planted in different years.

In the current study, all the carbon pools except dead organic matter are considered. The baseline stocks of aboveground biomass and soil organic carbon as well as growth rates for aboveground biomass and soil organic carbon were obtained from literature and belowground biomass is computed using the IPCC default value of 0.26.

Table 2 provides the estimates of incremental and cumulative mitigation potential for the different interventions proposed under the State Climate Change Action Plan.

Table 2 Incremental and cumulative mitigation potential (MtCO2) of different options

Options	Area ('000 ha)	Incremental annual mitigation potential 2020 ($MtCO_2$)	Incremental cumulative mitigation potential (Million tonnes of CO_2)		
			2010-2020	2010-2030	2010-2050
ANR_sal	1000	3.80	28.47	66.44	138.85
Teak	250	3.80	28.47	66.44	138.85
Conservation_dense	2800	22.55	214.18	439.64	890.55
Conservation_open	2000	18.94	179.96	369.38	716.83
Mangrove conservation	22	0.19	1.81	3.72	7.54
Mangrove_planting	5	0.04	0.32	0.76	1.62
Shelterbelt_casuarina	10	0.21	1.56	1.96	2.51
Roadside-AF/UF	12	0.15	1.14	2.67	5.71
Bald hills	2.5	0.01	0.06	0.14	0.30
Total	**6102**	**50**	**456**	**951**	**1903**

Notes: Carbon pools considered: Aboveground and belowground biomass, soil and litter pools; Area to be planted: 6.1 Mha phased equally over 5 years, starting 2011. Biomass growth rates: ANR_sal: 2.5 t/ha/yr1; Teak: 5.84 t/ha/yr2; Mangrove conservation:3.2 t/ha/yr3; Mangrove_planting: 3.2 t/ha/yr3; Shelterbelt_casuarina: 8.5 t/ha/yr4; Roadside AF_UF: 4.96 t/ha/yr5; Bald hills: 0.84 t/ha/yr1; Conservation_dense: 2.5 t/ha/yr1; Conservation_open: 3.56 t/ha/yr1.

As can be seen from Table 2, the mitigation potential of conservation activities is obviously very high (22.5 MtCO2 for conservation of dense forest and 18.9 MtCO2 for conservation of open forest) as opposed to the other proposed afforestation/reforestation activities. The incremental annual mitigation potential for 2020 considering all the proposed activities is 50 MtCO2. The cumulative incremental mitigation potential of all the activities for the period 2010-2020 is about 456 MtCO2 while it is 951 MtCO2 (52% higher) for the period 2010-2030 and 1,903 MtCO2 for the period 2010-2050.

4.5 Summary of State GHG Emission

The following is the summary of the GHG emission in the state.

Sectoral Emission per annum	Unit	Amount	Remark
Industrial, Transport and Energy Sector	Million tonnes of CO_2	82.68	Annualised adding the CO_2 and CH_4 emissions
Municipal solid waste and sewage	Million tonnes of CO_2	0.56	Annualised CH_4 emissions converted to CO_2 equivalent for 2010-20 period
Mitigation Potential from Conservation	Million tonnes of CO_2	45.6	Annualised CO_2 sequestration for 2010-20 period
Net Emission	Million tonnes of CO_2	37.64	
Per Capita Emission		1.02	With 2001 population estimated at 36.8 million
National Emission per capita		1.40	Estimated for 2007[1]

Theresults have been obtained using the Tier I approach of IPCC and approved methodology of UNFCCC which can serve as a crude estimate of GHG profile of the state.

Thetable above shows that the per capita emission of the state is well below the national average with suitable conservation plan in place.

1 **http://en.wikipedia.org/wiki/List_of_countries_by_carbon_dioxide_emissions_per_capita accessed on 15 December 2010**

Chapter 5

Climate change issues relevant to Orissa

5.1 Introduction

Climate projections for India suggest that impacts are likely to be varied and heterogeneous, with some regions experiencing more intense rainfall and flood risks, while others will encounter less rainfall and prolonged droughts. Among the more substantial effects is a projected spatial shift in the pattern of rainfall towards the already flood-prone coastal areas, while water-scarce regions become even more drought-prone and unproductive. India will also suffer from higher tides, more intense storms fueled by warmer oceans and further erosion along its coastline due to sea level rise. For India, climate variability and climate change pose huge risks to human life and threaten to endanger the sustainability of the country's economic growth. India's immense geographic diversity adds to the complexity of developing and implementing an adaptation strategy. The impacts will vary across States, sectors, locations and populations. Consequently, there can be no one-size-fits-all approach to developing a climate risk management strategy: approaches will need to be tailored to address state and local vulnerabilities and conditions.

Orissa has a 480 km vulnerable coast line, which is a periodic recipient of climate risks such as cyclones and coastal erosion. Orissa is rainfall dependent as its irrigation network does not cover the entire state. With a water-dependent crop, rice, as its main staple, the agriculture sector is vulnerable to the vagaries of climate-induced weather changes. In terms of health, the vector-borne disease - Malaria - is fairly rampant in many parts of the state. Although 38 percent of the state's geographical areas are forests, much these forests are degraded.

Orissa also remains one of India's poorest states. The estimates from the Planning Commission reflected in indices such as the percentage of population below the poverty line both in rural and urban areas, and the overall incidence of poverty in Orissa vis-a-vis rest of India reveal that Orissa remains one of the poorest among all the major states of India. The high poverty in Orissa is closely tied to low productivity in agriculture, which is in turn linked to the prevalence of small and marginal holdings. The GoO has realized that poverty reducing economic growth would need acceleration of progress in both agriculture and non-agricultural sectors.

Climate change is predicted to impede poverty alleviation programmes in Orissa both directly and indirectly compromising the current growth strategy. The direct impacts could include loss of life, livelihoods, assets, infrastructure, etc. from climatic extreme events. The indirect effects could be the effect on economic growth. Continuing climate change variation is predicted to alter the sectoral origins of growth, including the ability of the poor to engage in the non-farm sector. This could nullify the pro-poor potential of macroeconomic policies, trade and private sector investment.

Climatic variations could further multiply the vulnerability of poor people by adversely

affecting their health and livelihoods and jeopardizing growth opportunities vital for poverty reduction. Climate change in Orissa has the potential to tremendously aggravate water stress and enhance food insecurity.

GoO wants to ensure that climate change does not undermine the economic development of the state. Orissa has recently transformed itself in economic and fiscal terms. Double-digit growth for the past five years has had a multiplier effect throughout the economy. A remarkable fiscal turnaround, achieved through the state's own efforts and complemented by performance-linked support from the central government and external donors has released funds for development and greater public investments more generally. The state finances, which were in critical stage have improved. The GSDP during the 10th five year period (2002-2007) has increased by 8.5 percent per annum which is slightly more than the national level. Private investment of funds in the state has increased as a result of this; employment opportunities have increased in private sector leading to Poverty reduction.

The state's 11th Five Year Plan focuses on addressing the challenges in achieving sustainable, shared economic growth and accelerating human development. This includes measures to tackle problems in the agriculture and rural non-farm sectors; enhanced social protection and tribal empowerment; further improvement of the business climate and the regulatory framework for managing environmental and social impacts of resource-intensive investments in the State; greater attention to financial management and modernization of procurement systems for converting outlays to outputs and outcomes; and continuing tax reforms for transition to Goods and Services Tax.

Orissa is endowed with coal and a variety of mineral resources. It has the potential to generate coal-based thermal power not only for the state's needs but also to cater to the neighboring states in the region. The current development trends point to increased emphasis on power, mining, energy-intensive industries and infrastructure. It is anticipated that thermal power generation capacity will increase to 55-60,000 MW in the coming decade from the current 4,000 MW. In view of the pollution effects of the thermal plants,capping of the thermal power generation would be required. While climate adaptation remains a key issue, the state's role in mitigation in the broader national context could not be ignored.

Being mineral-rich, the state has mineral-based industries that are both energy and water intensive. The energy, mining and industry sector also contribute to the local environmental and social problems. Mining projects are threatening forests, livelihood of people dependent on forest based economy and creating conflicts between wild animals and local inhabitants due to loss of forest. All these developments will have a high carbon and environmental footprint. On the other hand, sustained management of the state's forests also offers possibilities in terms of providing for carbon sinks and protection of watersheds.

Given its profile, climate change is a very important subject for the state. It is presently on a carbon-oriented development path and, at the same time, it is vulnerable to climate-mediated risks. We describe below some key issues pertaining to climate change adaptation and mitigation.

5.2 Key Issues

5.2.1 Adaptation

Coastal/disasters

Orissa has long been prone to disasters.Recurring droughts, flood and cyclones are regular features in the state and have had a crippling effect on the economy. In 1999 a severe cyclone followed by a super severe cyclone lashed the entire coast of Orissa causing large scale loss of life. Whilst the extent to which climate change will exacerbate

floods and droughts is not yet fully understood yet it is clear that frequency and intensity of disasters will increase .

Cyclones may further intensify with climate change.

Water Resources

In Orissa, over 80 percent of annual rainfall occurs during the monsoon period with average rainfall of 1400 mm, with an average of 70 rainy days. The state experiences either heavy flood or drought every alternate year due to uneven distribution of rainfall. In recent years, wide fluctuation in climate has been observed and irregular rainfall causing both floods and droughts is a major concern. The impact of drought on farmers has been invariably deleterious . Floods in 1980, 1982, 2001 and 2003 were particularly severe and there have been notable flood events in each of the past 4 years. Saline water ingression has been observed in some coastal districts. With large demand for water coming primarily from the energy, industry and agriculture sectors and rainfall/precipitation levels turning erratic, the state will be confronted with water scarcity in varying degrees in different areas.

Agriculture

Almost 85 percent of the State's population is dependent on agriculture and yet the agriculture sector contributes only about 26 percent of the GSDP. With almost 60 percent of land devoted to rain fed agriculture and with a water-dependent crop, rice, as its main crop, the agriculture sector is vulnerable to the vagaries of climate-induced weather changes.

Health

The prevalence of Malaria, and other vector-borne disease, is already rampant. With the expected erratic nature of rainfall and extending seasons, there is a possibility that the prevalence of these diseases would become more rampant. Climate change has the potential to aggravate malarial as well as other vector-borne, water-borne and food-borne diseases.

5.2.2 Mitigation

Energy

The State of Orissa is poised for rapid industrial development and large use of electricity for industrial purpose for which the demand for electrical power is continuously increasing. Orissa is on the way to becoming an energy supplier to the grid. In the next 10 years, Orissa expects to be generating about 60,000 MW of power, most of which is based on coal (a multiple increase from the current 4,000 MW). On the demand side, there is potential for reducing T&D losses, energy-efficiency promotion / DSM and also tapping the unrealized potential for renewable energy particularly bio-mass and solar.

Mining

Being endowed with mineral resources,mining sector will continue to form an important part of the state's economy. Many of the mineral resources are found on forest land and these also have tribal/indigenous populations. Therefore, mining is already fraught with situations of conflict that are constantly being resolved. In the climate context these forests could serve as carbon sinks. In addition, there are a number of small mining companies that do not adopt sustainable practices. Combined with poor infrastructure, there is a serious concern pertaining to sustainable development issues.

Industry

Industries in Orissa mostly belong to the energy-intensive and highly polluting catagory. However, there is potential for improving energy efficiency through the use of cleaner production technologies, methods and practices. This will contribute towards mitigating green house gases. As most mineral-based industries have their own coal-based captive power plants, there are direct emissions from the industry sector as well. Therefore, making the captive power plants more energy-efficient is also a key issue in the Orissa context.

Transport

The state is solely dependent on petrol and diesel to meet its growing fuel needs. Strengthening legal framework for motor vehicles to regulate emission, introducing mass transport and/or switching to fuel will reduce both local and global emissions in the state.

5.2.3 Cross cutting Issues

Forestry

No assessment of the impact of climate changes on Orissa's forests has yet been undertaken using the latest range of climate scenario. Further there are the uncertainties about the future of the monsoon in all the models. At the national level past studies have indicated that whilst Orissa's forest areas are not the most vulnerable, more recent work indicates that within 50 years, most of India's forest biomass would be highly vulnerable to the change in climate. The forestry community nonetheless needs to evaluate the long-term effects of climate change on forests and determine what the community might do now and in the future to respond to this threat. A large part of these forests in Orissa are degraded and therefore there is scope for increasing forest cover as well as forest density.

Urban

Creation of sustainable habitats is a big challenge in urban areas. This will bring down emission levels substantively. Energy use by the urban local bodies for applications such as water/sewerage pumping and street-lighting is considerable. Large scale energy savings are possible and will contribute towards mitigating carbon emissions. Given the drainage situation in urban areas, a sudden and intense precipitation may cause flooding and water logging which would throw life out of gear. Urban local bodieswill have to be prepared for this.